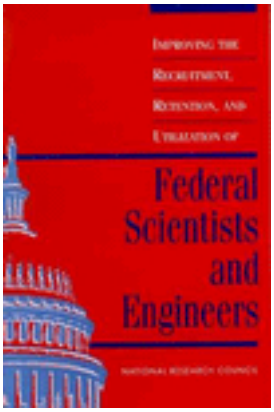

Improving the Recruitment, Retention, and Utilization of Federal Scientists and Engineers

Alan K. Campbell, Stephen J. Lubasik, and Michael G. H. McGeary, Editors;Committee on Scientists and Engineers in the Federal Government, National Research Council

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IMPROVING THE RECRUITMENT, RETENTION, AND UTILIZATION OF FEDERAL SCIENTISTS AND ENGINEERS

A Report to the Carnegie Commission on Science, Technology, and Government

Alan K. Campbell, Stephen J. Lukasik,
and Michael G. H. McGeary, Editors

Committee on Scientists and Engineers in the Federal Government
Office of Scientific and Engineering Personnel
National Research Council

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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Preface and Acknowledgments

This report is the result of the second stage of an effort begun in 1989 when the Carnegie Commission on Science, Technology, and Government asked the National Research Council to conduct an exploratory study of organizational and institutional processes that may affect the ability of the federal government to attract and retain scientists and engineers. A committee was appointed by the National Research Council's Office of Scientific and Engineering Personnel to undertake this exploratory study, which was completed and published in 1990 (*Recruitment, Retention, and Utilization of Federal Scientists: A Report to the Carnegie Commission on Science, Technology, and Government*, Washington, D.C.: National Academy Press).

The phase one report examined the current personnel practices of the federal government as they impact the effectiveness of the federal government's employment of scientists and engineers. The examination found a number of weaknesses as well as strengths in current practices and recommended that further study be done to address the weaknesses, with emphasis on how the weaknesses might be overcome. It was recommended that this continuing study be done in two parts. One should relate to the adequacy of the political appointments process for those agencies with major responsibilities in fields that make extensive use of scientists and engineers. The other study would examine issues surrounding the employment of scientists and engineers in the career service.

The first study—of the policy appointment process—was undertaken by a panel appointed by the National Research Council's Committee on Science, Engineering, and Public Policy. The findings of the panel were published in the report *Science and Technology Leadership in American Government: Ensuring the Best Presidential Appointments* (Washington, D.C.: National Academy Press, 1992).

The committee assigned to study the employment of scientists and engineers in the career service was directed to analyze the relative

effectiveness of mechanisms designed to recruit, retain, and utilize these personnel and to recommend organizational and decisionmaking strategies to strengthen weak points in the system.

Some major changes in the external environment—international and domestic—occurred during the committee's deliberations that had considerable relevance for its work. These were the end of the Cold War, a long-lasting recession, and the passage of the Federal Employees Pay Comparability Act of 1990. All of these have affected the recruitment, retention, and utilization of engineers and scientists by the federal government and are taken into account in the recommendations represented in this report. The recommendations cover the full range of personnel management practices, including the division of responsibility between central agencies and the operating departments, and within those departments, the organization of the career service for scientific and engineering work, the use of performance-based pay, and the encouragement of federal scientists and engineers to become involved in their professional associations.

Significant contributions were made to this study by people inside and outside government. The committee is grateful to the following individuals and organizations: at the Carnegie Commission on Science, Technology, and Government—David Z. Robinson, Executive Director; David Beckler, Associate Director; and Jesse Ausubel, Director of Studies; at the National Research Council—Alan Fechter, Executive Director; and Michael McGeary, Study Director. The Office of Personnel Management (OPM) provided assistance throughout the committee's deliberations, including presentations by Jean Barber, Deputy Associate Director, Personnel Systems and Oversight Group; Leonard Klein, Associate Director, Career Entry and Employee Development Group; Marilyn K. Gowing, Assistant Director, and Martin Beck, Research Psychologist, Personnel Research and Development; and Doris Hausser, Chief, Performance Management Division. Others at OPM who provided important information and insight were Brigitte W. Schay, Demaris Miller, and Paul Thompson, Research Demonstration Division. From the Department of Energy, guidance was provided by Richard Starostecki, Director, Office of Scientific and Engineering Recruitment, and Sharon Bobb, Director, Office of Personnel. Others who were generous in counsel were Christopher Jehn, Assistant Secretary of Defense for Force Management and Personnel, Department of Defense; James H. Trainor, Associate Director, Goddard Space Flight Center, National Aeronautics and Space Administration; Larry Slagle, Director, Personnel, U.S. Department of Agriculture (USDA); Sandy Wigdor, Study Director, National Research Council Committee on Performance Appraisal for Merit Pay; Allen Cassady, Chief, Personnel Demonstration Project Office, National Institute of Standards and

Technology; Timothy Coffey, Director of Research, Naval Research Laboratory; Essex Finney, Director, Beltsville Agricultural Research Center, USDA; Barbara Wamsley, Staff Director, Position Classification Project, National Academy of Public Administration; Norman Peterson, Argonne National Laboratory; Mark Mussell, Congressional Budget Office; Robert H. Dillon, National Institutes of Health; and John F. Wilkinson, National Science Foundation.

The response to the requests of the committee for advice and counsel was generous and very helpful. It reflects the strong interest and commitment by the departments and agencies to do everything possible to support and encourage the scientists and engineers who have chosen to make their professional contributions through the federal government.

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IMPROVING THE RECURITMENT, RETENTION, AND UTILIZATION OF FEDERAL SCIENTISTSAND ENGINEERS

A Report to the Carnegie Commissionon Science, Technology, and Government

Executive Summary

This report assesses the capacity of the federal government to recruit and retain highly qualified individuals needed to fill many important science and engineering positions. It reviews the problems that have been encountered in recruiting, retaining, and using the talents of scientists and engineers in the federal service, examines federal personnel demonstration projects that have experimented with a variety of mechanisms for enhancing the government's ability to recruit and manage well-qualified and motivated scientists and engineers, and recommends ways to build on knowledge gained from such demonstrations. Many useful policies and mechanisms to improve recruitment, retention, and working conditions have been authorized by the Federal Employees Pay Comparability Act of 1990 (FEPCA), but their success will depend on vigorous and creative implementation through the layers of government to have an effect at the working level. Other policies will require legislative action on new executive proposals.

In an earlier report,[1] the committee concluded that many kinds of management structures and practices could be used to carry out the different missions of the various federal agencies. This report examines the mechanisms or combinations of mechanisms for conducting federal

[1] Alan K. Campbell and Linda S. Dix, eds. *Recruitment, Retention, and Utilization of Federal Scientists and Engineers: A Report to the Carnegie Commission on Science, Technology, and Government*. Washington, D.C.: National Academy Press, 1990. The 1990 report also called for a study of problems in attracting top presidentially appointed scientists and engineers, which was conducted by another panel: *Science and Technology Leadership in American Government: Ensuring the Best Presidential Appointments*. Washington, D.C.: National Academy Press, 1992.

science and technology-related work that could be used more widely to enhance recruitment, retention, and utilization of federal scientists and engineers.

The report also addresses questions of organizational responsibilities for implementing changes that would give the government more flexibility to recruit and retain well-qualified scientists and engineers and the types of data and analysis needed to monitor the effectiveness of the system:

- Who should be responsible for personnel policy for federal scientists and engineers?
- What special provisions, if any, should be made for recruiting and administering the federal science and engineering work-force?
- At what level of the federal government should personnel policies affecting scientists and engineers be implemented and managed?
- How much of the implementation of personnel policies for scientists and engineers should be the responsibility of the Office of Personnel Management, and how much of the responsibility should be delegated to the mission agencies?
- At what level within these agencies should the responsibility be located?
- Who should be responsible for coordination and oversight in such a decentralized management system—the Office of Personnel Management, the Office of Management and Budget, or the Office of Science and Technology Policy?
- Who should be responsible for producing the information required to formulate policy and to monitor the effectiveness of the system?

- How should the effectiveness of the system be evaluated?
- Who should do the monitoring, and how frequently should the system be monitored? What is the role of Congress in this process?

In arriving at answers to these questions, the committee took into account several background events that have dramatically changed the situation since the first report was written.

CHANGES IN THE EXTERNAL ENVIRONMENT

Several recent factors are affecting the recruiting environment in a major way, especially the end of the Cold War with the collapse of the Soviet Union, a long-lasting recession, and the passage of FEPCA in late 1990. FEPCA not only provides a process for achieving greater comparability with private-sector pay; it also contains a number of mechanisms for greatly increased flexibility to deal with specific problems as they occur. FEPCA and the significant cutbacks in defense and nuclear weapons spending pose a challenge—and an opportunity—for the departments and agencies to use the flexibilities that have recently become available to create a more effective program of human resources management, including programs affecting federal scientists and engineers.

Given current conditions, the federal government is in a relatively favorable competitive position for recruitment and retention of scientific and engineering talent. The economy has been suffering an unusually long recessionary period, which has reduced private-sector opportunities and reduced turnover among federal employees. Independent of the business cycle, the private sector is engaged in downsizing activities in an effort to remain competitive in world markets, which will tend to dampen any future growth in demand that might occur when the economy emerges from its current doldrums. Similarly, academic labor markets are currently sluggish. As the military threat to the United States

lessens and changes, there will be less need for scientists and engineers in some defense areas.

Future conditions may operate to undermine this favorable position, however. Long-range projections of total requirements for scientists and engineers indicate further substantial growth. The number of experienced scientists and engineers who will be retiring from the federal workforce is expected to increase dramatically in the 1990s. The pool from which new scientists and engineers are recruited is shrinking and will continue to decline until the mid-or late 1990s, and the fraction of that pool expressing interest in careers in science and engineering is declining. The academic labor market is expected to revive in the mid-or late 1990s, and it is reasonable to expect the period of economic stagnation to have ended by then.

Thus, although current economic conditions are relatively favorable for recruitment and retention of federal scientists and engineers, the recession is only a temporary condition. When the economy resumes growing, the government will be competing for scarce talent again. It is not too early, therefore, for the departments and agencies to begin to develop a personnel program taking advantage of useful pay flexibilities authorized by FEPCA.

COPING WITH THE CIVIL SERVICE SYSTEM

The federal civil service system, with its strong emphasis on internal equity, has long hampered the government's abilities to compete for scarce talent in the labor market and to reward exceptional individual performance. Many of these instances have involved scientists, engineers, and medical personnel. Accordingly, over the years, a number of special authorities have been used to enable the government to be more successful in recruiting and retaining technically trained employees. The empirical growth of these authorities underlines the need for flexibility in recruiting highly qualified personnel and indicate the nature of mechanisms that can be usefully employed. They include special rates, which now apply to 12 percent of federal white-collar positions; Title 38 authority to pay medical personnel in the Department of Veterans Affairs and the National Institutes of Health (NIH) at market

rates; special authority to pay engineers and some scientific experts higher salaries; advance in-step hiring authority, which is used mostly for scientists and engineers; and special pay systems for agencies with difficult hiring situations.

More recently, authority to conduct personnel management demonstrations contained in the Civil Service Reform Act of 1978 has been used to address the problems of recruiting, retaining, and motivating scientists and engineers. These demonstrations were the basis for many of the pay-related flexibilities contained in FEPCA. Three of the projects are efforts to improve the recruitment, retention, and performance of scientists and engineers. The longest-running demonstration is the Navy's, popularly known as "China Lake."[2] Compared with control labs (1) starting salaries for scientists and engineers have increased substantially; (2) larger pay increases are given to highly rated employees, which has greatly increased the link between performance and pay; and (3) turnover among scientists, engineers, and other professionals with high performance ratings has fallen and has consistently been lower at demonstration labs than at control labs.

While they are not true experiments, these demonstration projects are consistent with the proposition that a more flexible pay and position structure improves the ability of federal research and development (R&D) agencies to recruit more qualified scientists and engineers and to reward and motivate good performers and thus retain them. They also show that the direct cost of such efforts is modest, in part because the agencies can (and do, because of budget constraints) tailor the compensation package to each case rather than increase salaries across the board. In addition, the differences among the demonstrations designed by each agency to meet its needs show that the various mechanisms can and should be adapted to the particular conditions facing each agency. Thus the agencies faced with implementing FEPCA should consider it an opportunity to design their own recruitment and retention programs.

[2] The other two are being carried out at the National Institute of Standards and Technology and the Department of Agriculture (Agricultural Research Service and Forest Service).

FEDERAL EMPLOYEES PAY COMPARABILITY ACT

FEPCA is an important step in revamping the civil service so that it can attract and keep well-qualified scientific and technical experts. It could go a long way toward improving the government's capacity to compete for scarce talent in the labor market. FEPCA does not, however, address all the important problems associated with the recruitment, retention, and utilization of scientists and engineers. For example, simplification of the position classification system would greatly increase the flexibility of the pay-related features of FEPCA, as shown by the China Lake and other personnel demonstrations. Several flexibility provisions broaden the application of current authorities; the rest are mechanisms that have been tested in the personnel demonstration projects.

FEPCA also created a Senior Biomedical Research Service (SBRS) in the Public Health Service for outstanding basic science or clinical researchers with doctoral-level degrees in a biomedical or related field. The SBRS will have its own pay scale, pay bands, and performance appraisal system. In addition, the act authorizes the President's pay agent to create special pay systems for individual occupations or groups of occupations that should not be under the regular civil service system "for reasons of good administration." This authority could be used to begin to plan and establish a governmentwide Senior Research and Development Service for senior scientists and engineers engaged in research or similar activities (although legislation would be needed to make such a service fully comparable to the Senior Executive Service).

RECOMMENDATIONS

Implemented appropriately, the new pay comparability act will help federal agencies to manage more effectively the recruitment and retention of scientists, engineers, and other experts needed by the government to conduct its science and technology (S&T) enterprise. It could go a long way toward making the federal government more competitive where it needs to be by increasing the flexibility of agencies

to pay more in higher-pay areas and higher-pay occupations and to better performers.

The committee believes, however, that effective implementation of the law will require careful monitoring and encouragement, and makes the following recommendations for ensuring that the federal government and its departments and agencies are more effective in managing recruitment and retention of scientists and engineers.

Implementing FEPCA

Recommendation 1. The pay reform provisions and related flexibilities provided by the Federal Employees Pay Comparability Act of 1990 (FEPCA) should be implemented as fully as possible by the President and the departments and agencies, in order to redress pay inequities and reward superior performance among all federal employees, including scientists and engineers.

Given the severe pressures on the federal budget, however, implementation of pay comparability is by no means assured. The act permits reductions under certain conditions. We believe, however, that presidents should invoke their authority to reduce pay increases only under the direst circumstances of economic distress or national emergency contemplated in the law. The long-term costs of noncompetitive federal salaries can outweigh the short-term savings in terms of the government's ability to carry out its national S&T functions.

Responsibilities of the Office of Personnel Management (OPM)

Recommendation 2. OPM should follow its aggressive effort to delegate its authorities under FEPCA with an equally strong effort to see that FEPCA authorities and flexibilities are decentralized to the appropriate levels within the departments and agencies.

This especially involves the line program managers and supervisors who are ultimately responsible for carrying out agency missions under widely varying circumstances. OPM also should expand its capacity to assist the departments and agencies, for example in workforce planning and personnel system design, so they make better use of the flexibilities of FEPCA to meet their strategic needs.

Recommendation 3. To help carry out its responsibilities for encouraging, assisting, and overseeing the departments and agencies, OPM should develop an organizational focus for science and engineering personnel policy staffed by individuals who have had experience as senior managers of scientists and engineers.

A specific organizational locus for science and engineering personnel policy within OPM would provide an ongoing, governmentwide S&T perspective on personnel policy and program development. It could provide a focal point for communication with career scientists and engineers throughout the government, particularly those in the Senior Research and Development Service (Recommendation 9). The staff should be highly experienced science and engineering managers who support the director of OPM as chair of the Committee on Federal Science and Engineering Personnel of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) recommended below (Recommendation 5).

Department and Agency Responsibilities

Recommendation 4. Each federal agency with a science and engineering workforce should develop a comprehensive action plan, with assistance from OPM, to (1) identify agency goals and develop an appropriate science and engineering staffing plan, and (2) use the authorities provided under FEPCA to improve recruitment, retention, and utilization of scientists and engineers.

The first step in implementing FEPCA is for officials and managers in the personnel offices of each agency to meet with line program and laboratory managers to develop a plan to meet that agency's needs. This approach creates the potential of achieving more than an incremental improvement in the traditional civil service system. It could be used to adapt the civil service system to each agency, within broad parameters that ensure the merit principle. This will require a dialogue between those in the agency responsible for planning and managing substantive programs and those managing the personnel system. Otherwise, FEPCA's flexibilities will be adopted piecemeal and incrementally, and its full advantages will not be realized.

Interagency Coordination

Recommendation 5. A new interagency committee on federal scientific and engineering personnel should be established in the Executive Office of the President under FCCSET to (1) evaluate and recommend science and engineering personnel policies and their implementation; (2) develop model strategies for combining the relevant flexibilities in FEPCA and for science and engineering personnel program evaluation; (3) share successful and unsuccessful experiences; (4) monitor the overall success of the government in recruiting and retaining scientists and engineers across agencies; and (5) provide a forum for identifying and working out solutions to common problems.

The major purpose of FCCSET is to develop more effective science and technology policies that involve multiple federal agencies. One major activity of the FCCSET Committee on Federal Science and Engineering Personnel would be annual reports to the President and Congress describing the status and approaches of the agency action plans for implementing FEPCA and related laws recommended above (Recommendation 4) and the overall progress in carrying out those plans

(the OPM organizational unit focusing on science and engineering personnel policy should review and critique the individual agency plans).

Congress

Recommendation 6. Congress and the executive branch should work together to make further changes in the civil service system that address the problems beyond pay flexibility per se. Meanwhile, Congress and OPM should continue the personnel demonstrations as testbeds for policies and practices that are not necessarily permitted under FEPCA or other federal personnel laws.

FEPCA does not make desirable changes in other aspects of personnel policies that also affect the recruitment, retention, and motivation of scientists and engineers, for example, simplifying the position classification system to permit more flexible pay banding, making performance appraisal more suitable for research scientists and engineers, and linking pay more closely with performance. OPM, with the advice of the FCCSET interagency committee on federal scientists and engineers, should formulate and propose legislative measures that would address these gaps. Congress, through its oversight activities, should monitor the performance of OPM and the departments and agencies in carrying out FEPCA and subsequent legislation.

Evaluation

Recommendation 7. The President's science advisor, working with the director of OPM, the FCCSET Committee on Federal Science and Engineering Personnel, and Office of Management and Budget (OMB) statistical staff, should develop better methodologies, data, and criteria for evaluating the effectiveness of the science and engineering personnel system.

Methodologies, data, criteria, and assumptions for achieving an effective science and engineering personnel system need to be developed in a concerted, long-term effort involving OPM and the departments and agencies, and coupled with the mechanisms that would be needed—e.g., special allowances to recruit scarce but uniquely defined pools of talent; bonuses to retain highly valued staff; and training programs to accommodate changing needs arising from shifting federal priorities.

Recommendation 8. OPM should assume the lead in developing a data base that can be analyzed to monitor the performance of the federal science and engineering personnel system.

This development activity should also involve the federal agencies with expertise and experience in large-scale data collection efforts to describe the human resource base (e.g., the Bureau of Labor Statistics, the Division of Science Resources Studies at the National Science Foundation, and the Bureau of the Census), probably coordinated through the proposed FCCSET Committee on Federal Science and Engineering Personnel.

A Senior Research and Development Service

Recommendation 9. A Senior Research and Development Service should be established with a separate pay system, an appropriate performance review and promotion process, and other features conducive to maintaining a high-performance workforce for senior science and engineering positions directly involved in intellectually significant work in research and development or other activities requiring a high level of technical training and expertise.

A Senior Research and Development Service would provide a dual-

career track that is appropriate for senior scientists and engineers who are more productive in the laboratory than in administration. Such a senior service would enable the federal government to use more appropriate performance review, merit pay, and promotion systems for senior R&D personnel (described in the next recommendation). Thus the Senior Research and Development Service would be separate from but parallel and equal to the Senior Executive Service, mirroring similar organizational arrangements in the private sector and in academia.

Peer Input for Science and Engineering Personnel Decisions

Recommendation 10. Compensation and promotion of scientists and engineers should be based in part on evaluation of their job performance by their peers. Governmentwide evaluation programs should be devised drawing on the experience of universities and industry.

Research personnel in the federal government—for example, scientists and engineers working in the laboratories at NIH, the National Aeronautics and Space Administration, and the Department of Defense—function more like faculty members in universities and researchers in industrial laboratories than the mainstream of federal employees. Although the academic model is not fully applicable to federal government work, especially for scientists and engineers working at the more applied and development end of R&D activities, its reliance on peer review may be usefully adapted, as it has been in many industrial laboratories. Pay and promotion decisions would be improved if there were more and better input from peers.

At least two federal research agencies, NIH and the National Institute of Standards and Technology, already use advisory input from visiting committees of outside experts on individual promotion decisions, as well as on the group performance of an entire research group or laboratory in carrying out organizational goals with imagination and creativity. Now that FEPCA provides an arsenal of ways to recognize and reward high performance, we believe that mechanisms for incorpo

rating peer reviews of individual and group performance should be developed and used more widely.

More Flexible Position Classification

Recommendation 11. OPM should develop legislation to create a simplified position classification system in federal research and development agencies both for the Senior Research and Development Service and for those now at the regular GS levels (GS-9/11 through 15), with grade levels comparable with those of counterparts in industry and academia. This flexibility could be combined with pay pools and longer evaluation periods to more closely link performance and pay.

With input from the R&D agencies, OPM should develop a simplified position classification system that would permit use of pay banding, one the most successful mechanisms used in the personnel demonstrations. The President and Congress should then agree on legislation that would establish such a simplified classification system for R&D agencies. The linkage between pay and performance would be strengthened further if the funds for within-grade increases, quality step increases, and other pay supplements and awards were pooled and used to reward high performers. At the same time, given the long-term nature of most R&D work, it would be beneficial to make the evaluation intervals longer.

Quadrennial Review of the Science and Engineering Personnel System

Recommendation 12. The director of OPM should have a quadrennial review of the science and engineering personnel system undertaken by a reputable nongovernmental organization to assess the performance of the system in light of current and expected future needs and conditions and to recommend improvements.

It would be prudent to undertake periodically a comprehensive assessment of how well the system is performing and especially how the new personnel management authorities of FEPCA are being used. Such an assessment would examine the adequacy of the various mechanisms aimed at meeting federal needs for scientists and engineers in areas such as compensation, career development, performance evaluation, and position classification. Based on this examination, recommendations for structural changes would be made, where appropriate, to Congress, the President's science advisor, OMB, and, via the director of OPM, the FCCSET Committee on Federal Science and Engineering Personnel for consideration.

Issues Beyond FEPCA

Adequate pay is a necessary but not a sufficient condition by itself for ensuring a well-qualified science and engineering workforce. Scientists and engineers are motivated to enter and stay in federal service by a number of nonpay factors, such as the opportunity to identify and develop the solutions to important national problems, the satisfaction of conducting scientifically important research and managing large-scale engineering projects, the quality of the facilities and equipment in federal labs, and the opportunity to engage in long-term projects. They also value the opportunity for further training and education and to engage in professional recognition and advancement.

Adequately Equipped and Staffed Laboratories

Recommendation 13. In order to attract and retain talented scientists and engineers, and increase their productivity, the federal laboratories must have adequate technical and support personnel and up-to-date equipment and facilities comparable with those available to their professional peers in other research settings.

The agencies and OMB should strive to strike a balance in the staffing and equipping of federal research laboratories.

Professional Development

Recommendation 14. OPM should develop and implement professional development policies and programs that meet the needs of federal scientists and engineers, including continuing professional training and education; retraining for occupational changes; support of participation in professional associations; and support of academic degree training for employees in hard-to-fill occupations. The departments and agencies should make active use of these authorities to encourage career development among their science and technology professionals.

OPM has begun to take a more systematic career-path approach to employee development policies and programs. We endorse this approach in the federal service, because continuing education, training, retraining, and participation in professional activities are especially integral to the career development of scientists, engineers, and other professionals.

Fairer Ethics Rules

Recommendation 15. In updating the code of ethical conduct for federal employees, the Office of Government Ethics (OGE) should take special care not to unnecessarily restrict appropriate involvement of federal scientists and engineers and other professionals in professional associations. OGE should continue to let federal employees be as involved in science and engineering societies as their agencies deem is helpful to their missions.

The attractiveness of federal employment to scientists and engineers is influenced by more than federal personnel policies per se. Scientists and engineers are especially sensitive to restrictions on professional development and recognition. Federal ethics laws and regulations are especially problematic in this regard, because federal employees are often

subject to stricter rules than their private-sector colleagues. Recently, for example, OGE proposed a rule to tighten restrictions on federal employee involvement in professional societies. Because participation in such societies is important to professional development and is often used in pay and promotion decisions, the committee urges OGE to let current practice continue, which is to (1) urge federal employees to participate actively in professional associations, (2) encourage agencies to cooperate with professional associations, and (3) permit agency heads to grant excused absences for purposes that benefit the public interest. These practices are already regulated by OPM regulations and agency rules.

1

Introduction

The federal government is the largest single employer of scientists and engineers in the United States. Approximately 223,000 federal employees are engaged in a wide variety of scientific and engineering occupations in every department and agency. Together they constitute more than 13 percent of the federal civilian white-collar workforce (NSF, 1991; OPM, 1989f).

The government is very involved in the conduct and support of scientific discovery and technological progress because science and technology (S&T) are critical components of the nation's economic growth, national security, public health, environmental safety, and other aspects of the public welfare. More than a quarter of federal scientists and engineers are engaged in research and development activities, primarily in laboratories in the departments of Defense, Agriculture, and Health and Human Services and specialized agencies such as the National Aeronautics and Space Administration (NASA). The other three-quarters are involved in a broad range of activities in virtually every department and agency, such as management and protection of public lands, parks, forests, fish, and wildlife; data collection and statistical analysis; regulation of health, safety, and environmental pollution; development of the federal highway system; testing and evaluation of large engineering systems in the defense, space, and energy areas; and administration of S&T programs (NSF, 1991).

Scientists and engineers account for 80 of the 441 white-collar occupations in the federal service. In 1989, the latest year for which there are detailed statistics, there were 112,000 scientists (24,000 of them

computer experts) and 111,000 engineers.[1] They worked in every department and agency, although 65 percent of the scientists worked in three departments (Defense, Agriculture, and Interior) and 79 percent of the engineers worked in just two (Defense and NASA).

Nearly 15 percent of federal scientists and engineers were women, but only 7.2 percent of scientists and engineers at the supervisor/manager level were women. Almost 14 percent were nonwhite. About 10 percent had Ph.D.s, and another 22 percent had master's degrees. They are located in every state, with only about 15 percent working in the Washington metropolitan area.[2]

PROBLEMS

To carry out its important science and technology functions, the federal government must be able to attract, keep, develop, and effectively use its share of the nation's well-qualified scientists and engineers. There were several major reports in the 1980s that the federal government was losing its best scientists, engineers, and other professionals at the height of their careers to higher-paying positions in the private sector (National Commission on the Public Service, 1989a; OPM, 1988a; NAPA, 1986). The government was also said to be less successful than in the 1960s and 1970s in hiring top graduates at the entry levels to

[1] These were full-time employees with at least a bachelor's degree working in a science or engineering occupational group (see the technical notes in NSF, 1991:1–4, for a fuller explanation). Some 70,000 health professionals, including 10,000 physicians and 40,000 nurses, are not included (OPM, 1989f). Another 139,000 federal employees with science or engineering degrees were working in nonscience or nonengineering positions and are not considered in this study (NSF, 1991:Table B-11). The study also does not cover scientists or engineers working under federal grants and contracts in the universities, national laboratories and other federally funded research and development centers, or private firms.

[2] The reader will find tables of descriptive statistics about federal scientists and engineers, what they do, and where they work in Appendix B.

replace the experienced talent that was leaving. Moreover, the situation was predicted to worsen in the long run because the supply of science and engineering graduates is declining, the demand for scientists and engineers from all sectors is expected to increase over the long term (Braddock, 1992), and fewer mid-career federal scientists and engineers will be held by the "golden handshake" of the old civil service retirement system (OPM, 1988a).

The committee reviewed the evidence that the government's capacity to hire and keep adequately qualified scientific and technical personnel is eroding. Careful studies of pay comparability by the General Accounting Office (GAO, 1990a, 1991a) and Office of Personnel Management (OPM, 1989a) document that by the late 1980s, federal white-collar employees were paid less than their private-sector counterparts in most occupations and most geographic locations.[3] The GAO, for example, looked at salary comparability by locality and found that the private sector paid more than the federal government in more than 90 percent of the cases (GAO, 1990a). Although the average private-sector advantage varied by metropolitan area, from 6 percent in San Antonio to 39 percent in San Francisco, the private sector paid more overall in all 22 metropolitan areas studied (GAO, 1991a).

A Merit Systems Protection Board (MSPB) survey of reasons for leaving federal employment in 1989 found not surprisingly that the most highly cited reasons for resigning were related to advancement and pay, but also that these reasons were most cited by those with more education, at higher grade levels, with outstanding performance ratings, and living in high-cost localities (MSPB, 1990). An MSPB survey of former members of the Senior Executive Service (SES) who retired or resigned between 1983 and 1988 found that the ceiling on SES pay was the most

[3] These studies show that salary differentials between the federal and private sectors increased greatly in the late 1970s and 1980s. Unfortunately, the studies did not compare total compensation, including retirement, health, and other fringe benefits, nor did they take into account noncompensation factors such as greater job security. These factors offset at least part of the salary differential, although they are being reduced—e.g., the new federal employee retirement system is less generous than the old civil service retirement system; layoffs are more likely; etc.

common reason given for leaving (MSPB, 1989a:Fig. 4). Meanwhile, supervisors and managers were reporting that they were losing their highest-quality scientists and engineers at a greater rate and that new hires were of lesser quality on average than before (Reck and Mann, 1991).[4]

Aggregate turnover and vacancy statistics do not, however, show a widespread recruitment and retention problem. Turnover among federal white-collar employees is about 9–10 percent a year, which is about one-third lower than in the private sector (MSPB, 1989b; CBO, 1986). Turnover is even lower among most science and engineering occupations, even though the pay gap may be higher (MSPB, 1989b:Appendix E). A GAO study of pay and attrition in 1985 found, for example, that the quit rate of 2.3 percent for federal chemists was the lowest among the seven occupations examined, although the average pay gap was the highest—from 28 percent to more than 50 percent less than comparable private-sector positions, depending on grade level (GAO, 1987:Table 1.1). Overall turnover among federal scientists and engineers was 4.9 percent in 1989 (calculated from MSPB, 1989b:Appendix E). As in the private sector, turnover is affected by a complex set of factors, of which pay is only one (GAO, 1990b:15).

Similarly, concerning workforce quality, aggregate studies do not find a general decline in factors presumed to be quality related among recently hired scientists and engineers, compared with those hired earlier (Reck and Mann, 1991). These factors include grade-point averages,

[4] It should be noted that there have been significant improvements in federal pay levels since 1989. The SES, for example, received pay increases averaging 25 percent in 1991. FEPCA introduced a new mechanism for increasing civil service salaries according to an employment cost index, which resulted in annual adjustments of 4.2 percent in 1992 and 3.7 percent in 1993. FEPCA also authorized an 8 percent cost differential for high-cost areas, which is being paid in Los Angeles, San Francisco, and New York City metropolitan areas. These increases, poor economic conditions, and other factors have reduced turnover significantly during the last several years.

class standing, numbers of publications, and performance appraisal scores.[5]

In an earlier report, this committee concluded that aggregate data collected by the OPM on turnover "are not very alarming" (Campbell and Dix, 1990:9). However, governmentwide averages might not reveal recruitment and retention problems in particular agencies, occupations, or localities that may have serious effects on certain government missions. Some federal agencies, in fact, have collected more detailed data that documented specific agency-level problems (e.g., PHS, 1989; EPA, 1990; IDA, 1990). The Environmental Protection Agency reported special problems in hiring and keeping health physicists (Mahan, 1990). The Public Health Service (PHS) found that turnover rates were generally low (6–7 percent), but more than half the scientific, medical, and engineering personnel will be eligible for retirement by 1993, which could increase turnover. Turnover was lower in 1988 than in 1980 among physicians, probably due to a "physician's comparability allowance," but at 13 percent, it was still relatively high (PHS, 1989:35). The PHS was finding it almost impossible to recruit scientists, physicians, and engineers at the SES level from the outside. Department of Defense (DOD) labs reported that vacancy rates were high for electrical engineering (19.7 percent), biomedical engineering (12.2 percent), and chemist (11.3 percent) positions (IDA, 1990:III-3). Consequently, we urged OPM to work with the agencies to make the Central Personnel Data File more useful to both OPM and the individual agencies in order to identify and deal with specific problems.

We also noted that maintaining and improving the quality of the federal science and engineering workforce was an important goal, but there was little agreement on how to measure quality. And, as with turnover statistics, favorable governmentwide averages concerning workforce quality indicators do not preclude the existence of serious problems in individual agencies, specific occupations, or critical areas. Although the OPM study of quality-related factors cited above indicated little change across age cohorts of scientists and engineers, a preliminary

[5] Similar results were found in a special OPM study of computer specialists (Harris, 1991).

report on a study of DOD scientists and engineers found declines in indicators such as the proportion with doctorates and the average number of publications and patents (Millburn, 1989). In any case, even though the retention or loss of a few top researchers may not be measurable statistically, they may be critical in enabling a research and development laboratory to conduct cutting-edge scientific and engineering work and to attract and motivate high-quality entry-level scientists and engineers. In addition, since it appears that there will be fewer graduating scientists and engineers for at least the next decade, we suggested in our first report that the individual agencies and the federal government at the interagency level examine the trends in the quality of federal scientists and engineers and assess more systematically the future requirements for scientists and engineers and ways to meet them (Campbell and Dix, 1990:31).

In the first report, the committee concluded that many kinds of management structures and practices could be used to carry out the different missions of the various federal agencies. The committee recommended an in-depth study of which mechanisms or combinations of mechanisms for conducting federal S&T-related work could be used more widely to enhance recruitment, retention, and utilization of federal scientists and engineers. We also urged OPM and the departments and agencies to work out an appropriate division of labor for carrying out human resources management—recruitment, development, retention, and utilization (Campbell and Dix, 1990:29–30).[6]

After the first report was published, the committee was asked by the Carnegie Commission to continue its activities. OPM, which was then involved in the development and passage of FEPCA to reform the pay-related aspects of the civil service system, was supportive and supplied useful information—e.g., data from the personnel management demonstrations, federal workforce quality assessment studies, and changes in recruitment activities—and OPM officials attended the August

[6] An additional recommendation for a study of the adequacy of the political appointment process for recruiting and retaining highly-qualified individuals in S&T-related positions was addressed in a companion study published in March 1992 (National Academy of Sciences, 1992).

1991 workshop held by the committee, along with personnel and science and engineering personnel from individual departments and agencies.

ISSUES

In the second phase of the study, the committee was charged with addressing the following issues:

- Who should be responsible for personnel policy for federal scientists and engineers?

Should OPM have the same general responsibility as for other federal employees, or is the science and engineering workforce so unique that its management requires special attention at the top? Should the Office of Science and Technology Policy (OSTP) in the Executive Office of the President, headed by the Assistant to the President for Science and Technology, be involved in formulating personnel policy affecting scientists and engineers? What should the roles be of the mission agencies and of Congress?

- What special provisions, if any, should be made for recruiting and administering the federal science and engineering workforce?

Should there be separate pay scales, position classification systems, performance appraisal and promotion policies, or other personnel policies for scientists and engineers? Should there be a special personnel system for senior executive scientists and engineers, scientists and engineers engaged in research and development work, or all scientists and engineers?

- At what level of the federal government should personnel policies affecting scientists and engineers be implemented and managed?

How much of the implementation of personnel policies for scientists and engineers should be the responsibility of OPM and how much of the responsibility should be delegated to the mission agencies? At what level within these agencies should the responsibility be located? Who should be responsible for coordination and oversight in such a decentralized management system—OPM, OSTP, or the Office of Management and Budget? There could be a special unit within OPM or there could be an interagency committee under the Federal Coordinating Council for Science, Engineering, and Technology, which is overseen by OSTP and the President's science advisor. How should this coordination take place?

- Who should be responsible for producing the information required to formulate policy and to monitor the effectiveness of the system?

Should it be OPM, the National Science Foundation, or the mission agencies? If the latter, who should be responsible for assuring comparability among agencies? How should this comparability be achieved?

- How should the effectiveness of the system be evaluated?

What are the appropriate indicators of effectiveness? Are there gaps in the existing data base that need filling? If so, what are they? Who should be responsible for filling them?

- Who should do the monitoring, and how frequently should the system be monitored?

Would a quadrennial review, similar to the ones undertaken for executive, congressional, and judicial salaries and for military compensation, be appropriate? Should it be done internally? If so, by which organization? OSTP? OPM? Or should it be done externally by an independent entity? If so, which one?

- What role for Congress is there in this process?

How should Congress organize itself to deal with a specialized personnel issue that cuts across agency lines, and therefore across committee jurisdictions?

In arriving at answers to these questions, the committee took into account several background events that have dramatically changed the situation since the first report was written. These are discussed in the next chapter.

2

The Changing External Environment

The recruitment and retention of federal scientists and engineers is constrained by external labor market conditions that affect the supply of and demand for scientists and engineers generally. Several recent factors are affecting the recruiting environment in a major way, such as the end of the Cold War with the collapse of the Soviet Union and a long-lasting recession. The passage of the Federal Employees Pay Comparability Act (FEPCA) in late 1990 had an equally dramatic effect on the internal recruitment and retention situation within the federal government. FEPCA not only provided a process for achieving greater comparability with private-sector pay; it also contained a number of mechanisms for greatly increased flexibility to deal with specific problems as they occur (see Chapter 4). Prior to the passage of FEPCA, the main challenge was to increase the flexibility of the federal personnel system to permit the government to be more competitive in high-wage local labor markets and in attracting and keeping specialized personnel generally.

Today, with the existence of FEPCA and with significant cutbacks in defense and nuclear weapons spending, the challenge is for the departments and agencies to use the flexibilities that have recently become available to create a more effective program of human resources management, including programs affecting scientists and engineers. The internal environment for federal personnel administration, its effects on scientists and engineers, and the potential impact of FEPCA are discussed in subsequent chapters. The rest of this chapter describes the dramatic changes taking place in the external environment for federal recruitment and retention and analyzes the opportunities they present for improving the conditions and effectiveness of the federal science and engineering workforce.

CHANGES IN THE EXTERNAL RECRUITING ENVIRONMENT

Labor markets are dynamic. Some cyclical and structural trends in the economy and changes in the international environment have put the federal government in a better current position to recruit and retain highly desirable scientists and engineers; other conditions and trends, however, may reduce the government's favorable labor market position over the next few years.

Favorable Changes

Given current conditions, the federal government is in a relatively favorable competitive position for recruitment and retention of scientific and engineering talent for the following reasons:

- The economy has been suffering an unusually long recessionary period, and it is unclear when the economy will emerge from this condition of relative stagnation.

The current recession has reduced private-sector opportunities. Consequently, turnover among federal employees has declined. For example, there were fewer than 30,000 voluntary quits among federal white-collar employees during the first three quarters of 1991, compared to more than 42,000 during the same time period in 1989, a reduction of 30 percent (Priest, 1991). The turnover rate among senior-level executives has dropped from 8.5 percent to 3 percent.[1] At the same time, the number of openings has also shrunk, from the usual 140,000 to about 100,000. In the short run, then, cyclical factors, along with

[1] The current turnover rate among Senior Executive Service (SES) and other federal personnel is lower in part because of a poor job market. This leads to fewer voluntary resignations. It is also probably lower because some incumbents eligible to retire are staying in a few years more. The sharp increases in SES pay beginning in 1990 provide a strong incentive to postpone retirement, because retirement income is based on the average of one's pay during the last three years of employment in the civil service.

higher pay levels after FEPCA was passed in late 1990, have made the federal government a more attractive employer.

- Independent of the business cycle, the private sector has for some years been engaged in downsizing activities in an effort to remain competitive in world markets. These activities can be expected to continue and will tend to dampen any future growth in demand that might occur when the economy emerges from its current doldrums.

These long-term structural adjustments in the economy tend to reduce the private-sector demand for skilled personnel, and they provide the government with an opportunity to be more competitive in the labor market. However, if the private sector and the government increase investment in research and development to meet the challenge of international economic competition, the demand for highly qualified researchers may increase.

- Similarly, academic labor markets are currently sluggish.

Faculty openings are scarcer, and relatively fewer new Ph.D.s—especially in the physical sciences—are able to secure employment (McClure, 1991; Czujiko and Silbernagel, 1991). According to the American Mathematical Society, 12 percent of new Ph.D. mathematicians were unemployed in September 1991, more than double the percentage the year before (Connors, 1991). The American Chemical Society found that 11 percent of new Ph.D. chemists were unemployed (Burrelli, 1991). A survey by the American Institute of Physics found that 1990 physics graduates took longer to find jobs, unemployment was higher, and median monthly starting salaries for Ph.D.s had fallen 5.0 percent, from $3,770 to $3,580 (Ellis and Mulvey, 1990, 1991).[2]

[2] The median monthly starting salary for those who took government jobs increased 7.8 percent, however, from $3,330 to $3,590.

- As the military threat to the United States lessens and changes, there will be less need for scientists and engineers in some defense areas.

The breakup of the Soviet Union is changing and reducing United States defense requirements. The armed services have plans to cut personnel levels about 25 percent, and the approximately 100,000 scientists and engineers in the Department of Defense (DOD) are not exempt from those cuts. Concerns about the recruiting and retention problems caused by the large defense buildup of the 1980s are being replaced by concerns about how to retain the best scientists and engineers in the face of seniority rules and how to recruit top entry-level scientists and engineers in program areas that are expanding. Overall, however, the downsizing of the defense establishment puts the federal government in a relatively favorable recruiting situation in the short term.

For example, defense cuts and the reduced demand for scientists and engineers in developing, testing, and maintaining weapons systems, not only in the DOD but also among defense contractors, raise the question, could the surplus scientists and engineers be retrained to work in high-priority federal programs such as environmental cleanup and restoration? At the same time, could DOD and the defense programs in the Department of Energy (DOE) be more successful in holding on to outstanding scientists and engineers who ordinarily would have been lost to the private sector?

Economic conditions thus place the federal government in a more favorable position today than in the 1980s to compete for highly qualified scientists and engineers and keep experienced federal scientists and engineers who otherwise might leave for higher-paying jobs in the private sector. This provides an opportunity for the government to improve the quality and effectiveness of its science and engineering workforce.

Undermining Trends

Future conditions may operate to undermine this favorable position, however, for the following reasons:

- Long-range projections of total requirements for scientists and engineers indicate further substantial growth.

Despite long-term structural adjustments in the national economy, the National Science Board predicts that requirements for scientists and engineers will grow at above-average rates. Average annual growth in science and engineering employment is projected to be 2.4 percent between 1988 and 2000, compared to 0.7 percent for the total workforce (NSB, 1989: Appendix Table 3-1). The projections of the Bureau of Labor Statistics are similar (Braddock, 1992; Silvestri and Lukasiewicz, 1991).

- The number of experienced scientists and engineers who will be retiring from the federal workforce is expected to increase dramatically in the 1990s.

This set of factors involves the aging of the federal science and engineering workforce. The median age of federal workers fell during the 1980s but is still relatively high, 41 years compared with 36 years among nonfederal workers (OPM, 1988a:20). Currently, the largest age cohort is the 36-to 40-year-old group. Most of this bulge of "baby boomers" is under the civil service retirement system and not eligible to retire without substantial penalties until age 55. In its study of the civil service, the Hudson Institute predicts a "retirement explosion" beginning in 2002 (OPM, 1988a:20).

Among some federal science and engineering workforces, however, the age profile is quite different. They are skewed toward the under-35 and over-44 age groups, with relatively few scientists and engineers in between. As a result, agencies such as the National Aeronautics and Space Administration (NASA) may lose many of their most experienced scientists and engineers during the 1990s before younger staff are ready

to take their place (U.S. Congress, 1989). The General Accounting Office (GAO) studied the situation and was reassured that few of the 29 percent of scientists and engineers eligible to retire through 1995 plan to do so immediately (GAO, 1991). The GAO report concluded that labor market adjustments would be adequate to replace NASA's senior technical workforce, given projected retirement plans, but it noted that those plans could change depending on events. As noted above, the state of the economy is another factor reducing retirement rates among eligible civil servants now. For one thing, a federal employee's retirement pay depends on an average of the last three years of active pay, and it is said that some have postponed retirement to take advantage of the higher pay raises mandated by FEPCA over the 1991–1993 period.

Over the long run, the new Federal Employees Retirement System (FERS) may increase early retirement among senior-level employees, because, unlike the old civil service retirement system (CSRS), FERS is portable. Under CSRS, anyone who leaves federal employment early cannot draw pension benefits until age 62, and those benefits are likely to be seriously eroded by inflation, because they are based on the salary that the employee earned just before leaving government service. Employees under FERS, however, will have substantially smaller disincentives to leave the government before retiring. FERS employees who reach 10 to 20 years of service in the 1994–2004 period are expected to resign at higher rates than CSRS employees, although the magnitude of this effect is unknown (MSPB, 1989b: 13; OPM, 1988:31). On the other hand, portability may make it easier to recruit senior-level people from outside the federal government.

- The pool from which new scientists and engineers are recruited is shrinking and will continue to decline until the mid-or late 1990s, and the fraction of that pool expressing interest in careers in science and engineering is declining.

The number of scientists and engineers in the supply pipeline has been falling, which means that the long-term competition for the shrinking number of highly qualified scientists and engineers could

increase unless private-sector demand grows less strongly than predicted or there are major supply adjustments. The overall number of 18-year-olds is projected to decline from about 4.1 million in the early 1980s to a low of 3.3 million in 1992, before increasing again to 3.8 million by 2000 (Bureau of the Census, 1990; 1989). The percentage of this shrinking cohort going to college that plans to major in the natural sciences or engineering has also declined, from a peak of 23.2 percent in 1982 to 17.4 percent in 1990 (the low was 17.1 percent in 1988). The number of science and engineering bachelor's degrees increased until 1986, but fell sharply in 1987 and 1988 (NSB, 1991:49). Extrapolating from past relationships between science and engineering degree production and freshman intentions suggests that the long-term decline in the proportion of natural science bachelor's degrees will turn around about 1991 and declines in engineering and computer science degrees will begin to recover about 1992. Meanwhile, the expected decline in supply of scientists and engineers with advanced degrees could be offset by various market adjustments, of course, such as an increase in the proportion of science and engineering majors, reentry of workers with science and engineering training now working outside the science and engineering labor markets, greater use of foreign nationals, and conversions of scientists and engineers from fields with less demand, such as defense engineering, to growing fields, such as environmental protection. Will the federal government be ready to take advantage of these adjustments?

- The academic labor market is expected to revive in the mid-or late 1990s (Bowen and Sosa, 1989).

The number of 18-to 22-year-olds will start to increase in the mid-1990s, and they are expected to attend college at a higher rate than in the past, due to higher incomes and smaller family size (Finn, 1991:25). If they enroll in science and engineering courses, the academic labor market will experience an upturn in demand for scientists and engineers by the mid-1990s.

- It is reasonable to expect the period of economic stagnation to have ended by the mid-or late 1990s.

Although current economic conditions are relatively favorable for recruitment and retention of federal scientists and engineers, the recession is only a temporary condition. When the economy starts growing again, the government will be competing for scarce talent again. It is not too early, therefore, for the departments and agencies to begin to develop a personnel program taking advantage of useful pay flexibilities authorized by FEPCA.

CHALLENGES AND OPPORTUNITIES

To carry out its various missions, the federal government directly employs more than 200,000 scientists and engineers. Although turnover rates have been relatively low, they increased during most of the 1980s. Nearly 10,000 scientists and engineers (4.9 percent) left the federal government for one reason or another during 1987. Also, at any given time, the government is competing with the private sector for additional talent in certain growth areas. In recent years, hard-to-hire scientists and engineers have included computer scientists, electrical engineers, specialists in artificial intelligence, health physicists, and environmental and safety engineers. Competition is expected to increase, because of an increased rate of retirement from the civil service and a smaller pool of qualified scientists and engineers in the labor force. Increasing turnover rates and problems in recruiting certain specialties and in high-wage areas were attributed mostly to the widening gaps between federal and private-sector salary levels. These were caused in part by a nationally uniform pay schedule that meant that even when average federal pay was comparable with average private-sector pay at the national level, federal pay levels were too low in some local labor markets (and too high in some others). This problem was exacerbated by the failure of federal pay to remain comparable after 1978, which meant that eventually federal pay levels were too low in virtually every locality.

This committee reviewed the situation in 1989 and early 1990. We concluded that there were spot recruitment and retention problems

affecting specific agencies, occupations, and localities (Campbell and Dix, 1990). At that time, we urged further investigation of mechanisms for increasing the government's flexibility to respond to spot problems, such as those being employed in personnel management demonstration projects sponsored by the Office of Personnel Management.

Subsequently, the committee was asked to conduct a second-phase investigation of such mechanisms. By the time we met again in late 1990, however, the situation had changed greatly. The collapse of communism in the Soviet Union and Eastern Europe and the end of the Cold War set the stage for significant cutbacks in defense and nuclear weapons programs, thus significantly reducing the overall demand for the 70 percent of federal engineers and 32 percent of federal scientists employed by DOD and DOE. FEPCA inaugurated a process for achieving near pay comparability in each locality and also authorized the use of many of the flexibility mechanisms being used in the demonstration projects.

Assuming that the pay gap is on its way to being closed (which is not, however, assured), the federal government is faced with new challenges and new tools for meeting them. The challenge two years ago was to increase the flexibility of the government's personnel system. FEPCA adds a great deal of flexibility, and the challenge today is to take advantage of the resulting opportunities it provides to improve the quality and effectiveness of scientists and engineers and other professional talent employed in the government.

As a result of defense budget cutbacks, DOD is planning to "draw down" its workforce by about 25 percent. The United States can reduce the force structure in response to the decrease in defense requirements, but it will need to be ready to build it up again if the situation in the former Soviet Union or Eastern Europe deteriorates (Carnegie Commission, 1990:9–10). The United States also faces a greater potential for military conflict in the rest of the world. DOD plans to respond to these changing conditions by relying more heavily on its defense technology base, much of which is conducted or administered by scientists and engineers in the DOD laboratories. This means that the labs will need to add new types of expertise at the same time they are reducing the overall size of their workforces. DOE is also cutting back its nuclear weapons activities, but is greatly expanding its environmental cleanup

efforts to deal with the aftermath of years of nuclear weapons production. New personnel needs can be met to some extent by retraining scientists and engineers no longer needed in other areas, but the situation will probably require at least some hiring from the outside.

In conclusion, the federal government today is in a better position to take advantage of the opportunities afforded by reduced demand, budget cutbacks, and FEPCA to plan and manage a higher quality science and engineering workforce that can more effectively meet the needs of each department and agency. The next chapter describes the origins and lessons of the personnel management demonstration projects, which were developed largely to deal with the problems of recruiting and retaining scientists and engineers in the federal personnel system. The fourth chapter reviews the features of FEPCA, makes recommendations aimed at its effective implementation, and analyzes the opportunities the new legislation provides to solve recruitment and retention problems. The committee's recommendations for using FEPCA and other flexibilities to address recruitment, retention, and utilization problems in a comprehensive and coordinated way are presented in Chapter 5.

3

Coping with the Civil Service System

The federal civil service system, with its strong emphasis on internal equity, has long hampered the government's abilities to compete for scarce talent in the labor market and to reward exceptional individual performance. A number of these instances have involved scientists, engineers, and medical personnel. Accordingly, over the years, a number of special authorities have been employed to enable the government to be more successful in recruiting and retaining technically trained employees, which are described in this chapter, both to underline the need for flexibility in recruiting highly qualified personnel and to indicate the nature of mechanisms that can be usefully employed. More recently, authority to conduct personnel management demonstrations contained in the Civil Service Reform Act of 1978 has been used to address the problems of recruiting, retaining, and motivating scientists and engineers. These demonstrations were the basis for many of the pay-related flexibilities contained in the Federal Employees Pay Comparability Act of 1990 (FEPCA). They are described here, because they provide valuable lessons for the successful implementation of FEPCA, which is analyzed in the next chapter.

THE CIVIL SERVICE SYSTEM

The Classification Act of 1949 established the General Schedule, a single, nationwide pay structure for federal white-collar employees that today consists of 15 grades, each with 10 pay steps. The grade level of each position in the more than 400 occupations employed by the federal government is classified on the basis of that position's complexity and

degree of responsibility. Thus each grade includes a very heterogeneous set of jobs—scientific, engineering, legal, accounting, medical, and other professions along with administrators, technicians, and clerical positions—that are deemed to be of equal rank, and they are paid within the same relatively narrow range regardless of geographic location.

The 1949 act, and the 1923 classification act that preceded it, were passed in response to interagency competition for skilled employees that occurred during the world wars; the new civilian war agencies that were created outside the civil service to give them more flexibility proceeded to steal skilled and experienced employees from the agencies under civil service by paying them higher salaries. This is the origin of the emphasis of the current system on internal equity among similar federal jobs without regard for external or market competitiveness (OPM, 1989b). Thus, for example, federal electrical engineers throughout the country who are in positions at a certain level of responsibility are paid basically the same. Moreover, they are paid the same as, say, chemists, mathematicians, and lawyers in the same grade, despite wide geographic and occupational variations in market-determined pay for those jobs across local labor markets.

In 1962 the Federal Salary Reform Act required that General Schedule (GS) pay rates for federal white-collar employees be comparable to pay rates in the private sector for similar levels of work. When federal pay levels nevertheless lagged, the Federal Pay Comparability Act of 1970 established regular procedures for making annual comparability adjustments in GS pay levels. The Bureau of Labor Statistics conducted sample surveys of salaries for 29 "benchmark" occupations across the country, which were used to derive a single average salary for each pay level. This system worked reasonably well for a time, but beginning in 1978 presidents proposed and Congress acceded each year to federal pay raises smaller than those required to achieve comparability with the private sector.[1] By 1990, the average pay gap reached 25 percent.

[1] The 1970 pay comparability law permitted such "alternative plans" if the President determined that smaller pay raises were justified by a "national emergency or economic conditions affecting the general welfare."

Table 3-1 displays the increases needed to achieve comparability and those actually granted from 1978 through 1990.

The problem with the comparability system, even when it was working, was that it posited an artificial monolithic labor market with a single national pay rate for the heterogeneous set of occupations classified at each grade level, each with dissimilar skill requirements, local labor market conditions, training and educational background, and geographic and career mobility patterns. Even when "comparability" is achieved under this system, a national average in conjunction with local and occupational diversity means that only some federal employees will be paid near the actual going rate in their field or where they live; the rest will be underpaid or overpaid. The system also looked only at salaries, not at fringe benefits such as health insurance, leave, and retirement, or at job security, even though these factors were often more favorable to federal than private employees.

As the GS pay levels grew more slowly than private-sector salaries generally since 1978, more and more pay disparities developed in more occupations and more localities. Eventually, better methods of comparing federal and private pay began to confirm that the disparities between federal pay levels and national average private-sector pay levels were real gaps in many local labor markets. The Office of Personnel Management (OPM), for example, commissioned a study comparing private and federal pay for certain federal jobs on a local basis, using 1987–1988 survey data. The study, conducted by the Wyatt Company, found that government salaries had fallen so far that it was becoming "difficult, if not impossible, to recruit and retain adequately qualified workers in some occupations and in some locations" (Wyatt Company, 1989:11–12). This problem affected government at all levels and probably in all departments and agencies, the report concluded.

More recently, the General Accounting Office (GAO) has conducted several studies comparing federal with private-sector pay by job and locality, which confirmed that private-sector salaries for similar jobs varied widely from area to area (GAO, 1990b, 1991a). The reports also showed that the general level of federal salaries had lagged so much behind the private sector's that the private sector was paying more for comparable jobs, regardless of locality. One GAO study of 10 occupations at different job levels in 63 metropolitan statistical areas (MSAs) in

Table 3-1. General Schedule Pay Comparability Adjustments, 1978–1990

Month/Year	Pay Agent Determination	Increase Provided	Pay Gap
October 1977	7.05%	7.1%	0.0%
October 1978	8.40	5.5	2.9
October 1979	10.41	7.0	3.4
October 1980	13.46	9.1	4.4
October 1981	15.10	4.8	10.3
October 1982	18.47	4.0	14.5
January 1984	21.51	4.0	17.5
January 1985	18.28	3.5	14.8
January 1986	19.15	0.0	19.2
January 1987	23.79	3.0	20.8
January 1988	23.74	2.0	21.7
January 1989	26.28	4.1	22.2
January 1990	28.62	3.6	25.0
January 1991	30.24	4.1	26.1

SOURCE: For 1978–1990, GAO, 1990a:Table 2.1. For 1977 and 1991, OPM.
NOTE: For 1978 through 1982, federal pay adjustments were made in October. They were shifted to January for the 1984 through 1990 period. Thus there was no adjustment in 1983.

1988 found that the private sector paid more in 90 percent of the MSA/job-level comparisons, an average of 21.9 percent more (in the other 10 percent of the MSA/job-level comparisons, the federal government was paying an average of 5.5 percent more) (GAO, 1990b:3).[2] The second study found that the size of private/federal-sector pay differences for 22 representative occupations (including chemists and engineers) varied substantially across MSAs and, within MSAs, across pay grades and occupations (GAO, 1991a:2). For example, the average private-sector advantage by MSA varied from 6.0 percent in San Antonio to 39.1 percent in San Francisco. However, the private sector paid more overall in all 22 MSAs studied, and the difference was more than 15 percent in 19 of the 22 MSAs.[3]

The second GAO report (1990a) presented the data for each MSA by occupation and GS level. The data indicate that private salaries for chemists, for example, are more uniform nationally than for most occupations, but the public-private pay gap for chemists is large—20 to 30 percent even in MSAs with a relatively small overall pay gap.[4]

This evidence of widespread salary disparities, small in some localities but large in others, and larger still for certain occupations in high-wage localities, provided support for the passage of FEPCA in Congress. The impetus for the administration's original proposal for pay

[2] Most of the jobs were clerical rather than scientific and engineering; the study did include GS-13 computer systems analysts. In 12 cases, the private sector paid an average of 15 percent more; in 4 cases, the government paid an average of 4 percent more) (GAO, 1990b:Table 4).

[3] Moreover, the private sector paid more than the federal government for all but 36 (2.8 percent) of the 1,267 MSA/grade-level comparisons made. Half of the 36 cases where the federal government paid more than the private sector were in two MSAs, San Antonio and Dayton-Springfield (calculated from Appendix III in GAO, 1991a).

[4] In Houston, private-sector chemists were paid 50 percent more. Since the overall federal-private pay gap was much less, even a locality pay system would not have put the government in a position to pay chemists the going rate without additional pay flexibilities.

reform was based on earlier studies sponsored by OPM of the interplay between federal recruitment and retention trends, public-private compensation comparability, and local labor market variations in pay (e.g., Wyatt Company, 1989; OPM, 1989d). On the basis of these studies, OPM concluded that federal salaries were trailing the private sector "in most occupations and most areas by widely varying amounts," the government was "experiencing significant recruitment and retention problems in some occupations and some geographic areas which cannot be addressed adequately under the existing system," and a shrinking supply of skilled labor in the future would "require more flexible, competitive pay practices to deal with growing recruitment and retention problems" (OPM, 1989e).

OPM cited other trends as indicating problems with the civil service system: the rapid increase in the use of the special rates program in the 1980s (from 11,500 in 1979 to 208,000 in 1992); the growing pressure to adopt more and more personnel demonstration projects as a way for agencies, especially those with science and engineering workforces, to escape the constraints of the GS system; and the growth of legislative initiatives to exempt agencies from the regular civil service provisions in Title 5, *United States Code*, when OPM would not sponsor demonstrations (e.g., the National Institute of Standards and Technology) (OPM, 1989a).[5]

The same year, the pay and compensation task force of the influential National Commission on the Public Service (Volcker Commission) concluded:

> Federal compensation levels have fallen so much that they are now major obstacles to recruiting and retaining a quality federal workforce. While the government's open recruitment policies still produce long lines of applicants for must federal jobs, those well qualified to perform the work in many key areas and occupations are not in those lines. Current

[5] OPM could have cited another trend, the use of direct-hire authority, which accounted for 70 percent of new federal hires in 1990, compared to 14 percent in 1981 (Campbell and Dix, 1990:13–14).

compensation levels limit recruitment for government jobs to the lower end of the labor market, to candidates who are willing to accept the below-average salaries the government offers. This limitation undermines government ability to maintain a high-quality workforce capable of providing reliable advice about tax provisions, effective inspections of food, banking practices or aviation safety, and efficient defense acquisitions (National Commission on the Public Service, 1989b:199).

ADAPTIVE RESPONSES TO THE GENERAL SCHEDULE SYSTEM

As the government's functions have multiplied since World War II, and the role of science and technology and other forms of expertise has expanded steadily in carrying those functions out, various mechanisms were developed to avoid the rigidities and pay limitations of the GS system. Perhaps the main device in the science and technology area has been the use of grants and contracts to tap the expertise of the academic, industrial, and nonprofit sectors. The government also relies heavily on advisory committees of outside experts. Within government itself, a number of mechanisms have been used to enable agencies to recruit and retain the scientific and technical expertise it needs to carry out critical functions, including various ways to exceed or bypass GS pay levels. These are described in the next section and summarized in Table 3-2.

Special Rates

As long ago as 1949, the Commission on Organization of the Executive Branch (First Hoover Commission) called for locality based pay for technical and clerical workers to enable the government to compete "on an equal footing" with the private sector. Although this advice was ignored when the GS system was created that year, "special," meaning higher, pay rates were authorized in 1954 for shortage occupations, defined as those for which private sector pay was seriously

Table 3-2. Adaptive Responses to GS Limits and Rigidities

Special Rates

Special pay rates were authorized in 1954 for shortage occupations, primarily scientific, medical, and technical that are otherwise hard to fill. They range from 3 percent to 30 percent above the regular GS schedule. Special rates now cover more than 12 percent of all GS positions, the majority of them engineers, health professionals, and scientists.

Title 38

Legislation dating from 1946 that allows the Department of Veterans Affairs to set special rates locally for 12 medical occupations to be competitive where it has medical centers. About 75,000 VA employees are covered, as are 1,100 nurses and other clinical personnel at NIH (Title 38 was extended to NIH in 1986).

P.L.-313-Type Positions

These are positions authorized since just after World War II to permit defense, nuclear energy, and space agencies to pay high salaries for critically needed scientists and engineers. There are about 600 of these positions.

Advance In-Step Hiring

Agencies have been authorized to hire above the step I rate for GS-11 and higher grades since 1964 for candidates with very high qualifications or with critically needed skills. Use of this authority grew rapidly in the late 1980s by agencies facing stiff private sector competition.

Special Pay Systems

A number of civilian white-collar pay systems have developed outside the GS (Title 5) to enable certain agencies to solve difficult hiring situations, including the intelligence agencies; banking and finance agencies; congressional support agencies; and agencies run like private corporations. These include about 100,000 positions (about 6 percent of civilian white-collar workers).

hindering civil service recruitment and retention. Special rates range from 3 percent to nearly 30 percent above the GS schedule. These special rates were enacted primarily as a "relief valve" to address recruiting needs for scientific, medical, and technical positions (OPM, 1989a:11).

As the regular GS pay rates lagged after 1978, the use of special rates exploded, from 11,700 in 1978 (constituting 2 percent of all GS positions) to 47,000 in 1985 (3 percent), 170,000 in 1989 (10 percent), and 208,000 in 1992 (12 percent). They apply to 47 percent of the white-collar federal employees in Boston, 35 percent in New York, and 30 percent in Los Angeles and San Francisco. Many of the special rates are for technician and clerical jobs in very high wage areas, but nationwide just more than half are for science, engineering, and medical positions.

GAO (1990d:22–26) found that special rates were helpful but not sufficient to make federal pay competitive for certain occupations. One department gave most engineers the maximum allowable special rate, which is 30 percent more than regular starting salaries, but this still left new GS-7 level engineers with $5,200 (21 percent) less than the average offer nationally. The situation varied by location, of course, with one of seven sites employing engineers finding special rates to have a large effect, five a moderate effect, and one no effect.

Title 38[6]

Meanwhile, the Veterans Administration (VA), faced with staffing an expanded VA hospital system after World War II, was authorized in 1946 to set up an alternative pay system under Title 38 of the *United States Code* that allows the agency to set special rates for 12 medical occupations at any of its medical centers where higher pay is needed to

[6] The Title 38 system, which includes other relevant features such as peer review boards that recommend hiring, promotion, and pay levels and awards, is described and analyzed in a report of the Merit Systems Protection Board (MSPB, 1991).

be competitive with other health care providers in the community. Approximately 75,000 employees are covered currently. This authority was extended to the National Institutes of Health (NIH) in 1986 when it was having problems staffing its clinical center with nurses and other clinical personnel (Institute of Medicine, 1988). By 1989 approximately 1,100 NIH employees were covered by Title 38 provisions (OPM, 1989a:66). FEPCA permits OPM to extend the pay and other features of Title 38 to employees involved in health care services in any agency.

P.L.-313 Positions

Another legislative provision dating from the post-war period authorized agencies to establish "P.L.-313" positions, specifically to pay higher salaries to recruit and retain a small number of critically needed scientists and engineers. This authority was used, for example, by the National Aeronautics and Space Administration (NASA) to bring in experts from industry needed for specific advances in the lunar mission effort of the 1960s (Levine, 1982). Today these are known as ST positions and enable agencies to promote their top research and development (R&D) experts to higher paid positions (e.g., GS-16,-17, and-18 pay levels) without requiring them to go into management positions in the Senior Executive Service (SES). In 1991, there were about 250 ST scientists and professionals working in R&D.[7] FEPCA includes them in the new senior-level positions that agencies can pay anywhere between 120 percent of step 10 of GS-15 and level IV of the Executive Schedule.[8]

[7] Most recently before FEPCA, these positions were authorized under Section 3104 of Chapter 5 of the United States Code. There was a legislative limitation of 517 ST positions governmentwide.

[8] The pay range was between $77,080 and $112,100 in 1992. In fixing individual pay levels, agencies are to consider not only alignment with other positions and incumbents with comparable responsibilities and qualifications but also private-sector pay for comparable personnel. OPM guidelines require a reasonable distribution of salaries within the pay range and indicate that pay

Advance In-Step Hiring

In 1964 the Government Employee Salary Reform Act authorized agencies to hire above the step 1 rate for GS-11 or higher grades of the General Schedule, in order to accommodate a candidate's salary history or unusually high or unique qualifications, or to meet the government's special need for the candidate's services. This is another device whose use expanded rapidly, especially after it was delegated to the departments and agencies in September 1988.[9] A GAO study (1991c) of a sample of 100 advance in-hire appointments at 10 civilian installations found that starting salaries averaged about $7,160 higher than step 1 of the position grade. The majority were used for engineering positions at NASA installations. Agencies also reported faster action in processing these personnel actions—taking only days rather than the months it had previously taken for OPM to approve advance in-hire appointments. FEPCA extends the authority to pay above the minimum to all grade levels.

Special Pay Systems

Finally, a number of civilian white-collar pay systems have developed outside the regular civil service provisions of Title 5, primarily to enable agencies to recruit and retain highly qualified experts,

exceeding level V of the Executive Schedule ($101,300) should be used only in "highly unusual situations where the position is especially important to the agency and/or the qualifications of the individual are unusually high." Senior-level employees are not eligible for the special bonus programs their counterparts in the SES receive—performance bonuses, Meritorious Rank Awards worth $10,000, and Distinguished Rank Awards worth $20,000.

[9] The ability to offer higher starting salaries was a major component of the success of the Navy's personnel management demonstration project at China Lake, although this flexibility derived directly from the broader pay intervals, or "bands," used there, and did not have to be authorized as an exception to the more rigid step and grade structure used in the General Schedule.

including scientists and engineers.[10] These include the intelligence agencies (Central Intelligence Agency, Defense Intelligence Agency, National Security Agency); banking and finance agencies (Federal Reserve, Federal Deposit Insurance Corporation (FDIC), Resolution Trust Corporation (RTC), Federal National Mortgage Association); agencies run like private corporations (Tennessee Valley Authority, U.S. Postal Service); and congressional support agencies (General Accounting Office, Congressional Budget Office, Office of Technology Assessment). Typically, these agencies have much more flexible personnel systems in terms of hiring and advancement as well as higher salary structures (up to $150,000 for attorneys at FDIC and RTC). The VA system has already been described, which allows that department to compete more effectively for highly paid medical personnel. The National Science Foundation (NSF) has statutory authority to hire outside Title 5 which it uses for approximately 280 of its 1,180 positions. This excepted service enables NSF to recruit scientists, engineers, and other professionals of distinction and pay them in five broad pay ranges, the top two of which extend beyond the GS-15 level.

Previous groups examining the federal civil service system have recommended the creation of special occupational schedules for groups that do not fit comfortably in the GS pay and job classification structure. A 1972 task force, for example, recommended establishment of four regular pay/job structures, including one for administrators and professionals, and it suggested that special pay schedules be considered for certain groups, including scientists and engineers in R&D as well as health care workers, attorneys, law enforcement officers, and teachers (CSC, 1972). FEPCA includes authority to establish special pay systems for occupations, or groups of occupations, and it creates a Senior Biomedical Research Service in the Public Health Service that is exempt from Title 5 provisions in order to recruit outstanding biomedical researchers and pay them from the minimum rate for GS-15s up to level I of the Executive Schedule ($143,800 in 1992).

[10] These alternative systems are described and analyzed in OPM, 1989e; NAPA, 1990.

The civil service pay and job structure, the General Schedule, has often not been flexible enough for adequate recruitment and retention of highly qualified individuals in high-wage areas or occupations in high demand by private employers. Historically, this has affected federal employment of certain types of scientists and engineers in certain locations, and a variety of devices and mechanisms have been used over the years to deal with these problems, some of which are embodied in FEPCA. Many of them had also been systematically tried out in a series of personnel management demonstrations before they were included in FEPCA.

LESSONS FROM THE PERSONNEL DEMONSTRATIONS

The Civil Service Reform Act of 1978 included authority to conduct and evaluate personnel demonstration projects requiring waivers from various Title 5 requirements. Currently, there are six projects involving about 21,000 employees. Three of the projects, described below, are efforts to improve the recruitment, retention, and performance of scientists and engineers. (The projects are profiled in Appendix C.)

China Lake Demonstration

The longest-running personnel management demonstration project is the Navy's, popularly known as "China Lake" after one of its two sites, the Naval Air Warfare Center in China Lake, California. The other site is the Naval Command, Control and Oceans Surveillance Center, in San Diego, California. The Navy project, which began in 1980, was designed to address the difficulties the two weapons labs were experiencing in recruiting high-quality scientists and engineers and keeping the best of them by making position classification and pay administration more flexible. Navy lab managers were also interested in delegating more managerial control to supervisors by increasing their control over classification, pay, and other personnel matters. Pay increases and promotions are tied more closely to performance ratings.

The 8,700 civilian white-collar positions at the two labs are grouped into five "career paths," each associated with a salary range. There are career paths for (1) scientists, engineers, and other professionals; (2) technicians; (3) technical specialists; (4) administrative specialists; and (5) clerical personnel. The salary range for each career path is divided into four to six broad bands that each span at least two GS grades, which makes it easier to offer desirable recruits a higher starting pay level. It also dovetails with the project's performance-based approach to pay by making it possible to move high performers to relatively higher pay levels than adequate or poor performers because the pay band is much broader than a GS grade.[11] This makes it possible to increase pay substantially without having to promote the employee. Finally, since 1987, the labs have been authorized to offer recruitment bonuses of up to 15 percent of starting salary.

Under the traditional GS system, pay levels are adjusted every January, and all employees (except for supervisors in grades GS-13 through-15 who are in a merit review program called the Performance Management and Recognition System) receive the annual raise automatically. Employees also receive within-grade increases of one step (about 3 percent) every one, two, or three years, depending on length of service and a performance rating of fully successful or better. Regular GS employees may be given quality step increases at any time for outstanding performance, which advances the employee to the next-higher step earlier than the normal waiting period, but only a very small fraction receive them. Since more than 90 percent of employees are rated fully successful, and only a few percent receive quality step increases, pay advancement in the GS system is determined almost completely by length of service rather than performance.

In the Navy project, employees receive the annual governmentwide pay adjustment if they are rated at least fully successful. The funding for within-grade increases, sustained superior performance awards, and in-

[11] Step 10, the highest step in a GS grade, is only about 30 percent higher than the first step, while, for example, the top of the first, entry-level scientific pay band is nearly 80 percent higher than the bottom, and the other pay bands are between 53 and 57 percent wide.

level promotions, however, is put in an incentive pool and given out in proportion to the points earned in annual performance appraisals. The labs also pay bonuses, mostly to reward performance on temporary assignments or for one-time accomplishments. The incentive and bonus pools together amount to 3.2 percent of salaries at the China Lake lab and 3.3 percent at the San Diego lab.

OPM is conducting the evaluation, which compares the project to two similar labs, the Naval Surface Warfare Center (White Oak, Maryland, and Dahlgren, Virginia) and the Naval Air Warfare Center (Warminster, Pennsylvania). To date, 14 reports have been issued by OPM. Among the key findings, according to OPM, are that, compared to control labs, (1) starting salaries for scientists and engineers have increased substantially (but subsequent pay progression during the first five years is slower under banding than under the GS system of grades); (2) larger pay increases are given to highly rated employees, which has greatly increased the link between performance and pay; (3) turnover among scientists, engineers, and other professionals with high performance ratings has fallen and has consistently been lower at demonstration labs than at control labs (although the turnover at all the labs is affected by trends in the economy, falling when unemployment rises and rising when unemployment falls) (OPM, 1988b, 1991a).[12]

OPM recently completed its analysis of the effect of flexible starting salaries, recruitment bonuses, and pay for performance on recruitment success at the demonstration labs (OPM, 1991b). According to OPM's evaluation, the demonstration labs have been more successful in fulfilling their staffing requirements since the demonstration began. The turnover rate among employees with high performance appraisals has consistently been about 50 percent lower at the demonstration labs compared to the control labs (but turnover has been declining in all labs since 1987, and more steeply at the control labs, even before unemployment rates began to increase). Finally, certain quality indicators (grade-

[12] OPM has also completed a study of broad-banding in three demonstration projects that concludes that average salaries for Navy scientists and engineers have increased by 5.5 percent as a result of broad-banding (Schay, et al., in press).

point averages and job acceptance rates) increased at the Naval Air Warfare Center at China Lake, which had more recruitment problems than the San Diego center.

In a longitudinal attitude survey, the percentage of lab managers agreeing that their center was able to attract high-quality candidates increased at the demonstration labs from 47 percent in 1981 to 60 percent in 1987 before falling to 47 percent in 1989. Meanwhile, the percentage of control lab managers who said they were able to attract high-quality candidates hovered around 50 percent until 1984, before dropping to 34 percent in 1987 and 30 percent in 1989. OPM also found higher and increasing job satisfaction among scientists and engineers at the demonstration labs relative to the control labs—76 percent in 1979 and 81 percent in 1989 at the demonstration labs, compared with 73 percent at the control labs in both years (CBO, 1991:25, citing OPM, 1988c, and unpublished OPM data).[13] OPM concluded that the demonstration labs were generally better able to recruit and retain scientists and engineers than control labs, and, on average, the quality of recruits was higher. Higher salaries, along with pay for performance, appeared to be the main reason; demonstration labs were able to pay 20-30 percent higher starting salaries than control labs for comparable positions.

National Institute of Standards and Technology (NIST) Demonstration

In 1986, Congress mandated a personnel management demonstration project to be carried out at NIST. It was a response to the failure to adopt legislation implementing the personnel-related recommendations

[13] Other key findings cited by OPM are: (1) the classification system is simpler and less time-consuming, permitting managers to take a much more active role; (2) overall salary costs have increased by only 2.35 percent under the project, despite substantially higher starting salaries for scientists and larger pay increases for high performers; and (3) supervisors believe they are much more empowered to make personnel decisions.

of the Packard Panel, which called for the creation of "a scientific/technical personnel system independent of current Civil Service personnel systems" at government-operated labs (OSTP, 1983). The project, which began in January 1988, is an expanded version of the China Lake project and has similar aims: to improve recruitment and retention of high-quality scientific, technical, and other employees and to simplify the personnel system in order to increase the control of managers over personnel decisions. It covers 3,000 white-collar employees at research labs in Maryland and Colorado.

Like China Lake, the NIST project features simplified position classification through the consolidation of narrow GS grades into broader pay bands and a pay-for-performance system. As originally conceived, the project added the concept of total compensation (pay and benefit comparability with private sector pay and benefits, which was to be achieved by granting raises larger than the annual governmentwide pay adjustment for the General Schedule. By paying larger comparability increases, NIST could make its salary levels approximate the private sector's and thus improve recruitment and retention of scientists and engineers. Instead, NIST found that pay disparities varied significantly by occupation and site. Larger general comparability increases would have NIST overpaying some employees in some occupations while still underpaying others in one or both sites (the same problem encountered by the GS pay comparability system established in 1970). Instead, the NIST director has opted to pay the governmentwide increase in 1989, 1990, and 1991, and rely on higher starting salaries, performance pay increases, promotions, and bonuses to redress individual pay disparities and reward deserving employees (OPM, 1990:18).

All white-collar occupations are grouped in four career paths: (1) scientific and engineering professionals; (2) scientific and engineering technicians; (3) administrative staff; and (4) support staff. Each career path has a different pay range, divided into five levels reflecting the career stages in each path—entry and trainee, developmental, full performance, senior and supervisory, and managerial. Performance-based pay is allocated to employees through two pools, based on annual performance reviews. The first, for performance-based salary increases, consists of funds formerly used for within-grade step increases, quality step increases, merit pay increases, and promotions from one GS grade

to another now within a single pay band. The second pool, for cash bonuses, includes funds formerly used for Performance Management and Recognition System awards and other awards.

The project included expanded direct-hire authority and agency-based examining authority, which was used to fill 95 percent of the science and engineering vacancies during the first three years of the project. As a result, NIST has been able to reduce the average time to fill vacancies by several weeks (Rosenthal et al., 1991:13).

The project also included authority to give recruitment and retention allowances. This authority, however, has been used very selectively. In the first two years, recruitment allowances averaging about $5,700 were given to 17 new hires and one retention allowance of $5,000 over two years was awarded, all to scientists and engineers mostly in the top rather than entry levels (Rosenthal et al., 1991:10). However, as in the Navy demonstration, regular starting salaries were higher at NIST than before and higher than in a comparison lab in Colorado, which may account for the low use of recruitment bonuses at lower levels.

Finally, pay increases at NIST are strongly related to performance ratings, which they are not in comparison organizations in the Department of Commerce. NIST employees at high rating levels are receiving larger pay increases, and employees with low ratings are receiving smaller pay increases, than their counterparts in the comparison organizations. Also, NIST employees with higher ratings are more likely to receive performance bonuses (OPM, 1990:ii).

According to the third-year evaluation report, NIST has been able to pay new hires more than other agencies for comparable jobs. Overall, the salaries of NIST scientists and engineers increased 5 percent more than those for scientists and engineers in comparable federal agencies between 1987 and 1989. The comparability of science and engineering salaries with the private sector did not change, but they would have been less comparable in the absence of the demonstration project (Rosenthal et al., 1991:Ch. 4).

There have been no significant changes in NIST's workforce quality indicators—undergraduate grade-point averages, quality of graduate schools, and performance appraisal ratings—which traditionally have been high. Turnover rates, already very low, have not changed,

although surveys of leavers indicate that salary has become a less important reason for leaving.

Department of Agriculture Demonstration

The committee also heard presentations by officials from the U.S. Department of Agriculture (USDA) and its Agricultural Research Service (ARS) about a personnel demonstration project begun in mid-1990 in 140 experimental and 70 comparison sites of the Forest Service and the ARS. The project is largely a testing of a comprehensive simplification and decentralization of the hiring system, but it does include recruitment bonuses and relocation expenses and use of an extended probationary period for scientists in research positions.[14] The committee heard that the recruitment incentives have been rarely used, although they were important in attracting a microbiologist and a plant physiologist. It is too early to evaluate the results of the longer probationary period on the retention and productivity of research scientists.

Lessons

While they are only quasi-experiments, and they do not measure the effects of the interventions on organizational effectiveness, other effects of the various interventions have been measured, the Navy and NIST demonstration projects are consistent with the proposition that a more flexible pay and position structure improves the ability of federal agencies to recruit more qualified scientists and engineers and to reward and motivate good performers and thus retain them. They also show that the direct cost of such efforts is modest, in part because the agencies can (and do, because of budget constraints) tailor the compensation package to each case rather than increase salaries across the board. In addition, the differences among the demonstrations designed by each agency to

[14] The extended probationary period does not apply to foresters and other scientists not in research positions.

meet its needs show that the various mechanisms can and should be adapted to the particular conditions facing each agency. Thus the agencies faced with implementing FEPCA should consider it an opportunity to design their own recruitment and retention programs. Unfortunately, FEPCA does not include all the devices and flexibilities being used by the demonstration projects. Additional steps needed beyond FEPCA to improve the federal government's capacity to recruit well-qualified scientific and technological personnel are recommended in the last chapter. First, the next chapter discusses the flexibilities offered under FEPCA to agencies faced with attracting and keeping well-qualified scientists and engineers and identifies potential obstacles to effective implementation of FEPCA.

4

Federal Pay Reform

The Federal Employees Pay Comparability Act (FEPCA), if fully implemented, has the potential to improve greatly the federal government's capacity to recruit and retain highly qualified scientists and engineers. FEPCA, passed in November 1990, established new procedures for setting civil service pay levels to make them nearly comparable to private-sector salaries for similar work. First, the act provides a mechanism for automatic annual adjustments based on changes in an index of private-sector salaries. As a result, federal civil service salaries increased by 4.2 percent on January 1, 1992, and by 3.7 percent on January 1, 1993.

Second, the act lays out procedures for increasing salaries in high-wage areas beginning in 1994 to make federal pay nearly comparable to nonfederal pay in each local labor market in steps to be completed in 2002. The president was also given authority to make interim locality adjustments of 8 percent, which were granted in December 1990 to employees in New York, San Francisco, and Los Angeles.

Third, FEPCA provides a number of pay-related flexibilities, such as recruitment bonuses, retention allowances, expanded authority to pay new hires above the minimum rates, designation of critically needed positions so they can be paid above General Schedule (GS) and even Senior Executive Service (SES) levels, and performance awards. These new or expanded flexibilities should help government agencies to fill important positions with leading experts who otherwise would be difficult to recruit and retain.

Finally, FEPCA established a more flexible personnel system for senior scientists in one agency (the Senior Biomedical Research Service in the Public Health Service), and it authorized the director of the Office

of Personnel Management (OPM) to create additional occupational pay systems for classes of employees for whom the General Schedule pay system is not suitable. OPM is currently studying the desirability of establishing a separate pay system for physicians, dentists, nurses, and other hard-to-recruit health care professionals. In the past, this approach has been suggested for scientists and engineers involved in research and development activities in the federal government.

We believe that FEPCA is an important step in revamping the civil service so that it can attract and keep well-qualified scientific and technical experts. It could go a long way toward improving the government's capacity to compete for scarce talent in the labor market. FEPCA does not, however, address all the important problems associated with the recruitment, retention, and utilization of federal scientists and engineers. For example, it does not change the current position classification system, which is another major cause of the rigidities of the GS system (NAPA, 1991). Simplification of position classification would greatly increase the flexibility of the pay-related features of FEPCA, as the Navy and other personnel management demonstration projects demonstrate. FEPCA does not change recruitment procedures per se or address employee development, issues that merit attention. For example, given the increasing proportions of women, minorities, and other groups among new entrants to the workforce, a special focus may be required for these groups. It also does not address the tenuous linkage between performance and pay in the GS system, although it created a Pay-for-Performance Labor-Management Committee to study and report on the design and implementation of a stronger pay-for-performance system.

FEPCA PROVISIONS

FEPCA is primarily intended to achieve general comparability of

federal with nonfederal salaries in each locality.[1] It also permits use of a number of pay-related flexibilities to enable the government to offset any remaining pay disparities in areas or occupations for which there is a special need or special expertise is required, or both. Third, the new law also authorizes creation of separate pay systems for occupational groups that do not fit the general system.

General Pay Comparability

Pay comparability for GS employees will be achieved in two ways: (1) annual nationwide adjustments and (2) locality-based comparability adjustments.

Nationwide Salary Adjustments

GS pay increases will be effective January 1 of each year. They will be based on the change in the Employment Cost Index (ECI) for the wages and salaries of private-industry workers between the third quarter of the year before the preceding calendar year and the third quarter of

[1] According to FEPCA, "It is the policy of Congress that federal pay fixing for employees under the General Schedule be based on the principles that——

(1) there be equal pay for substantially equal work within each local pay area;
(2) within each local pay area, pay distinctions be maintained in keeping with work and performance distinctions;
(3) federal pay rates be comparable with non-federal pay rates for the same levels of work within the same local pay area; and
(4) any existing pay disparities between federal and non-federal employees should be completely eliminated."

the second year before the preceding calendar year.[2] The ECI was developed by the Bureau of Labor Statistics (BLS). It is "a fixed employment-weighted index which tracks the quarterly change in labor costs (wages, salaries, and employer costs for employee benefits), free from the influence of employment shifts among occupations and industries" (BLS, 1989). FEPCA prescribes the use of the ECI series pertaining to the salaries and wages (excluding employer costs for employee benefits) of private-industry workers (excluding federal, state, and local government, farm, and household workers). Because the ECI tracks the Consumer Price Index fairly closely, its use should ensure that the gap between federal and private salaries does not increase (Gressle, 1990, compares GS salary increases with index data).

FEPCA stipulates that the annual GS increase will equal the ECI in 1992 and 1993; in 1994 and after, the increase will be 0.5 percentage points less than the ECI. Thus the January 1, 1993, pay adjustment was 3.7 percent, based on the increase in the ECI from the third quarter of 1990 to the third quarter of 1991. The January 1994 increase is slated to be 2.2 percent, unless it is reduced by the President because of "severe economic conditions" (this procedure is described below).

Locality-Based Comparability Adjustments

Annual surveys conducted by the BLS will be used to determine the average federal-nonfederal pay gap in each locality. Beginning in 1994, GS employees in localities determined to have a pay disparity

[2] The 1989 Ethics Reform Act mandated use of the same ECI to determine annual increases for congressional and executive-level salaries. However, the base period is different (December to December rather than October to October for the year ending a year before the adjustment) and the 0.5 percentage point reduction took effect in 1992, not 1994. This means the increases will usually be different for GS employees and executive-level appointees. In 1992, for example, executive-level appointees and congressmen received an increase of 3.5 percent (4.0 percent change in the ECI from December 1989 to December 1990 minus 0.5 percentage points), compared with the 4.2 percent given to GS employees.

greater than 5 percent will receive salary adjustments in addition to the annual cost-of-living adjustment. For 1994, the adjustment for each such locality will equal 20 percent that amount necessary to reduce the pay gap between public-and private-sector pay for that area to no more than 5 percent, and the gap will continue to be reduced gradually to no more than 5 percent over the next eight years.

Presidential Discretion to Reduce Increases

As discussed in Chapter 3, before FEPCA, presidents had discretion to reduce or eliminate pay increases under the Federal Pay Comparability Act of 1970 for reasons of economic conditions or national emergency. Although such an action was originally intended to be a last resort, presidents used their authority to issue an alternative pay plan every year beginning in 1978 (the actual adjustments and cumulative gap in comparability were shown in Table 3-1 on page 40).

The congressional sponsors of FEPCA wanted to eliminate presidential discretion altogether, but a veto threat resulted in a compromise meant to give presidents some discretion, but less than under the 1970 act. The President may reduce the level of annual nationwide adjustments or locality payments, or both, in the face of a national emergency or serious economic conditions affecting the general welfare. If the President does reduce the increase, he must report to Congress the reasons and provide an assessment of the impact of the alternative pay adjustment on the government's ability to recruit and retain well-qualified employees.

During the 1992–1994 period, however, the President's discretion is limited as follows: (1) adjustments of up to five percent may not be reduced unless "a state of war or severe economic conditions" exist;[3] and (2) adjustments greater than five percent may be reduced to five percent under the less stringent conditions of "national emergency or serious economic conditions." Also, in 1994, if the locality-based adjustments

[3] Severe economic conditions are defined as two consecutive quarters of negative growth in the gross national product (GNP).

would be less than $1.8 billion, the president may not reduce them unless there is a state of war or there are severe economic conditions. If they amount to $1.8 billion or more, he may adjust them to $1.8 billion for reasons of national emergency or serious economic conditions affecting the general welfare or to less than $1.8 billion on the more stringent grounds.

It is too soon to tell whether or not the FEPCA procedures for making federal pay nearly comparable to nonfederal pay will be more successful than the 1970 comparability act procedures.[4] Because current economic conditions were poor in the first several years of FEPCA, the President could have reduced the 1992 pay raise on the basis of consecutive quarters of negative GNP growth, but did not. President Bush suggested postponing the 1993 pay increase for one quarter in order to reduce the fiscal year 1993 budget by $460 million, but there was no support for this in Congress, which would have had to pass legislation. In February 1993, President Clinton proposed postponing the 1994 pay adjustment for one year and revising the adjustment formula thereafter to be another percentage point less than the ECI (i.e., 1.5 percentage point in all). He also proposed postponing the locality-based comparability adjustment from 1994 to 1995 (OMB, 1993:85)[5]

[4] FEPCA also establishes a pay agent and a Federal Salary Council with nine members —six representatives of employee organizations and three knowledgeable public members. The pay agent sets the pay locality boundaries and recommends to the President comparability payments that would eliminate pay disparities. The pay agent also transmits the views and recommendations of the Federal Salary Council to the president on the procedures for determining locality-based comparability payments and on the levels of comparability payments needed to reduce the disparities.

[5] OMB also said that the methodology for determining locality based comparablity was flawed and would be revised to "permit more equitable and accurate determinations."

Pay-Related Flexibilities

FEPCA includes a number of authorities to pay individuals more when needed to recruit and retain highly qualified personnel in high-pay areas or occupations. The first two provisions broaden the application of current authorities; the rest are mechanisms that have been tested in the personnel demonstration projects (they are listed in Table 4-1).

Broader Special Pay Authority

The President may establish higher minimum pay rates in an area or areas where the government is likely to be handicapped in recruiting and retention due to higher private wages, hazardous working conditions, geographic remoteness, or other circumstances that the President or OPM considers appropriate. The special rate cannot exceed the regular pay rate by more than 30 percent, however, although covered employees may also receive locality-based payments.

Authority to Start New Hires Above Minimum Rate

This authority for advance in-step hiring, previously authorized for GS-11 and above, was extended to all GS levels and permits an agency to offer a higher starting salary to a desired candidate who is already being paid more, or who has unusually high or unique qualifications, or who is needed to meet the government's special need for the candidate's skills and experience.

Critical Positions

The Office of Management and Budget (OMB), in consultation with OPM, may authorize agency heads to fix pay rates for up to 800 positions governmentwide deemed "critical" for accomplishing an important government mission. The authority is to be used if needed to recruit or retain an exceptionally well qualified individual, and they may

Table 4-1. Flexibility Provisions of FEPCA

Broader Special Pay Authority
Expanded Authority to Start New Hires Above the Minimum Rate (Advance In-Step Appointments)
Critical Positions
Senior-Level Pay Band
Recruitment Bonuses
Relocation Bonuses
Retention Allowances
Advances of Pay to New Hires
Travel and Transportation Expenses
Time Off as Incentive Award
Performance-Based Cash Awards
Reemployment of Retirees
Application of Title 38 Provisions to All Patient Care Positions
Senior Biomedical Research Service
Special Occupational Pay Systems

be paid up to level I of the Executive Schedule ($143,800 in 1992) or even higher, on written approval of the President. It is expected that OMB will control the number of positions closely, however, and agencies may find it easier and faster to use recruitment bonuses and retention allowances in conjunction with SES or Senior-Level positions (described in next section) to pay adequate salaries for top scientists and engineers.[6]

Senior-Level Pay Band

The approximately 270 employees still in GS-16,-17, and-18 positions and another 250 in so-called ST positions for specially qualified R&D scientists and professionals will now be paid within a single, ungraded pay band extending from 120 percent of the top GS-15 rate to the rate for level IV of the Executive Schedule. Since ST positions were limited to 517, OPM was going to limit the senior-level to 517, but that limitation was removed by technical amendments to FEPCA in 1992 (P.L. 101–378).

Recruitment, Relocation, and Retention Payments

Under OPM regulations, agency heads may pay lump-sum bonuses of up to 25 percent of base pay to a new employee or one asked to relocate, if the agency would otherwise have a problem in filling the position. Agency heads also may pay an annual retention allowance of up to 25 percent of base pay if needed to keep an employee with unusually high or unique qualifications or to fill a special need of the agency for the employee's services. The employee must agree to stay for a certain number of years to receive the allowance.

[6] For example, an appointee to an SES-6 position with a 25 percent recruitment bonus could be paid more than $140,000 without OMB approval of a critical pay position.

Advances of Pay

An agency head may authorize advance pay of up to two pay periods in amount to new hires.

Travel and Transportation Expenses

Agencies can pay travel or transportation expenses to and from pre-employment interviews for individuals being considered for employment and for new appointees or student trainees if they are entering federal employment on completion of college.

Time Off as an Incentive Award

Agencies may grant time off, without loss of pay or charge to leave, as an award "in recognition of superior accomplishment or other personal effort that contributes to the quality, efficiency, or economy of government operations."

Performance-Based Cash Awards

Agency heads are authorized to pay lump-sum cash awards to employees with at least "fully successful" performance ratings (or the equivalent). The award is limited to 10 percent of base pay (or up to 20 percent for "exceptional" performance).

Reemployment of Retirees

The director of OPM may, on a case-by-case basis, waive the law prohibiting double payments—salary and pension—for civilian and military retirees if they take positions for which there is "exceptional difficulty in recruiting or retaining a qualified employee," and agency heads may exercise the same authority temporarily "due to an emergency

involving a direct threat to life or property or other unusual circumstances." OPM plans to allow the waiver only in "very rare cases" (Laurent, 1991:3).

Health Care Positions

OPM may extend the position classification, pay, and hours-of-work provisions of Title 38 of the *United States Code* to employees of any department and agency working in patient care services.

Additional Pay Systems

FEPCA mandated creation of two new pay systems, one of them for biomedical researchers (the other is for law enforcement personnel), and it authorized creation of additional "special occupational pay systems" for which the classification and pay level systems of Title 5 "do not function adequately."

Senior Biomedical Research Service

The Senior Biomedical Research Service (SBRS) of up to 350 positions was established in the Public Health Service (PHS). SBRS positions are for outstanding basic science or clinical researchers with doctoral-level degrees in a biomedical or related field. They are not subject to Title 5 provisions concerning GS pay rates, classification, performance appraisal and performance actions, retention preference, and adverse actions. The secretary of Health and Human Services was authorized to set pay, although the act specifies that it may not be less than the minimum rate for GS-15s ($64,233 in 1992) or exceed level I of the Executive Schedule ($143,800 in 1992), unless approved by the President. The secretary is also directed to develop a systematic performance appraisal system to encourage excellence. To encourage recruitment from academia, the PHS may contribute an annual amount

up to 10 percent of the base pay to an employee's retirement program at an institution of higher learning.

Special Occupational Pay Systems

FEPCA recognizes that Title 5 may not be suitable for certain occupations, even with locality-based comparability pay and special provisions to deal with specific high-pay areas and occupations. Accordingly, sec. 105 of the act authorizes the President's pay agent to create special pay systems for individual occupations or groups of occupations that should not be under Title 5 or subject to the General Schedule "for reasons of good administration." They are not subject to those laws, rules, and regulations of Title 5 that currently may be waived for personnel management demonstrations. Thus position classification could be simplified and broad pay bands used, as at China Lake and NIST. The top pay would be capped, however, at the lowest level (level V) of the Executive Schedule, which means that it would not be comparable to the SES pay level, which may higher, to level IV of the Executive Schedule.

OPM is currently conducting studies of two potential occupational pay systems, one of them covering health care professionals.[7] OPM does not have plans to look at other occupations at this time, although other groups have been suggested for study in the past, including scientists and engineers in research and development, attorneys, and teachers (OPM, 1989c:6–7).

[7] The other study is to develop a plan for a protective services pay system, which would include the congressionally mandated law enforcement pay system. It would use the general authority to create special pay systems to extend the plan to guards and security personnel.

5

Next Steps and Recommendations

This report has documented the problems of recruiting and retaining highly qualified scientists and engineers in competition with the private sector (Chapter 2), the history of special mechanisms employed by the federal government to put itself in a better competitive position (Chapter 3), and the lessons of a series of personnel demonstration projects employing experimental policies and procedures for attracting and keeping skilled technical personnel (Chapter 3). The report also analyzes the potential impact of the Federal Employees Pay Comparability Act of 1990 (FEPCA) in increasing the federal government's flexibility to respond to changing labor market conditions for scientists and engineers and other specialists (Chapter 4).

This chapter presents the committee's conclusions and recommendations for responding to the policy issues concerning scientific and technical personnel identified in Chapter 1. To a large extent, these involve exploiting FEPCA's array of new authorities and mechanisms that could help the federal government recruit, retain, and motivate the qualified scientific and engineering personnel it needs.

There are some additional steps beyond FEPCA that should be taken to improve federal personnel administration as it affects scientists and engineers. Some could be accomplished under the authority of FEPCA itself, such as the establishment of a special occupational pay system for senior scientists and engineers who deserve high-level positions for their research accomplishments but who are not managers or executives and therefore do not qualify for promotion to the Senior Executive Service (SES). Others, such as making the position classification system more flexible, which would permit pay banding, would require new legislation.

Effective use of these new and proposed policies and mechanisms for flexibility also requires a new organizational structure and data system that will enable the system to react effectively to positive and negative changes in the recruitment and retention environment. Currently the government is in a favorable employment position, even concerning recruitment and retention of relatively scarce specialists in science and technology (S&T) fields, but this condition is temporary. The federal personnel system must be prepared for changes—whether favorable or unfavorable—in the supply and demand for the highly skilled scientists, engineers, and other experts the government needs.

A structure must be in place to monitor the recruitment and retention situation and to make adjustments in the face of changing labor market and other conditions affecting the employment of scientists and engineers. Accordingly, we make recommendations concerning the collection of data, ongoing monitoring, and periodic assessment of science and engineering recruitment and retention, and for interagency adjustments to changing conditions.

RECOMMENDATIONS

Implemented appropriately, the new pay comparability act will help federal agencies to manage more effectively the recruitment and retention of scientists, engineers, and other experts needed by the government to conduct its S&T enterprise. It could go a long way toward making the federal government more competitive where it needs to be by increasing the flexibility of agencies to pay more in higher-pay areas and higher-pay occupations and to better performers.

The committee believes, however, that effective implementation of the law will require careful monitoring and encouragement, and makes the following recommendations for ensuring that the federal government and its departments and agencies are more effective in managing recruitment and retention of scientists and engineers.

Recommendation 1. The pay reform provisions and related flexibilities provided by the Federal Employees

Pay Comparability Act of 1990 (FEPCA) should be implemented as fully as possible by the President and the departments and agencies, in order to redress pay inequities and reward superior performance among all federal employees, including scientists and engineers.

Full implementation of FEPCA's procedures for achieving pay comparability between federal and nonfederal pay levels at the local level would go far toward making the government competitive in attracting, retaining, and motivating the scientific and technological talent it needs to carry out vital policies and programs. Given the severe pressures on the federal budget, however, implementation of pay comparability is by no means assured. The President's authority to reduce the annual salary adjustment or locality-based comparability payments is somewhat limited during the first several years. Although the legislative language governing exceptions to pay increases is more restrictive than that in the 1970 pay comparability act, which presidents used to justify less-than-comparable pay increases from 1978 through 1989, it permits reductions under certain conditions. We believe, however, that presidents should invoke their authority to reduce pay increases only under the direst circumstances of economic distress or national emergency contemplated in the law. The long-term costs of noncompetitive federal salaries can outweigh the short-term savings in terms of the government's ability to carry out its national S&T functions.

WHO SHOULD BE RESPONSIBLE FOR PERSONNEL POLICY FOR FEDERAL SCIENTISTS AND ENGINEERS?

The dramatic changes associated with the enactment of FEPCA require a revamping of the organizational structure for federal personnel policy if its full potential is to be realized. Effective implementation of FEPCA and management of the federal personnel system for scientists and engineers puts increased responsibilities on the agencies and departments, which is where they belong. The Office of Personnel Management (OPM) should increase its capacity to assist the agencies in managing the more decentralized personnel system implied by FEPCA,

and a stronger mechanism for interagency coordination should be created at the level of the Executive Office of the President.

OPM Responsibilities

OPM should continue to decentralize personnel administration by delegating operational authority to the departments and agencies, but it cannot delegate the overall responsibility for seeing that the purposes of FEPCA are achieved. At the same time, most of the work of carrying out the intentions of FEPCA will be responsibility of the agencies. The S&T activities of the federal government are very diverse, and the issues and problems affecting federal scientists and engineers vary accordingly and are often best handled at the program level. If the line program managers and departmental personnel officers do not work together in a constructive fashion, the full potential of FEPCA will not be realized.

Recommendation 2. OPM should follow its aggressive effort to delegate its authorities under FEPCA with an equally strong effort to see that FEPCA authorities and flexibilities are decentralized to the appropriate levels within the departments and agencies.

This especially involves the line program managers and supervisors who are ultimately responsible for carrying out the agency's missions under widely varying circumstances. OPM also should expand its capacity to assist the departments and agencies, for example in workforce planning and personnel system design, so they make better use of the flexibilities of FEPCA to meet their strategic needs.

At our 1990 workshop with federal officials, the committee heard, on the one hand, from agency S&T program managers and laboratory directors about rigidities and restrictions in the civil service system that hampered their ability to recruit and retain the science and engineering talent they needed and, on the other hand, from OPM officials that various flexibilities to deal with those problems had already been delegated to their agencies. The problem, it appears, is the centralization of personnel authority within the agencies. At our 1991 meeting, we

heard, for example, from the assistant secretary of defense for force management and personnel about the multiple layers within the defense establishment through which personnel authorities must be delegated. With each layer reserving some discretion for itself, little may end up reaching the federal laboratory directors and managers who need it.

Recommendation 3. To help carry out its responsibilities for encouraging, assisting, and overseeing the departments and agencies, OPM should develop an organizational focus for science and engineering personnel policy staffed by individuals who have had experience as senior managers of scientists and engineers.

A specific organizational locus for science and engineering personnel policy within OPM would provide an ongoing, governmentwide S&T perspective on personnel policy and program development. It could provide a focal point for communication with career scientists and engineers throughout the government, particularly those in the Senior Research and Development Service (Recommendation 9). The staff should be highly experienced science and engineering managers who support the director of OPM as chair of the Committee on Federal Science and Engineering Personnel of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) recommended below (Recommendation 5).

Department and Agency Responsibilities

Recommendation 4. Each federal agency with a science and engineering workforce should develop a comprehensive action plan, with assistance from OPM, to (1) identify agency goals and develop an appropriate science and engineering staffing plan, and (2) use the authorities provided under FEPCA to improve recruitment, retention, and utilization of scientists and engineers.

FEPCA authorizes a number of discrete flexibilities that federal agencies could use to tailor the Title 5 civil service system to their specific needs. This means that the first step in implementing FEPCA is for officials and managers in the personnel offices of each agency to meet with line program and laboratory managers to develop a plan to meet that agency's needs. Such a plan should identify agency goals, match them with scientific and engineering personnel needs, and outline an appropriate strategy for combining the relevant flexibilities in FEPCA to achieve the number, type, and quality of science and engineering personnel needed. The agencies should be prepared to provide the organizational resources to carry them out.

FEPCA has the potential of being more than an incremental improvement in the traditional civil service system. It could be used to adapt the civil service system to each agency, within broad parameters that ensure the merit principle. This will require a dialogue between those in the agency responsible for planning and managing substantive programs and those managing the personnel system. Otherwise, FEPCA's flexibilities will be adopted piecemeal and incrementally, and its full advantages will not be realized.

Model plans for relating agency goals to agency personnel needs and for using the flexibilities of FEPCA to achieve these goals could be developed in the FCCSET committee proposed in the next recommendation.

Interagency Coordination

Recommendation 5. A new interagency committee on federal scientific and engineering personnel should be established in the Executive Office of the President under FCCSET to (1) evaluate and recommend science and engineering personnel policies and their implementation; (2) develop model strategies for combining the relevant flexibilities in FEPCA and for science and engineering personnel program evaluation; (3) share successful and unsuccessful experiences; (4) monitor the overall success of the government in recruiting and retaining scientists

and engineers across agencies; and (5) provide a forum for identifying and working out solutions to common problems.

FCCSET is chaired by the director of the Office of Science and Technology Policy in the Executive Office of the President, who is also the President's science advisor. FCCSET members are the department and agency heads or chief technical officials from departments and agencies involved with technical issues. The major purpose of FCCSET is to develop more effective S&T policies that involve multiple federal agencies. The council works through interagency working groups or committees like the one recommended here, and its reports go through the regular budget process, although the Office of Management and Budget (OMB) gives special consideration to interagency policies and programs developed under FCCSET auspices.

One major activity of the FCCSET Committee on Federal Science and Engineering Personnel would be annual reports to the President and Congress describing the status and approaches of the agency action plans for implementing FEPCA and related laws recommended above (Recommendation 4) and the overall progress in carrying out those plans (the OPM organizational unit focusing on science and engineering personnel policy should review and critique the individual agency plans).

The director or a representative of OPM should chair the FCCSET committee, and OPM should report on its efforts to monitor implementation and to assist agencies in carrying out FEPCA's provisions. The committee could be supported by a dedicated professional staff located in OPM or OSTP.

The FCCSET committee should find ways to obtain the views and advice of federal laboratory directors to ensure direct contact with R&D personnel.

A new FCCSET Committee on Federal Science and Engineering Personnel would not be a panacea; there are limits on the interagency coordination committee approach. Heretofore, for example, FCCSET committees have focused on substantive topics, such as high-performance computing and global warming research, rather than administrative issues. We believe, however, that the quality and performance of the federal science and engineering workforce is critical to the success of the

government's programs. It merits high-level attention by a forum of S&T agencies and representatives of the President's staff agencies for science and technology, personnel, management and budget. The new FCCSET committee, convened by the President's science advisor, chaired by the OPM director, and attended by OMB as well as agency representatives, would provide a broader perspective and additional incentives for the agencies to implement FEPCA more effectively and to formulate additional reforms.

Congress

Recommendation 6. Congress and the executive branch should work together to make further changes in the civil service system that address the problems beyond pay flexibility per se. Meanwhile, Congress and OPM should continue the personnel demonstrations as testbeds for policies and practices that are not necessarily permitted under FEPCA or other federal personnel laws.

FEPCA does not make desirable changes in other aspects of personnel policies that also affect the recruitment, retention, and motivation of scientists and engineers, for example, simplifying the position classification system to permit more flexible pay banding, making performance appraisal more suitable and effective for research scientists and engineers, and linking pay more closely with performance. OPM, with the advice of the FCCSET interagency committee on federal scientists and engineers, should formulate and propose legislative measures that would address these gaps. Also, Congress, through its oversight activities, should monitor the performance of OPM and the departments and agencies in carrying out FEPCA and subsequent legislation in terms of adequate recruitment, retention, and utilization of scientists and engineers. Finally, the agencies should make use of the personnel management demonstration authority to try out mechanisms or sets of mechanisms that promise to make scientists, engineers, and other federal personnel more productive and effective.

HOW SHOULD THE EFFECTIVENESS OF THE SYSTEM BE EVALUATED?

The goals of the personnel system are derived from the nature of the federal mission. The ultimate objective is to assure that it is able to attract, train, and retain a workforce of scientists and engineers that is adequate in both quantity and quality to effectively carry out the federal S&T mission.

Evaluation

Recommendation 7. The President's science advisor, working with the director of OPM, the FCCSET Committee on Federal Science and Engineering Personnel, and OMB statistical staff, should develop better methodologies, data, and criteria for evaluating the effectiveness of the science and engineering personnel system.

In theory, the most appropriate way to evaluate the science and engineering personnel system would be to compare the characteristics of the existing workforce with those necessary for the effective accomplishment of the federal role in S&T. A perfect match would imply a highly effective system. A less-than-perfect match would suggest that actions are needed to reduce the imbalance. In practice the methodologies, data, criteria, and assumptions for achieving a proper match need to be developed in a concerted, long-term effort involving OPM and the departments and agencies.

Ideally, the system would contain mechanisms that would permit such actions to be taken—e.g., special allowances to recruit scarce but uniquely defined pools of talent; bonuses to retain highly valued staff; and training programs to accommodate changing needs arising from shifting federal priorities.

Responsibilities

As noted earlier, existing data bases are not capable of providing the information necessary to effectively monitor and evaluate science and engineering personnel changes in the system. There are wide differences in estimates of the amount of turnover occurring, depending on which data base is examined. There is little information on the characteristics of the federal science and engineering workforce. There is little agreement on what would be appropriate indicators of the quality and performance of this workforce. Systematic indicators of compensation are difficult to compile because of the complexity of the federal pay system and the barriers involved in coordinating across agencies.

Recommendation 8. OPM should assume the lead in developing a data base that can be analyzed to monitor the performance of the federal science and engineering personnel system.

This development activity should also involve the federal agencies with expertise and experience in large-scale data collection efforts to describe the science and engineering human resource base (e.g., the Bureau of Labor Statistics, the Division of Science Resources Studies at the National Science Foundation, the Bureau of the Census). Given that the federal agencies will play a central role in providing much of the needed information, the activity should be coordinated through the proposed FCCSET Committee on Federal Science and Engineering Personnel.

In addition, the Central Personnel Data File (CPDF) should be used more aggressively to monitor recruitment, retention, and quality conditions and to identify problems by occupation, agency, and locality. Finally, each agency should collect and analyze data pertinent to its unique science and engineering workforce situation and management issues and provide it to OPM.

OPM collects standard data on all federal employees, including scientists and engineers (described in Falk, 1991). For example, data

elements in the CPDF include information on sex, race, age, highest degree obtained, scientific field of highest degree, occupational area, federal agency employer, years of service, etc. The set of standard data elements should be carefully reviewed by the FCCSET committee and revised to ensure that they meet governmentwide management needs.

SPECIAL PROVISIONS FOR ADMINISTERING THE SCIENCE AND ENGINEERING WORKFORCE

A Senior Research and Development Service

Recommendation 9. A Senior Research and Development Service should be established with a separate pay system, an appropriate performance review and promotion process, and other features conducive to maintaining a high-performance workforce for senior science and engineering positions directly involved in intellectually significant work in research and development and other activities requiring a high level of technical training and expertise.

At least 40 percent of the members of the SES have science or engineering credentials. Some still would be highly productive researchers if they had not entered the SES to advance in rank and pay beyond the GS-15 level. Others remain actively involved in research and technical activity, although the SES is intended for managers.[1] Creation of a Senior R&D Service that would be parallel and equal to the SES—and that would include exemplary scientists and engineers who have achieved professional distinction—would be more appropriate for such high-level technical personnel and would contribute to more effective federal activities in these areas.

[1] Those promoted to ST positions (now Senior-Level positions) are not eligible for the bonuses and rank awards that SES members are. Others leave federal employment after reaching the GS-15 level.

Senior scientists and engineers engaged in such work constitute a distinct occupational group in terms of personnel administration. This has long been recognized in the private sector, where industrial R&D groups are usually subject to different policies, procedures, and organizational arrangements than the rest of the workforce in an effort to attract and keep top scientific and engineering talent and to promote creativity and innovation.

Pay problems could be resolved in many individual cases without establishing a Senior R&D Service by using the bonuses, allowances, and critical position authorities of FEPCA. In addition to accommodating the higher pay that may be needed to recruit and keep certain scientific, engineering, medical, and other critically needed researchers in the federal service, however, a special occupational pay system for senior R&D personnel would enable the federal government to use more appropriate performance review, merit pay, and promotion systems (described in the next recommendation). It would also enable the government to promote highly productive researchers without forcing them to leave their laboratories for management positions, as is required for entry into the current SES. A Senior R&D Service would provide a dual-career track more appropriate for senior scientists and engineers who are more productive in the laboratory than in administration. Thus the Senior R&D Service would need to be separate from but parallel and equal to the SES. Scientists and engineers in the executive management hierarchy would be in the SES, while those involved in research and technology management would be in the Senior R&D Service. This would mirror similar organizational arrangements in the private sector and in academia.

The line between research and technology management—e.g., heading a large research team—and management responsibilities beyond research and technology per se that are more appropriate for SES members may be difficult to define precisely in the abstract. Senior scientists and engineers who enthusiastically take on team leadership roles should not be perceived as having changed their career objectives toward the managerial track.

The Senior R&D Service should have the same rank-in-person features as the SES, which would facilitate interagency assignments of top research managers. This is especially useful during this time of

rapidly changing federal activities and responsibilities in the S&T area.

The committee recognizes the need for diversity in the planning and implementation of career paths for federally employed scientists and engineers. There will be times when it may be appropriate to assign individuals who are members of the Senior R&D Service to managerial positions. The committee suggest, therefore, that there be enough flexibility built in the system to permit short-term and permanent transfers between the Senior R&D Service and the SES.

The distinctive personnel system requirements of researchers have already been recognized by the creation of a Senior Biomedical Research Service (SBRS) in the Public Health Service, which is exempt from Title 5 provisions for pay rates, position classification, performance appraisal, retention preference, and adverse actions. FEPCA authorized the SBRS—with a pay band ranging from the GS-15 level to executive level I—and also authorized the establishment of additional special pay systems for occupations not well suited to Title 5 (see Chapter 4). There are a number of other laboratories in various agencies and departments that might benefit from a special occupational pay system.

Rather than establish such pay systems piecemeal, which would fragment the federal service and possibly create interagency competition for top people, we believe that it would be preferable to create a single, governmentwide senior service for scientists and engineers engaged in R&D work or similar high-level work. Such a Senior R&D Service is a reasonable compromise between a monolithic personnel system covering every occupation and a decentralized system in which each agency has its own personnel system meeting its particular requirements.

A problematic aspect of Recommendation 9 is how to design the service so that it includes only those exemplary scientists and engineers who have achieved professional distinction. The danger is that the concept could be undermined by ingenious supervisors to reward their staffs, regardless of the amount of professional distinction they may have actually achieved. To minimize this danger, clear guidelines on eligibility would be necessary. The development of such guidelines could be one of the initial tasks of the proposed FCCSET interagency committee on federal scientific and engineering talent.

Creating a Senior R&D Service comparable in status and parallel in pay provisions would require new legislation. The beginning of such

a service need not wait for the passage of new legislation, however, because FEPCA provides authority to create a special occupational pay system for occupations that do not fit well under Title 5. Under FEPCA, the same waivers of Title 5 laws, rules, and regulations that are now used in the personnel management demonstrations at China Lake and the National Institute of Standards and Technology could be used in beginning a governmentwide Senior R&D Service. Top pay would be capped at a lower level than that for the SES (level V rather than level IV of the Executive Schedule), and the merit pay features of the SES could not be used. New legislation would also clarify the status of the SBRS and of the Senior-Level positions also established under FEPCA.

As another temporary measure, the use of Senior-Level positions in government R&D activities could be expanded. This approach offers a way to promote senior science and engineering personnel without forcing them into management positions—e.g., it would amount to a dual-track system. Use of Senior-Level positions also help avoid the rigidities of the position classification system, because it consists of a single pay band ranging from 120 percent of the GS-15 rate to the rate for level IV of the Executive Schedule. Thus pay increases may be more flexibly linked to performance rather than just to longevity. But Senior-Level scientists and engineers would not be eligible for the merit pay provisions that should be a key part of the Senior R&D Service program (and that are currently available to SES executives). OPM could immediately begin the process of creating the Senior R&D Service by working actively with agencies to begin to analyze their needs, create positions, identify candidates, and appoint them. These positions and their incumbents could then be included in the Senior R&D Service when it is created.

Peer Input for Science and Engineering Personnel Decisions

Recommendation 10. Compensation and promotion of scientists and engineers should be based in part on evaluation of their job performance by their peers. Governmentwide evaluation programs should be devised drawing on the experience of universities and industry.

Research personnel in the federal government—working in the laboratories at the National Institutes of Health (NIH), the National Aeronautics and Space Administration, and the Department of Defense (DOD), for example—function more like faculty members in universities and researchers in industrial laboratories than the mainstream of federal employees. Although the academic model is not fully applicable to federal government work, especially for scientists and engineers working at the more applied and development end of R&D activities, its reliance on peer review may be usefully adapted, as it has been in many industrial laboratories. In the more hierarchical environment of government and industry, supervisors make pay and promotion decisions, but those decisions would be improved if there were better input from peers.

The procedures used in the academic community for rewarding scientific performance and contribution to the institution may not be directly applicable to federal laboratories because of differences in the nature of the work and in measuring contributions to the institution (e.g., with internal rather than external criteria). However, systems should be explored to realize the principle of relating pay and professional advancement to scientific merit and organizational contribution on an agency and interagency basis aimed at achieving this objective.

At least two federal research agencies, NIH and the National Institute of Standards and Technology, already use advisory input from visiting committees of outside experts on individual promotion decisions, as well as on the group performance of an entire research group or laboratory in carrying out organizational goals with imagination and creativity. Now that FEPCA provides an arsenal of ways to recognize and reward high performance, we believe that mechanisms for incorporating peer reviews of individual and group performance should be developed and used more widely.

More Flexible Position Classification

Recommendation 11. OPM should develop legislation to create a simplified position classification system in federal research and development agencies both for the Senior Research and Development Service and for those now at

the regular GS levels (GS-9/11 through 15), with grade levels comparable with those of counterparts in industry and academia. This flexibility could be combined with pay pools and longer evaluation periods to more closely link performance and pay.

The current GS grade classification and steps within those grades, even with a flexible pay schedule provided by FEPCA, tends to create a rigid system—one in which GS rates are adjusted each year in January and most employees receive automatic raises and within-grade increases based on length of service. With input from the R&D agencies, OPM should develop a simplified position classification system that would permit use of pay banding, one the most successful mechanisms used in the personnel demonstrations. The President and Congress should then agree on legislation that would establish such a simplified classification system for R&D agencies, with levels comparable to research appointments in industrial laboratories and academic ranks for college and university faculty. A National Academy of Public Administration committee recently studied this issue for OPM and recommended the establishing 10 occupational families in place of the 441 current occupations, each with three classification levels of the 15 grades currently existing, each with 10 pay steps (NAPA, 1991). The use of pay banding in conjunction with reform of the classification system would provide an opportunity for much greater pay growth for the valued employee, and it increases the range of salaries available to potential new hires.

The linkage between pay and performance would be strengthened further if the funds for within-grade increases, quality step increases, and other pay supplements and awards were pooled and used to reward high performers. While no one's pay would be cut, failure to receive a performance increase would be a signal that one's performance needs improvement.

At the same time, given the long-term nature of most R&D work, it would be beneficial to make the evaluation intervals longer. This would give the scientists and engineers employed in R&D a more appropriate period of time in which to show results.

Quadrennial Review of the Science and Engineering Personnel System

Recommendation 12. The director of OPM should have a quadrennial review of the science and engineering personnel system undertaken by a reputable nongovernmental organization to assess the performance of the system in light of current and expected future needs and conditions and to recommend improvements.

FEPCA will go a long way toward introducing flexibility into the system so that it will be better able to accommodate changes in federal priorities and shifts in the competitive position of the federal government with respect to recruitment and retention. However, one of the eternal verities of federal personnel policy is that it has been saddled with a considerable amount of inertia. Thus, it has been slow in its response to change.

The committee believes, therefore, that it would be prudent to undertake periodically a comprehensive assessment of how well the system is performing and especially how the new personnel management authorities of FEPCA are being used. Such an assessment would examine the adequacy of the various mechanisms aimed at meeting federal needs for scientists and engineers in areas such as compensation, career development, performance evaluation, and position classification. Based on this examination, recommendations for structural changes would be made, where appropriate.

The committee notes that such a periodic review has been undertaken quadrennially over the past 30 years by DOD. The DOD review focuses on military compensation. The review proposed in this report is intended to be broader, involving both pay and nonpay mechanisms and covering all facets of recruitment, retention, and utilization.[2]

[2] The quadrennial commission device has also been used since the 1960s to assess the adequacy of compensation for executive-level federal officials,

The report should be addressed to Congress, the President's science advisor, OMB, and, via the director of OPM, the FCCSET Committee on Federal Science and Engineering Personnel for consideration.

ISSUES BEYOND FEPCA

Adequate pay is a necessary but not a sufficient condition by itself for ensuring a well-qualified science and engineering workforce. Scientists and engineers are motivated to enter and stay in federal service by a number of nonpay factors, such as the opportunity to identify and develop the solutions to important national problems, the satisfaction of conducting scientifically important research and managing large-scale engineering projects, the quality of the facilities and equipment in federal laboratories, and the opportunity to engage in long-term projects. They also value the opportunity for further training and education and to engage in professional recognition and advancement. These are issues addressed in this section that go beyond FEPCA.

Adequately Equipped and Staffed Laboratories

Recommendation 13. In order to attract and retain talented scientists and engineers, and increase their productivity, the federal laboratories must have adequate technical and support personnel and up-to-date equipment and facilities comparable with those available to their professional peers in other research settings.

In a time of budget restraint and federal downsizing, it is important to recognize that a laboratory with too many professionals (scientists and

congressmen and senators, and judges. These commissions have had the authority to take a broader look at overall personnel management but rarely have gone beyond making salary-level recommendations.

engineers) and not enough technical and support personnel can be neither efficient nor productive and that a certain critical mass of the right kind of personnel is necessary in order to function. The latest equipment is of limited value in the absence of trained technicians and other support personnel to operate that equipment and to carry out experiments.

Lack of supplies and small scientific instruments delayed by having to go through departmental procedures designed for large-scale purchasing may unduly hamper R&D progress. Departments and agencies with R&D programs should review their policies and procedures for obtaining equipment and supplies to ensure that they are adequately flexible and timely for researchers.

Federal budgets are shrinking and fiscal accountability is becoming more stringent. One way to cope and to continue to be scientifically productive is to allow greater flexibility and local autonomy in distribution of funds. Specifically, the policy of "matching personnel to budget" rather than absolute personnel ceilings or specific numbers of personnel in certain job categories would allow the laboratory manager to hire the appropriate combination of professional, technical, and support personnel for that particular laboratory. Chronic hiring freezes and/or promotion freezes for certain civil service grade levels are demoralizing for both managers and current staff and negatively impact productivity and planning strategies. Many research programs are impeded by restrictions such as the requirement to spend money allocated for a specific fiscal year only in that fiscal year. Two-year budgeting would allow the flexibility that is required by the ever-changing nature inherent in research programs. The agencies and OMB should strive to strike a balance in the staffing and equipping of federal research laboratories.

Professional Development

Recommendation 14. OPM should develop and implement professional development policies and programs that meet the needs of federal scientists and engineers, including continuing professional training and education; retraining for occupational changes; support of participation in professional associations; and support of academic

degree training for employees in hard-to-fill occupations. The departments and agencies should make active use of these authorities to encourage career development among their science and technology professionals.

OPM has begun to take a more systematic career-path approach to employee development policies and programs. We endorse this approach in the federal service, because continuing education, training, retraining, and participation in professional activities are especially integral to the career development of scientists, engineers, and other professionals.

OPM should set standards for continuing professional development of critical occupational groups and ensure that they are met by the agencies. OPM also should assist the agencies in identifying and meeting needs for retraining where there are major occupational shifts. Currently, for example, nuclear engineers in the Department of Energy are facing a major cutback in weapons production at the same time the department is sharply increasing its environmental cleanup efforts.

Federal departments and agencies also should strongly encourage memberships and participation in the activities of professional societies, because participation in such organizations is an important part of the career development of practicing scientists and engineers. The agencies should provide travel support for such activities from their research budgets rather than from administrative travel, because professional development of the government's scientists and engineers is integrally related to agency goals.

Finally, the departments and agencies should make active use of new authority contained in the Defense Authorization Act of 1990 that permits all federal agencies to pay tuition leading to higher academic degrees for employees with critical job skills that the government needs to recruit or retain. According to recent OPM guidelines, the government not only can help scientists and engineers obtain a degree that would qualify them for otherwise hard-to-fill positions, it can also pay tuition for employees if it contributes to their performance in their current position. Since continuing education was already a major incentive cited by scientists and engineers for entering and staying in the public service, the new authority to pay expenses leading to a higher degree, not just for specific courses substantively related to the employ

ee's current work, will make the federal government a more attractive employer.

Fairer Ethics Rules

Recommendation 15. In updating the code of ethical conduct for federal employees, the Office of Government Ethics (OGE) should take special care not to unnecessarily restrict appropriate involvement of federal scientists and engineers and other professionals in professional associations. OGE should continue to let federal employees be as involved in science and engineering societies as their agencies deem is helpful to their missions.

The attractiveness of federal employment to science and engineering professionals is influenced by more than federal personnel policies per se. Scientists and engineers are especially sensitive to restrictions on professional development and recognition. Federal ethics laws and regulations are especially problematic in this regard, because federal employees are often subject to stricter rules than their private-sector colleagues.

Under current OPM rules, agencies may grant paid administrative leave to employees participating in professional association activities. However, such leave, or excused absence, "generally should be limited to situations in which the activity is directly related to the agency's mission, will enhance the professional development or skills of the employee...or is officially sponsored by the head of the agency" (OGE, 1991a).

Scientific societies are important to researchers, because they hold the scientific meetings and publish the scientific journals where researchers publish their results. Federal agencies often use degree of participation in professional associations as a measure of the qualifications and career attainment of employees.

Scientific societies are also a forum where science and engineering researchers from all sectors—governmental, academic, industrial—meet to share results and discuss the future research agenda. Since 10 to 30

percent of the membership of the major societies are federal employees, restrictions on their participation hamper the ability of such societies to hold conferences and publish journals, which in turn slows down scientific progress. Accordingly, many federal science and engineering agencies encourage employees to be active in scientific associations and societies.

In July 1991, OGE published a draft of updated "Standards of Ethical Conduct for Employees of the Executive Branch," last issued in 1964, that would have prohibited the use of official time by federal employees who are officers of professional associations "to administer the internal affairs of any such organization or to carry out its business" (OGE, 1991b:33811). Since at least some federal agencies were permitting employees to serve as officers of scientific societies as part of their jobs, and since the line the proposed rules tried to draw between allowed and unallowed activities was unclear, this section received 980 of the 1,100 responses in all to the entire proposed code during the 60-day comment period.

Eventually, OGE deleted the section from the final rule and announced plans to revise it and publish it again for further comment at a later date (OGE, 1991b). The committee urges OGE to let current practice continue, which is to (1) urge federal employees to participate actively in professional associations, (2) encourage agencies to cooperate with professional associations, and (3) permit agency heads to grant excused absences for purposes that benefit the public interest. These practices are already regulated by OPM regulations and agency rules.

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B Statistics on Federal Scientists and Engineers

This appendix consists of tables of statistics on federal government scientists and engineers. The data were taken from a series of reports produced by the Division of Science Resources Studies at the National Science Foundation (NSF). They were published annually through 1988. The 1989 report was drafted but not issued due to budgetary and staff shortages at NSF. More recent reports have not been attempted.

The data for the NSF reports came directly from tapes of the central personnel data file of the Office of Personnel Management. They cover all civilians employed full time by the federal government (1) who are in one of the occupational series defined as science and engineering (as listed in Table B-2) and (2) who hold at least a bachelors degree (NSF, 1989:1–2).

The tables are:

B-1. Federal Scientists and Engineers by Occupational Group and by Sex, 1989

B-2. Federal Scientists and Engineers by Occupational Group and Series, 1988 and 1989

B-3. Federal Scientists and Engineers by Type of Work Activity, 1989

B-4. Federal Scientists and Engineers by Occupational Group and Scientific/Engineering Field, 1989

B-5. Federal Scientists and Engineers by Department and Agency, 1989

B-6. Federal Scientists and Engineers by Occupational Group and by Degree Level, 1989

TABLE B-1. Federal Scientists and Engineers by Occupational Group and by Sex, 1989

Occupational Group	All	Women	Men
TOTAL	**223,343**	**32,803**	**190,539**
Scientists	**111,988**	**24,104**	**87,884**
Physical sciences	26,556	3,940	22,616
Mathematics and statistics	9,668	2,322	7,346
Computer sciences	24,262	7,774	16,488
Life sciences	33,839	5,517	28,322
Social sciences	14,271	3,712	10,559
Psychology	3,392	839	2,553
Engineers	**111,355**	**8,699**	**102,655**
Industrial	3,080	447	2,633
Materials	1,253	174	1,079
Chemical and related	1,709	298	1,411
Civil engineering	18,404	1,755	16,649
Electrical and electronics	34,774	2,520	32,254
Mechanical and related	27,561	1,830	25,731
Other engineering	24,574	1,675	22,898

SOURCE: NSF, 1991.

TABLE B-2. Federal Scientists and Engineers by Occupational Group and Series, 1988 and 1989

Occupational Group and Series	1988	1989	Change
TOTAL	**217,618**	**223,343**	**+2.6%**
Scientists	**109,400**	**111,988**	**+2.4**
Physical sciences	**26,548**	**26,556**	**-***
Astronomy and space sciences	471	475	
Chemistry	7,331	7,269	
General physical sciences	5,511	5,655	
Geodosy	290	276	
Geology	2,503	2,438	
Geophysics	592	582	
Hydrology	2,236	2,267	
Metallurgy	345	294	
Meteorology	2,067	2,134	
Physics	3,839	3,798	
Health physics	570	598	
Oceanography	710	682	
Textile technology	83	88	
Mathematics and statistics	**9,773**	**9,668**	**-1.1**
Actuarial science	141	157	
Mathematics	2,531	2,455	
Mathematical statistics	989	969	
Operations research	3,828	3,864	
Statistics	2,284	2,223	
Computer sciences	**22,706**	**24,262**	**+6.9**
Life sciences	**33,152**	**33,839**	**+2.1**
General biological sciences	5,308	5,570	
Microbiology	1,908	1,933	
Agricultural sciences	10,549	10,459	
Agricultural extension	53	54	
Agricultural management	3,516	3,532	
Agronomy	325	327	
Horticulture	103	99	
Husbandry	111	112	
Soil conservation	4,707	4,625	
Soil science	1,734	1,710	

Occupational Group and Series (cont.)	1988	1989	Change
Animal sciences	1,312	1,336	
Entomology	704	704	
Physiology	502	526	
Zoology	106	106	
Plant sciences	1,957	2,022	
Botany	162	167	
Plant pathology	319	330	
Plant physiology	334	340	
Plant protection and quarantine	1,142	1,185	
Forestry	5,755	5,819	
Forestry	5,684	5,749	
Forestry products technology	71	70	
Fishery and wildlife	3,717	3,973	
Fishery biology	1,369	1,486	
General fish and wildlife admin.	181	192	
Wildlife biology	1,600	1,742	
Wildlife refuge management	567	553	
Other life sciences	2,531	2,567	
Food technology	267	293	
Genetics	347	345	
Pharmacology	400	385	
Range conservation	1,153	1,140	
Ecology	364	404	
Toxicology	115	160	
Social sciences	**13,934**	**14,271**	**+2.4**
Anthropological sciences	684	738	
Archeology	638	688	
General anthropology	46	50	
Economics	5,509	5,475	
Foreign agricultural affairs	189	196	
Social science	2,893	3,167	
Sociology	59	68	
Geography and cartography	4,083	4,117	
Geography	227	227	
Cartography	3,634	3,669	
Land surveying	222	221	
Community planning	517	510	

Occupational Group and Series (cont.)	1988	1989	Change
Psychology	**3,287**	**3,392**	**+3.2**
Engineers	**108,218**	**111,355**	**+2.9**
Industrial	**3,091**	**3,080**	**-0.4**
Materials	**1,195**	**1,253**	**+4.9**
Chemical and related	**1,831**	**1,709**	**-6.7**
Ceramic	67	59	
Chemical	1,764	1,650	
Civil engineering	**18,628**	**18,404**	**-1.2**
Civil	15,760	15,380	
Environmental	2,868	3,024	
Electrical and electronics	**32,521**	**34,774**	**+6.9**
Electrical	5,531	5,569	
Computer	N/A	1,214	
Electronics	26,990	27,991	
Mechanical and related	**26,882**	**27,561**	**+2.5**
Aerospace	8,768	9,254	
Mechanical	13,591	13,572	
Naval architecture	1,203	1,201	
Nuclear	3,320	3,534	
Other engineering	**24,070**	**24,574**	**+2.1**
General	19,944	20,431	
Agricultural	384	388	
Architecture	1,739	1,765	
Fire prevention	133	143	
Mining	422	397	
Petroleum	453	435	
Safety	593	619	
Welding	101	109	
Biomedical	301	287	

SOURCE: For 1988 figures, NSF, 1989:Table B-1; for 1989 figures, NSF, 1991.

NOTE: * means the change was less than 0.1 percent.

TABLE B-3. Federal Scientists and Engineers by Type of Work Activity, 1989

Activity	Total	Scientists	Engineers
TOTAL	**223,343**	**111,988**	**111,355**
Research	22,932	18,386	4,546
Development	33,213	7,247	25,966
Design	17,775	364	17,411
Data collection, processing, and analysis	16,691	14,864	1,827
Natural resources operations	16,878	15,649	1,229
Management	15,379	5,184	10,195
Installation, operations, and maintenance	12,766	350	12,416
Planning	8,194	4,729	3,465
Test and evaluation	10,432	2,534	7,898
Research contract and grant administration	1,173	832	341
All other activities	45,395	19,627	25,768
Activity unknown	22,515	22,222	293

SOURCE: NSF, 1991.

TABLE B-4. Federal Scientists and Engineers by Occupational Group and Scientific/ Engineering Field, 1989

Occupational Group	All	Defense	Nondefense
TOTAL	**223,343**	**111,176**	**112,167**
Scientists	**111,988**	**34,711**	**177,277**
Physical sciences	26,556	8,557	17,999
Mathematics and statistics	9,668	5,434	4,234
Computer sciences	24,262	12,890	11,372
Life sciences	33,839	1,994	31,845
Social sciences	14,271	4,723	9,548
Engineers	**111,355**	**76,465**	**34,890**
Industrial	3,080	2,914	166
Materials	1,253	847	406
Chemical and related	1,709	981	728
Civil engineering	18,404	10,576	7,828
Electrical and electronics	34,774	27,373	7,401
Mechanical and related	27,561	19,913	7,648
Other engineering	24,574	13,861	10,713

SOURCE: NSF, 1991.

TABLE B-5. Federal Scientists and Engineers by Department and Agency, 1989

Department/Agency	Total	Scientists	Engineers
TOTAL	**223,343**	**111,988**	**111,355**
Agriculture	28,584	26,041	2,543
Commerce	8,172	7,382	790
Defense	111,176	34,711	76,465
Air Force	18,593	4,968	13,625
Army	36,940	11,873	25,067
Navy	47,882	11,993	35,889
Other Defense	7,761	5,877	1,884
Energy	4,453	1,546	2,907
Health and Human Services	8,560	8,180	380
Interior	14,950	12,069	2,881
Transportation	5,400	1,046	4,354
Veterans Affairs	5,156	3,994	1,162
Environmental Protection Agency	5,448	3,359	2,089
National Aeronautics and Space Administration	12,840	1,602	11,238
National Science Foundation	402	348	54
Tennessee Valley Authority	3,394	784	2,610
All others	14,808	10,926	3,882

SOURCE: NSF, 1991.

TABLE B-6. Federal Scientists and Engineers by Occupational Group and by Degree Level, 1989

Occupational Group	All	Ph.D.	MS/MA	BA/BS	Prof'l	Unknown
TOTAL	**223,343**	**22,012**	**50,010**	**145,667**	**1,615**	**4,039**
Scientists	**111,988**	**18,748**	**27,566**	**63,280**	**1,008**	**1,386**
Physical	26,556	7,720	6,982	11,197	277	380
Math/stats	9,668	1,149	3,522	4,915	64	18
Computer	24,262	345	4,304	18,986	130	497
Life	33,839	5,711	6,604	20,873	333	318
Social	14,271	1,583	5,263	7,072	186	167
Psychology	3,392	2,240	891	237	18	6
Engineers	**111,355**	**3,264**	**22,444**	**82,387**	**607**	**2,653**
Industrial	3,080	16	584	2,421	16	43
Materials	1,253	187	358	698	7	3
Chemical	1,709	186	323	1,104	8	88
Civil	18,404	305	3,900	13,658	145	396
Electrical	34,774	769	6,216	26,878	129	782
Mechanical	27,561	1,031	4,859	20,794	101	776
Other	24,574	770	6,204	16,834	201	565

Source: NSF, 1991.

C Profiles of the Personnel Management Demonstration Projects

NOTE: These profiles are adapted from Appendixes B and C of a report of the U.S. Merit Systems Protection Board, *Federal Personnel Research Programs and Demonstration Projects: Catalysts for Change*, Washington, D.C., December 1992.

1. Navy Personnel Management Demonstration Project (China Lake)

The Navy demonstration project, begun in 1980, is being conducted at the Naval Air Warfare Division (formerly the Naval Weapons Center), China Lake, California, and at the Naval Command, Control and Ocean Surveillance Center (formerly the Naval Oceans Systems Center), San Diego, California. The project covers almost 8,000 white-collar employees—scientists, engineers, technicians, administrative personnel, technical specialists, and clerical staff. The project was extended twice, the last time in 1988 to run until 1995. The project's focus is to simplify personnel management and make line managers the primary decisionmakers for major personnel management issues, such as classification, compensation, and performance appraisal. The Navy hopes to enhance the effectiveness and productivity of its laboratories through this simplification and increased management involvement. To achieve the project goals, the demonstration project tests:

- A simplified classification system that consolidates job series into five career paths and combines several General Schedule (GS) grades into broad pay bands (up to six);
- A performance appraisal system that links pay to performance;

- Higher than the minimum starting salaries for new hires;
- Recruitment bonuses;
- A system which encourages changes in behavior for employees experiencing drug and/or alcohol problems by suspending penalties for misconduct and poor performance; and
- Modified lay-off procedures where performance is the primary criterion for retention.

The University of Southern California's Graduate School of Public Administration developed the original evaluation plan, but Coopers and Lybrand were contracted to do the first evaluation. The Office of Personnel Management (OPM) took over as the outside evaluator in 1982 and is being paid by the Navy for the service. Fourteen reports have been published to date. The evaluations were unable to measure whether the labs' productivity and efficiency have been enhanced by the demonstration project. However, the evaluations showed that pay banding is a workable concept. Some key findings are as follows:

- The classification system is simpler and less time-consuming, permitting managers to take a more active role;
- Starting salaries for scientists have increased substantially;
- Large pay increases for good performance have greatly strengthened the link between performance and pay;
- Turnover among high performers has decreased;
- Supervisors believe they are more empowered to make personnel decisions; and
- Employee approval of the project has reached an all-time high, with 70 percent favoring the project.

2. Alternative Personnel Management System at the National Institute of Standards and Technology (NIST)

Congress directed OPM and NIST to jointly design a demonstration project to be conducted by the director of NIST. Covering slightly over 2,500 white-collar employees in Gaithersburg, Maryland—scientists, engineers, technicians, clerks, administrative staff, and others—the project was implemented on January 1, 1988, and was scheduled to run until December 31, 1992. In December 1991, OPM granted a 33-month extension because NIST radically revised its performance management system. The project is designed to improve hiring and retention of high-quality personnel by adopting such approaches as total compensation comparability (TCC), where compensation includes basic pay, bonuses, allowances, retirement benefits, health and life insurance benefits, and leave benefits. The director of NIST has not exercised TCC. Instead, the director opted to adjust pay based on the general federal cost-ofliving pay increases, since TCC would make salaries of some covered positions above the going market rate. NIST is conducting the project on a cost-neutral basis—that is, the costs of salary increases would not exceed the costs NIST would incur with the usual federal pay increases. NIST is testing:

- A simplified classification system that combines job series into four career paths and consolidates GS and GM grades into five broad pay bands;
- Examination of the applicants' qualifications and their employment without going through the OPM hiring process;
- A performance appraisal system that links pay to performance;
- Pay differentials for supervisors;
- Recruitment and retention bonuses;
- A flexible probationary period for scientists and engineers; and

- Sabbaticals for scientists and engineers.

The enabling legislation required OPM to fund and conduct the evaluation; OPM contracted out the evaluation aspect to the University Research Corporation. After a year, HumRRO International, Inc., became the outside evaluator in 1990. NIST has conducted one internal evaluation. These evaluations found that:

- NIST exclusively hired candidates without going through the OPM hiring process, a step that shortened hiring time;
- Time to classify jobs was reduced;
- Employees viewed the adjectival "fully successful" rating negatively, resulting in significant changes to the performance appraisal system;
- The quality of scientists and engineers hired remained unchanged—i.e., NIST consistently hired quality employees before and after implementation of the project; and
- Turnover was not a problem before or after the implementation of the project.

3. Department of Agriculture Demonstration Project

The Agriculture project was implemented in July 1990 and is scheduled to run until July 1995. Its purposes are to test a flexible and responsive recruitment and selection program for new hires that will facilitate the attainment of a diverse, well-qualified workforce and increase the reliability of decisions to grant career tenure to scientists. To meet these goals, the project is testing:

- A streamlined examining and selection system featuring category groupings instead of numerical rating and ranking;

- Authority to hire for locally identified shortage occupations without going through the OPM hiring process;
- Discretionary use of modified qualification standards;
- Recruitment incentives, including cash payments and reimbursements for relocation travel and transportation expenses; and
- A 3-year probationary period for scientists to allow managers to fully assess employee performance before granting tenure.

The Department of Agriculture projects that over the life of the project, 5,000 new hires—including white-collar and blue-collar positions at randomly selected units of the Forest Service and the Agricultural Research Service—will be covered by the demonstration project. The project has not been operating long enough for an evaluation.

4. Department of Transportation/Federal Aviation Administration Demonstration Project

The project—implemented in June 1989 and scheduled to run until June 1994—covers 2,100 white-collar employees in several air traffic control facilities in the Chicago, New York City, Oakland, and Los Angeles areas. It tests the use of retention allowances or bonuses of at least 20 percent of base pay, to attract and retain well-qualified, full-performance-level personnel to control air traffic, operate and maintain airway facilities, and certify and inspect aircraft and operators in the four hard-to-fill locations.

5. PACER SHARE: A Federal Productivity Enhancement Program (terminated)

PACER SHARE was implemented in February 1988 by the Air Force's Directorate of Distribution at the Sacramento Air Logistics Center, McClellan Air Force Base, California, and ran until February 1993.

In 1991, the project was amended because the Directorate reorganized, a step that brought approximately 60 percent of the 1,700 participating employees under the management of the Defense Logistics Agency. The goals of the project were to increase organizational productivity and enrich the quality of worklife by adopting the principles of total quality management. The concepts being tested were:

- A simplified classification system that consolidated 66 job series into 6 broad categories and combined white-collar and blue-collar pay grades in 4 broad pay bands;
- A group performance rating instead of the individual performance rating;
- An incentive system that motivates and rewards organizational productivity by sharing any cost savings realized equally between the agency and employees (cost savings are realized only if the same work is performed for a lower labor cost or more work is performed for the same labor cost);
- A flexible on-call employment program geared to adjust to changing workload and budgets; and
- Revised supervisory grading criteria which reflect job responsibilities and the difficulties of carrying them out instead of the number and grades of subordinates.

The Defense Manpower Research Center, a component of the Rand Corporation's National Defense Research Institute, was the outside evaluator for the first 3 years of the project. The Navy Personnel Research and Development Center was the external evaluator for the remainder of the project. OPM published an Implementation Report in August 1989, while Rand published its baseline report in 1990 and the first-year evaluation in 1991. Some key findings for the first year are as follows:

- Employee morale worsened during the first year of the project. The low morale was attributed to uncertainty about how pay and promotions were to be determined under pay banding and the inability of the sponsoring organization to pay productivity gainshares;
- No conclusive evidence was found that PACER SHARE led to cost savings (the cost/benefit aspect of the project was the main focus of the evaluation for the first year); and
- Error rates in shipping orders were maintained during the first year (a period of great change because of the project's implementation as well as DOD's downsizing), but it took longer to ship the orders. The decline in timeliness was partly attributed to difficulties in implementing a new automated warehouse system at the time.

6. Department of Transportation/Federal Aviation Administration (FAA) Airway Science Curriculum Demonstration Project (terminated)

Implemented in 1982 and extended once in 1987 (for the purpose of validating the results), the project was terminated in 1991 by mutual agreement of FAA and OPM when it became clear that FAA would not be able to hire enough candidates and obtain meaningful data to validate the results. The project, which was implemented immediately after the air traffic controllers' strike and their subsequent dismissal in 1981, tested an alternative selection process for four major FAA occupations: air traffic controller, aviation safety inspector, electronics technician, and computer specialist. The purpose was to facilitate the rebuilding of FAA's workforce after the strike. The project tested the use of an FAA-developed Airway Science curriculum (which was being offered by some colleges and universities) as an alternative to the traditional testing process conducted by OPM. The performance of graduates of the Airway Science curriculum was to be compared to that of traditional hires to determine whether Airway Science graduates perform better in their jobs.

FAA was responsible for conducting the evaluation, closely monitored by OPM. FAA contracted with Research Management Consultants, Inc. (RMCI) to perform this function. RMCI has published one report. After one year of testing, the staffing level of air traffic controllers had increased, but the results were not conclusive for the other occupations (i.e., personnel hiring for flight standards and airway facilities did not significantly increase). It appears that the retention allowance was a factor in employee decisions to transfer to participating facilities.