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ABSTRACT

The House Committee on Science and Technology, Subcommittee on Science, Research and Technology, sponsored an American Association for the Advancement of Science seminar (July 28, 1981) and 6 days of hearings (September 9-17, 1981) on "The Human Factor in Innovation and Productivity." These hearings were designed to increase knowledge about the role of human factors in technological growth so that innovation and productivity in United States industries can be increased. Presented are findings and recommendations of the Subcommittee and an analysis of the hearings. Findings/recommendations focus on the importance of the human factor, labor-management cooperation, human factor and new technology, human resources for technology, Federal focus on productivity, and the need for research. The analysis includes an overview (summarizing major views expressed by seminar and hearings participants) and more detailed discussions of these views. These discussions address issues related to: (1) the importance of the human factor; (2) the American work force (focusing on worker attitudes/values, participation in decision-making, and management/labor issues); (3) efforts to improve productivity (focusing on approaches, introduction of new technology, and need for more research); and (4) role of the Federal Government, indicating lack of a central focus within the Government for innovation and productivity issues. (JN)

[COMMITTEE PRINT]

THE HUMAN FACTOR IN INNOVATION AND PRODUCTIVITY

INCLUDING AN

ANALYSIS OF HEARINGS ON THE HUMAN FACTOR

PREPARED BY THE

CONGRESSIONAL RESEARCH SERVICE

REPORT

BY THE

SUBCOMMITTEE ON

SCIENCE, RESEARCH AND TECHNOLOGY

TRANSMITTED TO THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

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*On assignment to Budget Committee for 97th Congress.

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C., November 17, 1982.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology,
House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: During September 1981, the Subcommittee on Science, Research and Technology held 6 days of hearings on the Human Factor in Innovation and Productivity. Earlier that summer, you and I cosponsored an American Association for the Advancement of Science seminar on the same topic. These activities were part of the Subcommittee's continuing study of innovation and productivity.

The following report of the Subcommittee is based on the hearings and upon an analysis of the record which I would like to have printed together with this report. The report contains the findings and recommendations of the Subcommittee. It is submitted for the use of the Committee on Science and Technology.

Sincerely,

DOUG WALGREN,
Chairman, Subcommittee on Science,
Research and Technology.

REPORT OF THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY

ON THE

HUMAN FACTOR IN INNOVATION AND PRODUCTIVITY

INTRODUCTION

We are living during a time of dramatic technological change. New technology is being implemented in the office and in the factory at a rapid and accelerating rate.

Our society is also undergoing considerable social change. Women are having a greater and long overdue impact on the world of work. Both men and women are delaying the decision to begin families and instead are seeking greater fulfillment through work. Due to technological breakthroughs in medicine, people are living longer. World food supplies and natural resources are being strained by continued world population growth, which demands the development of new technologies to bring about greater efficiency of utilization of these precious resources. As man enters the new era of round trip space travel, the heroes of today's children are from *Star Wars* and *E.T.*

Never before has the interface between technology and people who use technology been more important if our society is to prosper economically. Technology will not exist unless people design, build, buy, and use it. Rapid technological change has created a new attitude among workers and young people who are affected as a result of this change. If the technological change we are undergoing is to be predominantly a positive one, it is important that we understand the positive and negative impacts technology can have on workers, and develop methods and skills for augmenting the positive ones and mitigating the negative ones.

Beginning in the 96th Congress and continuing in the 97th, the Subcommittee on Science, Research and Technology has conducted a program of study and legislative action in innovation and productivity. As part of the program, the Subcommittee held six sessions of hearings on "The Human Factor in Innovation and Productivity" during September 1981. Two months earlier the American Association for the Advancement of Science held a seminar "Innovation and Productivity: A Human Perspective" which was sponsored by Members of the Committee on Science and Technology. The hearings and the seminar dealt with similar topics.

This report of the Subcommittee on Science, Research and Technology discusses issues of the human factor in innovation and productivity and gives the findings and recommendations of the Subcommittee.

The record of the hearings and the seminar has been published for the use of the Committee on Science and Technology as Committee publication Number 51. At the request of the Committee, an analysis

of the hearings record has been prepared by Ms. Wendy Schacht, Specialist in Science and Technology, of the Congressional Research Service.

Focus

The hearings and the seminar which formed the basis for this report focused on the following issues:

1. What types of worker involvement in decision-making are effective to promote worker satisfaction, high quality work, and productivity improvements?

Have there been significant improvements in productivity where workers participate in design, installation, and management of new technology?

2. How can work be structured in the workplace and what promotion and reward systems will assure high-quality products, foster a sense of caring about doing a good job, and lead to worker satisfaction?

3. Will the introduction of new technologies lead to increased employment or increased unemployment?

4. Where the introduction of new technologies changes the nature of work, what training programs or other action should be taken to insure the well-being of the worker?

5. What is the importance of long-term versus short-term management strategies to innovation and productivity improvement? How can the promotion and reward systems of top management be set to insure sufficient concern with the long term?

6. How can top management be made to have sufficient knowledge of technology and be comfortable enough with technology to manage new technological enterprises effectively?

7. What direction should federal research concerning the interaction between technology and the worker take, given the contribution that the human factor can make to innovation and productivity improvements, and what is the best way for the Federal Government to influence and support these research goals? What federal actions, beyond research, should be taken on these issues?

The Subcommittee received testimony from sixteen individuals involved in research on these issues affiliated with business, labor, government, universities, and independent research organizations; two of the researchers were from foreign countries. The Subcommittee heard also from four business managers (two American and two Japanese) and ten other witnesses.

I. Importance of the Human Factor

Finding 1. Historically, the importance of the human factor to innovation and productivity improvement has been underestimated. As a result, it has not been carefully studied and is not well understood. What is known is that organizations in Japan, Scandinavia, and the United States which are demonstrating a sensitivity to the interaction between individuals, both vertically and horizontally in the organization, are realizing reduced turnover, absenteeism, and grievances from employees. These organizations, generally, are also remaining competitive and exhibiting healthy productivity performance in a troubled world economy.

Discussion

The Subcommittee's hearings showed that the interaction among the physical, social, and financial aspects of the corporation and employees' efforts and experiences must be given explicit consideration in order for both the corporation and the employees to prosper. Management in the United States, by and large, has been characterized by working towards short-term profits to the detriment of technical or social innovation in the corporation which would better insure the long-term health of the organization. This attitude is reflected in the teaching of management by business schools, as well.

Despite the difficulties of analyzing the social and physical aspects of an organization, an understanding of them is essential to comprehend the organization as a whole, and to stimulate workplace innovation and productivity improvement. This understanding is needed even if the only corporate objective is to maximize "the bottom-line". The financial aspects of a corporation, of course, enjoy the advantage of being measurable. There are analytical techniques of evaluating the financial aspects of business and of potential investments. The social aspects of the corporation, meanwhile, are less readily quantifiable. Even where they are quantifiable (number of ideas in the suggestion box, number of employees attending the picnic), there is no numerical technique which can be applied to these measurements to yield information useful in corporate decision-making.

The physical aspects of the corporation are generally quantifiable, but the important numbers describing technical capability (number of units produced per hour, defects per thousand units produced, etc.) for a proposed new technology are not generally available until after the investment in technology. Moreover, if the product is new, predicting demand is extremely difficult.

The skills required of managers must, therefore, include not only financial skills, but the ability to understand people and technology as well. Some degree of skill in these areas can be obtained from academic training. The rest involves a commitment to cooperation between management and workers in the decision-making process involving the character of the workplace, the structure of work, and the implementation of new technology.

RECOMMENDATION 1

The subcommittee encourages managers and scholars of management techniques to work for the improvement of techniques of social and technological analysis for corporate use. Management is encouraged to adopt organization structures that encourage worker participation in problem solving and decisionmaking regarding the implementation of new technology in the workplace and the structure of work.

II. Labor-Management Cooperation

Finding II.A. There are many distinguished features between American and other cultures which prohibit broad emulation in the United States of foreign management styles. The American workforce is generally more heterogeneous in nature than the workforces of our main trade competitors, and American culture is centered on the individual. The Japanese, on the other hand, for example, are raised to regard the group, and not the individual, as the central organizational element.

Finding II.B. Work attitudes in America are changing, evolving toward a heightened sense of self and emphasis on participation in decisions pertaining to the workplace. The result is a desire to develop organizational mechanisms to permit the worker to have a direct role in decisions affecting the workplace, and in some cases, the management and profitability of the organization. Quality of worklife programs, quality circles, labor-management committees, gains sharing plans, and participation teams are all examples of socio-technical designs being utilized to a greater extent to accommodate changing worker attitudes toward jobs.

Discussion

Although broad emulation in the United States of foreign management styles does not appear feasible, in looking at both foreign and domestic styles the subcommittee found that a strict hierarchical approach to management is not generally as effective as an approach involving greater communication and cooperation between all levels of the organization where all employees participate in the management of their own work.

Because of the evolution of attitudes in America toward a heightened sense of self and emphasis on participation in decisions pertaining to the workplace, it has become more necessary than ever to take account of the experiences of employees in the workplace in order to motivate workers. At the same time, worker compensation plans, which have long been the focus of attention in motivating workers, deserve continued attention and innovation.

The central problem is to motivate workers to want to do a good job. If this motivation is present on a continuing basis (which implies that the worker must be provided with an environment in which it is *possible* to do a good job) then most employees will do a good job. The organizational and functional design of the corporation must include provisions for providing this motivation.

While "a good job" is subject to a wide range of definitions, almost all definitions include producing high-quality products. Not only has high quality become a key factor in international competition (witness automobiles and consumer electronics), it is also often less expensive—because of the cost of rejects, repairs, and testing—to produce a high-quality item of a given design than a shoddy one.

To address the issue of quality, the "quality circle" has been instituted among employees with growing frequency around the country. In a quality circle, a small group of employees (9 is typical) meets regularly to undertake work-related projects designed to advance the company, improve working conditions, and spur mutual development. The projects are most often focused on quality improvement and cost reduction. While quality circles are too often faddish today in America, and must be implemented only as part of an overall concern in the organization for quality, it is clear that social-technical devices of this sort, which both motivate labor to perform well and provide a concrete means for harnessing that motivation, should be more widely instituted.

In addition to quality circles, labor-management committees, quality of worklife programs, gains sharing plans and participation teams are all examples of social-technical designs being utilized to a greater extent to accommodate changing worker attitudes toward jobs. Various compensation plans have been proposed which are designed to motivate employees to do a good job. These fall in two main categories: profit-sharing and employee ownership.

Calls for increasing cooperation between labor and management permeated the hearings. The Subcommittee believes strongly that this cooperation should be fostered. In a world of international competition, adversary relations between labor and management have become obsolete. Those firms whose energy is sapped by infighting will be weakened, but more importantly, those firms that practice labor-management cooperation will be strengthened.

Efforts must be made to develop better organizational structures for cooperation. Labor-management committees which meet to discuss common problems are one type of structure widely used to practice cooperation. Federal efforts to promote labor-management cooperation are authorized as part of the Labor-Management Cooperation Act of 1978, Public Law 96-524.

Another type of organizational structure for cooperation, one involving the federal government, is exemplified by the Steel Tripartite Committee, an advisory group consisting of representatives from industry, labor and government, which discussed federal policy for steel and made recommendations to the government regarding that policy.

RECOMMENDATION II

Federal policies should encourage development of participative decisionmaking structures both within the Federal government and in the private sector. Compensation plans, such as profit-sharing and employee ownership should be encouraged. The Labor-Management Cooperation Act should continue to receive congressional support. Efforts modeled on the Steel Tripartite Committee to deal with the evolution of Federal policy setting on innovation and productivity improvements should be widely adopted in Federal agencies.

III. The Human Factor and New Technology

Finding III. New technology can have both positive and negative effects on productivity performance, depending on the manner in which the new technology is implemented in the workplace. Technological developments can improve the efficiency and safety of our workplaces, and permit the elimination of the more menial jobs. At the same time, there is evidence that not enough care is being given to involving the worker who will be utilizing the new technology in the decisionmaking process regarding whether or not, and how, to implement that technology. Failure to properly take into account the human factor involved in implementing and utilizing new technology in the workplace can be detrimental to productivity improvement.

Discussion

The combination of man and machine will be most effective in completing a task if the man is compatible with the machine and is motivated to do a good job. The typewriter and the lathe provide clear examples. In order to ensure the compatibility of man and machine, the user of the machine should be involved in its design, particularly design of the control mechanisms at the interface between man and machine.

Man-machine interfaces should be designed with a view towards harmonizing the machine with its intended human users. On the simplest level, this means matching the dimensions of the machine to the dimensions of a human. For example, typewriter keyboards should be about two relaxed hand-spans wide, and keyboards should be high enough that the user's back is not hunched over, but not so high that wrists have to be arched.

Machines should harmonize with human sensory and output capabilities. For example, the contrast and character size on TV-type screens should permit viewing information without causing eye strain, and touch-typing keyboards should have a threshold of force high enough that an accidental finger touch will not cause a keystroke, but not so high that fingers will tire from the exertion of pushing keys.

Machines should be compatible with human psychological characteristics. For example, assembly lines should permit self-pacing by the worker. Machines of all types should require that judgment appropriate to the trade be exercised by their users.

Beyond the man-machine interface, the social arrangements among management and labor under which machines are introduced and used in the workplace are critical.

VI. Human Resources for Technology

Finding VI. A cooperative public-private effort of continuous education and training is needed to upgrade skills and insure that an appropriate number of engineers and other technical specialists are available.

Discussion

The Subcommittee has noted that there are serious shortages of trained workers in many technical specialties essential to a healthy modern economy. These specialties include both those taught at colleges and universities and those taught by other means. In the former group, there are now serious shortages of computer scientists and several types of engineers (including manufacturing engineers, biochemical engineers, and others). In the latter group, there are tool and die makers, and many other specialties.

The demand for specialists is sensitive to economic conditions. But even now, in a time of deep economic recession, there is more demand than supply in many technical areas. Economic recovery will bring with it an upsurge of demand that will starkly reveal the nation's inattention to the supply side of human resources.

The Subcommittee is considering one approach, H.R. 7130, the "National Engineering and Scientific Manpower of 1981," to begin to have the federal government assist in the solution of these problems. The Subcommittee believes that industry and state and local governments must also turn their attention to these manpower issues.

Modern society is not only very technical, it is rapidly changing as well. Today's technology may be outmoded next year, and today's technical training may be equally outmoded. While decreasing the rate of change of technology may seem an appealing solution, it is rarely beneficial to society as a whole, and it is rarely feasible (since some other company, perhaps in some other country, will adopt the new technology and outperform the adherents to the old.)

Labor organizations and individual workers in the United States must, therefore, be willing both to adopt new technology and to be retrained. Labor should be flexible in regard to new technology, both the physical aspects and the social aspects. Management must also be prepared to adapt to new technical, economic and social realities, and be prepared to change its basic methodologies when needed through management retraining and development.

Usually, new technologies lead to increased overall employment in a company because they give the company a competitive advantage. New technology may very well displace a particular specialty, however. In order to gain acceptance of such new technology (and to have new technology in general viewed as desirable by workers), provision must be made for cushioning its impact. This impact support is primarily the responsibility of the company. It is also a broader social responsibility, particularly where the company cannot provide support. For example, former employees of companies that may be put out of business by the introduction of new technology by their competitors should receive impact support, but their former employers are not able to provide it.

Within an individual company, impact support may simply take the form of introducing the new technology slowly enough that the rate of job displacement is less than the normal attrition rate. A more active form of support is retraining—either to operate the new machinery being introduced or to perform other jobs in the company (often those for which the new technology has caused increased demand).

The critical elements for the social success of the introduction of new technology are a commitment by the management to protect the welfare of the employees and a willingness by employees and employee organizations to adapt to changed conditions.

Training and retraining programs are needed to provide individuals with the skills they need to get and hold desirable jobs, to provide companies with the trained labor they need to be competitive in a technological marketplace, and to cushion the impact of the introduction of new technologies.

The California Worksite Education and Training Act (CWETA) provides a good example of a state program. The program retrains employees for better jobs in the same workplace, where there is a lack of trained people to fill these jobs. It is a cooperative effort among the state, the employer, and the employees. The Subcommittee commends the CWETA program for its work. It appears to be a good model for other training programs.

RECOMMENDATION. IV

A collaborative effort to design a training program for skilled personnel should be launched and should involve the Federal government, private industry, and educational institutions.

V. Federal Focus on Productivity

Finding V. The role of the human factor in innovation and productivity performance has not received sufficient attention at the federal level, in part because the federal government lacks a center of focus for analyzing factors which affect productivity in the American economy.

Discussion

There have been many short-lived, half-hearted efforts at the initiative of the executive branch to establish an institutional framework for productivity policy analysis. President Carter had his National Productivity Council. It did little and has been abolished. President

Reagan has a National Productivity Advisory Committee. It is scheduled to go out of existence after a year. As a result, policy formation at the federal level that affects innovation and productivity performance has lacked continuity and focus.

The Subcommittee endorses the efforts of organizations such as the American Productivity Center and the Profit Sharing Research Foundation to understand issues of the human factor in innovation and productivity, to resolve outstanding questions, and to disseminate information about productivity improvement to organizations throughout the United States. Business and labor should lend their support to the efforts of these groups.

RECOMMENDATION V

The executive and congress should work together to establish by statute an institutional mechanism to provide a continuing focus for analyzing the impact of various Federal policies on innovation and productivity performance. This institutional mechanism should be established with the support of government, labor and management and should rely on tripartite consensus in recommending policy.

VI. Need for Research

Finding VI. There is a need for research by social scientists and economists to better understand the workplace and the relationship of human factors to innovation and productivity. The impact of technology on the workers, and the factors necessary to realize the effective implementation of technology in the workplace need to be explored. Problem-oriented, as well as discipline-oriented research should be encouraged.

Discussion

Because the importance of the human factor to innovation and productivity has been underestimated in the United States, it has not been carefully studied and is not well understood. The information resulting from research on this subject is needed for the design of new technological hardware, and the appropriate utilization of technology in the workplace. It is also needed to understand how to better organize work in the workplace and to address specific problems that might arise from a particular way of work.

RECOMMENDATION VI

Private organizations which perform research on the human factor in innovation and productivity should be encouraged by the Federal government. Creation of an inter-disciplinary, problem-oriented research program as part of the National Science Foundation, or as an independent entity, should be authorized and funded by Congress. Congress should provide funds for research on the interaction between human factors and innovation and productivity. National Science Foundation programs, in particular the social sciences, should be emphasized. Research efforts funded should explore the various aspects of human factors, including the impact of the human factor on technological development, and vice versa. Organizational behavior in the workplace should be studied with the goal of understanding and developing solutions to problems which arise in the workplace involving human factors. A demonstration pilot program oriented to case studies of organizational problems and experimentation with possible solutions would be particularly helpful.

Congress should provide incentives to the private sector for efforts to understand the interaction between the human factor and the workplace. Disincentives should be removed where they exist. The exclusion of social science research from the definition of basic research given in section 221 of the Economic Recovery Tax Act of 1981, which allows a tax credit for increased funding of basic research, is a disincentive to private funding of human factors research which should be eliminated by repealing the exclusion.

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C., October 1, 1982.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology,
House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: I am transmitting herewith a report prepared by the Congressional Research Service. The report analyzes the hearings on the Human Factors in Innovation and Productivity held by the Subcommittee on Science, Research and Technology in September, 1981 and the seminar held on this subject which you and I joined in cosponsoring in July 1981. This report was prepared at my request by Ms. Wendy Schacht, Specialist in Science and Technology. The hearings analysis forms much of the basis for the findings and recommendations put forth by the Subcommittee in its report on this subject.

This report is an excellent distillation of the essence of the subcommittee's hearings and the seminar held on the human factor in innovation and productivity. I commend it to your attention and the attention of all Members.

Sincerely,

DOUG WALGREN,
Chairman, Subcommittee on Science,
Research and Technology.

LETTER OF SUBMITTAL

MAY 6, 1982.

Hon. DOUG WALGREN,
Chairman, Subcommittee on Science, Research and Technology, Committee on Science and Technology, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: I am pleased to forward the enclosed report, entitled "Analysis of Hearings on the Human Factor in Innovation and Productivity," prepared at the request of the Subcommittee on Science, Research and Technology. The paper was prepared by Wendy H. Schacht, Specialist in Science and Technology, Science Policy Research Division.

This study both summarizes and analyzes the testimony presented at the September 1981 hearings and the July 1981 seminar on the Human Factor in Innovation and Productivity. It discusses the innovation environment and efforts to improve productivity utilizing human resource considerations. It is hoped that this analysis will assist the subcommittee in defining further activities in this area.

On behalf of the Congressional Research Service, I would like to express my appreciation for the opportunity to undertake this timely and challenging assignment.

Sincerely,

GILBERT GUDE, *Director.*

Enclosure.

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ANALYSIS OF HEARINGS ON THE HUMAN FACTOR IN INNOVATION AND PRODUCTIVITY

(Prepared at the Request of the House Committee on Science and Technology, Subcommittee on Science and Technology)

I. INTRODUCTION

The House Committee on Science and Technology, Subcommittee on Science, Research, and Technology, sponsored an AAAS seminar (July 28, 1981) and 6 days of hearings (September 9, 10, 11, 15, 16, 17, 1981) on "The Human Factor in Innovation and Productivity." The length and depth of these hearings are indicative of the importance the committee places on human factor considerations in the quest for improved productivity and innovation in the United States. As Mr. Lundine, presiding as chairman of this inquiry, stated in his opening remarks:

> * * * human resource development is the least understood factor affecting productivity performance, and in my opinion, in the long term, perhaps the most crucial. In an increasingly complex work world, the quality of the interaction between human beings will often be the factor that distinguishes a productive business undertaking from a failing one (4).[1]

What these proceedings would do, Mrs. Heckler suggested, is explore "* * * America's social capacity, the capacity of Americans to cope, adopt, and excel in an increasingly technological society." (5)

Subcommittee Chairman Doug Walgren concurred. "I don't think anything else that I have seen has more implications for stronger economic life in this country." (19). He regretted that the Reagan Administration has decreased substantially human factor-related work, especially with respect to the National Science Foundation. It is hoped, Mr. Walgren explained, that "the 6 days of hearings devoted to this subcommittee's interest, will stimulate a broadening of thought in that area." (19) As Mr. Lundine noted:

> Continued technological development and innovation are critical to human progress. History clearly demonstrates this over and over again. At the same time, however, human beings must effect and control technological development. (4)

These hearings were designed to increase knowledge about the role of human factors in technological growth so that innovation and productivity in the Nation's industries can be increased.

Witnesses from Government, industry, academia, and professional societies provided testimony. They included:

[1] Numbers in parentheses indicate page numbers of the printed record of the hearings (No. 51).

Dr. Michael Maccoby, Director, Harvard Program on Technology, Public Policy and Human Development, Kennedy School of Government, Harvard University

Mr. Einar Thorsrud, Director, Work Research Institute, Oslo, Norway

Mr. Brian Usilaner, Associate Director of the National Productivity Group, General Accounting Office, accompanied by Ed Fritts, Group Director, Private Sector Productivity, General Accounting Office

Mr. Keiske Yawata, President, Nippon Electric Company, U.S.A., Inc.

Dr. Harvey Brooks, Benjamin Pierce Professor of Technology and Public Policy, Harvard University

Mr. Richard Balzer, Vice President, Yankelovich, Skelly & White, Inc.

Dr. Lewis F. Hanes, Manager, Human Sciences Research and Development Center, Westinghouse Electric Corp.

Dr. Otto N. Larsen, Director, Division of Social and Economic Science, National Science Foundation

Mr. Berth I. Jonsson, Assistant to the President, Volvo Co., Sweden

Mr. Joji Arai, Manager, U.S. office, Japan Productivity Center, Washington, D.C., and R. Douglas White, Senior Vice President, American Productivity Center, Houston, Texas

Mr. Jack Sheehan, Assistant to the President, United Steelworkers of America

Mr. Ronnie J. Straw, Director, Development and Research Department, Communications Workers of America

Mr. Bert L. Metzger, President, Profit Sharing Research Foundation

Mr. William H. Koch, Assistant Chief, System Design and Integration Division, Office of Systems Engineering Management, Federal Aviation Administration

Mr. James W. Driscoll, Assistant Professor, Sloan School of Management, Massachusetts Institute of Technology

Ms. Judith Gregory, Research Director, Working Women, National Association of Office Workers

Mr. Donald E. Erwin, Human Factors Engineer, Bell Telephone Laboratories, and Ruth Schimel, Human Resource Management Division, Office of Management, Bureau of Personnel, Department of State

Mr. Travis Marshall, Vice President and Director of Government Relations, Motorola, Inc., and Mr. Raymond Demere, Jr., Vice President, Manufacturing Services, Hewlett-Packard Co.

Honorable Mervyn M. Dymally, a Representative in Congress from the State of California, accompanied by William Greene, Chairman, Senate Industrial Relations Committee, State of California; Ben Munger, Staff Economist for Senate Industrial Relations Committee, State of California; and Steve Duscha, Director of CWETA, California State Employment Development Department

Dr. Richard W. Rahn, Vice President and Chief Economist, U.S. Chamber of Commerce, accompanied by Dr. Carl Nolles, Director, U.S. Chamber of Commerce Productivity Center

Mr. Sadami (Chris) Wada, Assistant Vice President, Sony Corp. of America

Seminar participants included:

Professor William J. Abernathy, School of Business Administration, Harvard

Professor Robert E. Cole, Department of Sociology, University of Michigan

Professor William G. Ouchi, Graduate School of Management, UCLA

Dr. Kenneth Prewitt (Moderator), President, Social Science Research Council

II. OVERVIEW OF THE HEARINGS[2]

The U.S. lead in technological innovation appears to be diminishing. Much time and effort has been expended in the study of the causes for this decline which has led to the identification of various tax, financial, political, and regulatory factors as contributing to the problem. However, to date, there has been little recognition of the part that human resources play in innovation and productivity. Industry, labor, Government, and academia are only now beginning to recognize the impact of the human factor. These hearings were held to examine the role of human factors in productivity and technological innovation and to discuss the proper role for the Federal Government in this area.

As used in these hearings, the term "human factors" relates to those elements of the innovation process which involve management, labor, and their interrelationships. They are the components which contribute to improved human resource development, the nontechnological aspects of innovation which allow the worker to be more effective. Consideration of the human factor is an attempt to understand and improve the employee's interaction with technology, so that both the technical and human concerns of the industrial enterprise can be integrated to achieve increased productivity and innovation.

The human factor is perhaps the least understood facet of innovation. In the United States, little time and attention have been devoted to this subject. This is in sharp contrast to Japan where the employee is considered the most valuable resource in the innovation process. Similarly, studies have found that the most innovative companies in the United States tend to be those that recognize the value of human resource considerations. The human factor is so important because, ultimately, it is the employee who must apply new techniques in the workplace. New products and processes are ineffective in engendering increased productivity if they are not accepted and used by the workers. As Brian Usilaner from the General Accounting Office testified, "a machine, a process, or a system may be ever so brilliantly contrived, but it is no more effective than the people operating and managing it want it to be, or know how to make it." (53)

[2] This overview summarizes the major views expressed by Members and participants at the hearings and seminar on the human factor in innovation and productivity and which are discussed in more detail in the following sections of this report.

Some traditional views on labor and management are changing as the U.S. workforce moves away from a manufacturing economy to a service economy. The composition and values of this workforce are also changing. There is an increased emphasis on the "self" which has had important implications for the conduct of work. Conventional mechanisms for worker motivation are no longer applicable in many cases—employees want input into the decisions which affect them at their jobs. The feelings of involvement and efficacy which accompany increased employee participation in decisionmaking have been shown to increase productivity. Levels of absenteeism and employee turnover decrease while productivity levels are augmented. When they are part of the decisionmaking process, workers are more likely to feel that they make contributions to the objectives of the company and will receive more benefits from their labor. Efficiency is further motivated as employees with applicable experience provide input to improvements in the workplace.

The successful efforts of increasing productivity through the human factors approach utilize, as a common feature, the sharing of decisionmaking between management and labor. Despite studies which indicate that the most productive companies are those which display an ability to use social and managerial innovations rather than those which have only a superior capacity for the development of new technologies, U.S. management is still traditionally hierarchical. Decisions are made at the top with little, if any, consideration of the value of on-the-job knowledge acquired by the employees. This approach, developed to ensure efficiency of production, no longer appears to be effective in the current work environment where cooperative motivation has been shown to be more successful in improving productivity and innovation.

Management is an important factor in productivity in that it establishes the overall environment in which innovation either flourishes or stagnates. Trust in management permits the introduction of new technologies and techniques designed to increase efficiency. Thus, the relationships between labor and management have become adversarial and are no longer productive. The hearings testimony suggested that an emphasis be placed upon management-worker teamwork, cooperation, and problem-solving. The tendency of management to think only in terms of financial considerations and short-term profits, which may result from the fact that the majority of corporation officers are lawyers, or financial analysts, must be overcome to allow both the introduction of new management techniques and the institution of long-term development necessary for innovation.

Any attempt to understand this situation is hindered by the absence of an accurate, detailed body of knowledge regarding the impact of human factors on increased innovation and productivity. There is little information available, in the United States, at least, on which concepts and programs work and which do not. Various other areas in need of additional research were identified throughout the hearings including, but not limited to, the innovation process itself, and the impact of social and managerial activities on innovation, measures of productivity in an information- and service-oriented economy, and the impact of new technology on workers. These topics necessitate a cross

or multidisciplinary approach that is problem-oriented rather than discipline-oriented. It also is important that the practical (as opposed to theoretical) aspect be emphasized. As Einar Thorsrud stated, "research needs to maintain very direct, collaborative relationships with real life situations, to insure that previous knowledge is still relevant under the new conditions and even more [importantly] to stimulate new thinking, new approaches, and new results relevant to the futures we are already living in." (24)

Of particular concern to the committee was a determination of the proper role of the Federal Government in promoting human factor considerations in the private sector. There was general agreement that the Government lacks a focus for innovation and productivity activities. There is no legislative mandate for an organization to take lead-agency responsibility in this area. It was suggested by various witnesses that legislation be passed to give organizational responsibility for productivity and innovation issues to the executive branch, while simultaneously avoiding the impression of advocating governmental planning.

The testimony also indicated that the Government has a role in encouraging research on human factors, innovation, and productivity. This would include research on new approaches to the issues which cut across industries and which would not be undertaken by individual companies. The Government could assist in the development of models and the dissemination of the resulting information. This knowledge could be applied and utilized within an atmosphere of cooperation between unions and management with the Government acting as a catalyst.

Other identified alternatives include the use of traditional economic means to encourage labor-management cooperation and the integration of human factor considerations in the private sector—especially tax measures. Concern was expressed over the fact that the Economic Recovery Tax Act of 1981 (P.L. 97-34) specifically exempts social science research from the qualified expenditures eligible for tax credits. The testimony presented indicated that permitting tax credits for work in the social sciences would augment efforts to understand the human resource components of innovation and foster the utilization of the resulting knowledge. Given the importance of human factor considerations to increasing innovation and productivity, as attested to during the course of the 6 days of hearings, it was suggested that this activity could have a significant impact on the U.S. innovation problem.

III. IMPORTANCE OF THE HUMAN FACTOR

The testimony presented during these hearings attested to the critical role that human factors play in the realm of productivity and innovation. The witnesses also indicated the lack of integration of the human element in decisionmaking in this area. Much attention has been focused on the R&D, tax, financial, and regulatory aspects of increasing the innovative capacity of the United States, but little attention has been focused on the utilization of human resources to accomplish this. Mr. Lundine observed that ". . . human resource de-

velopment is the least understood factor affecting productivity performance and . . . in the long term, perhaps the most crucial." (4) All too often, Richard Balzer stated, the importance of people in the process is undervalued and underestimated. (93) This has contributed to the declining productivity of the U.S. workforce. As James Driscoll maintained, ". . . the primary contribution to productivity and innovation in American society is the human factor and it is a requirement for social innovation to create that productivity." (424)

The United States must now compete in a diverse and competitive technological market. Taking a historical perspective, Michael Maccoby noted that ". . . the difference today is, unless we develop our human resources . . . American industry will not be able to compete." (18) The slowdown in productivity can be associated with several factors. Among these, according to Brian Usilaner, are capital investment, technology, innovation, work methods, and the productive quality of the work force. (48) The emphasis in finding a solution has been concentrated on the first four factors because, he asserted, ". . . management finds it easier to place the blame for productivity problems not on itself but on government regulations, tax policy, higher energy and material costs, or unjustified wage increases." (49) The human element is thought to be more difficult to address. Yet without management's and labor's understanding of its impact, workers may, for example, resist new technology and thereby negate efforts spent on technological development and increased productivity through innovation. (52)

> To put it bluntly, capital and technology by themselves produce nothing. A machine, a process, or a system may be ever so brilliantly contrived, but it is no more effective than the people operating and managing it want it to be or know how to make it. (53)

Chris Wada offered a similar perspective. He concluded, from his experience at Sony, that:

> * * * The human factor is far less emphasized than it deserves . . . we need a faster depreciation, tax credit, cheaper funds, modernized and numerically controlled machines, but none of these help if people have low morale or poor dedication. Money cannot buy it. It must be earned. (679)

The preeminence of the human component in industrial processes was exemplified by Congressman Walgren's reference to a remark by the Chairman of General Motors who, when asked what his greatest problem was, answered that if only his employees would come to work half the time, he would have no problems. (73) The payoffs of a good work environment can be immense: improved productivity, fewer layoffs, less employee turnover. The importance of this was not lost on several industry witnesses. Berth Jonsson indicated that the concern for human factors at Volvo is ". . . a pragmatic approach to solv[ing] our problems and an appreciation of the potential energy which only man can mobilize." (185) Similarly, Travis Marshall ascribed the success of Motorola to its people and to the attitude of the company in utilizing its human resources. The firm does ". . . not hire an individual simply to operate a machine or to run a department or run an office, but that person we expect to make a contribution to the success of the entire enterprise." (568) This attitude also is reflected in the policies

at Hewlett-Packard. The importance of human factors there was affirmed by Raymond Demere who asserted that motivated employees are more productive and more innovative: "If a company or an organization believes in and practices this philosophy, and fosters technological innovation and high quality, . . . it will be a leader in increased productivity and in successful human relations, and will also have a positive influence upon our society." (580)

The human element not only impacts upon the productivity of the firm or industry in question, but also upon the society as a whole. Congressman George Brown remarked that there is "a lack of adequate concern (with) the impact on the community; both the local community in which the workplace is sited, and the national community where economic activity has a direct bearing on the national welfare." (61) The continued competitiveness of the United States is partially dependent on recognition of the human factor. It may be that, as Mr. Demere stated, ". . . the future prosperity of the United States hinges greatly on our ability to break down some of the adversary relationships in our society—relationships between management and labor, between vendors and manufacturers, between business as a whole and government. (582)

The human factor must not become the missing element in productivity improvement, Lewis Hanes emphasized. (124) Otto Larsen commended the committee for having "linked the elements of human social factors and technology because . . . that is where we are going to have to work to be able to improve the productive capabilities of our society." (149) Similarly, Jack Sheehan noted the interrelationship of productivity and the quality of work life and remarked that ". . . it is reassuring to find this Committee addressing itself to the human factor of the reindustrialization process." (302)

IV. THE AMERICAN WORK FORCE

A. Attitudes and Values

The U.S. work force is changing in terms of the types of jobs being performed as well as in terms of worker attitudes. As Mr. Balzer noted, the Nation is moving away from an industrial economy toward a service economy. (92) The demographics also are being altered. According to the information provided by Balzer, the figure which is most representative of this change is that ". . . in 1955, 70 percent of the American workforce was made up of a male head of household, the only working member in that family, with a wife and one or more children in the house. In 1981, that person represents less than 17 percent of the workforce." (92)

Mr. Balzer identified workers with new work values as being of two types: (1) "fulfillment seekers" who are looking for satisfaction in the workplace and (2) "money seekers" who are interested in expressing themselves outside of their job. (94) The typical organization is not able to address this heterogeneity. Balzer also indicated that there is an increased focus, among workers, on the self. (94) A situation has resulted where, when an organization requires an extra effort, the employees are unwilling to make the commitment. This has serious implications for the work experience and is why, in fact, the organization must be concerned with the human factor. (95)

Mr. Jonsson reiterated this emphasis on the self by the work force. In Sweden he noted that ". . . we are moving very fast from a situation where the parents of our young people used to come to work for their standard of living or for survival, while the young people are coming with values which are much more toward developing one's self and towards self-fulfillment." (186) In a 1979 work attitude study conducted by the U.S. Chamber of Commerce, Carl Noller found that "workers . . . place a greater emphasis on attitudes, and . . . felt that the greatest improvement that could be made to raise productivity was in their own area of worker attitudes and abilities." (650)

The Nation is experiencing various economic problems because, Balzer suggested, the organizational motivations and rewards were developed for a work force that no longer exists as a majority. (92) While Dr. Maccoby acknowledged that ". . . the work ethic is still strong" (12), the situation has become one where "Americans increasingly object to work that does not allow them to use their brains and which robs them of their dignity." (12) It appears that typical U.S. workers are now interested in some sense of ownership, of some input into the decisionmaking process as it affects them. (113)

B. Participation in Decisionmaking

A result of the changes in attitudes and values of the work force has been the movement toward increased participation of employees in decisionmaking with the organization. This has been identified as a premier component of improved productivity. The feeling of involvement and efficacy which accompanies this participation often is a crucial factor in increased innovation. According to Douglas White, ". . . the single most important task in restoring the economic well-being of this country is the removal of the barriers which impede and inhibit the full participation and involvement of people in their work." (259) He explained:

> Appropriate and well-managed methods for involvement and participation can increase overall organization effectiveness by broadening the input to decisions. At the same time these methods help earn employee commitment to successful implementation of those decisions.
>
> Unless this perspective is at the forefront of our considerations of scientific and technological innovation we will continue to fail to realize our full potential for economic development, in fact even economic survival.
>
> The impact of scientific and technological innovations is still largely dependent upon people. It is people who design, implement and utilize technological systems. To be successful a technological system must be understood and accepted by the people it affects.
>
> There are many technical systems which have failed because people were not motivated to adapt it to their use. Participation and involvement offers [sic] the key to fully realizing the potential benefits of scientific and technological innovations. (259–260)

The vast majority of the work force, Mr. Balzer remarked, is concerned with increased participation in decisionmaking in the workplace. (95) As evidence, he argued that the real results from the Hawthorne studies demonstrated that ". . . if you pay attention to people, and if you give them some sense of ownership in the process that they are part of, they are likely to be more productive." (96) Balzer concurred with the survey results of the Chamber of Commerce which indicated labor's belief that if workers were more involved in company decisionmaking, they would perform better. (Balzer 108, Noller 650) The problem, according to witnesses, is that U.S. workers have never been asked.

The labor representatives were emphatic that workers must participate in the decisionmaking processes within the firm. Sheehan argued that "joint participation in solving these problems at the departmental level is an essential ingredient in any effort to improve the effectiveness of the country's performance and to provide employees with a measure of involvement adding dignity and worth to their work life." (304) Similarly, Ronnie Straw remarked that a large percentage of employees feel that management does not trust them to make decisions and that ". . . this lack of trust caused serious stress and discontent at work." (331) It was noted by Straw that workers in the United States have always been responsible. Mr. Brown agreed that they would be more responsible if allowed further participation in decisionmaking. (347) As Mr. Straw pointed out, and the testimony substantiated, decisions in the workplace should be made by the people actually doing the work (355-356) The concept of participation is designed according to Ed Fritts, as a method "to get the employee closer to what he or she is there for, and that is for the business to make a profit." (61)

Einar Thorsrud testified that the Norweigian experience has demonstrated that "improved conditions for personal participation in everyday work life decisions, in planning, and in job and organizational design, showed considerable gains for workers as well as the enterprises." (25-26) The levels of absenteeism and employee turnover decreased while productivity on the departmental level increased. Usilaner found corresponding results with productivity sharing programs which ". . . realized significant savings in workforce costs as well as such non-monetary benefits as reduced turnover and absenteeism, and fewer grievances." (50) Similarly, Maccoby suggested that the success of Japanese style participative management (both in the United States and abroad) has shown that:

> * * * properly organized, workers today can manage themselves, raising the level of performance and reducing the costs of administrative overhead and waste as they also find work more satisfying.
>
> Furthermore, if adequately trained and informed, factory and office workers contribute to a continual process of innovation. Small improvements and cumulative savings add up and can be just as important as more dramatic innovations. (8)

The belief that people are unimportant within the scheme of the corporation is a self-fulfilling prophecy according to Bert Metzger.

However, ". . . if you really believe people are valuable, people count and people can make a positive contribution . . . they will." (361) If you believe people do not count, ". . . your worst expectations will be fulfilled." (361)

C. Management and Labor

Management is a critical element in the improvement of productivity. According to Harvey Brooks, the superior performance of industrial leaders can be attributed to social and managerial innovations rather than to any superior capacity to originate new technology. (78) Trust in management is essential for innovation and productivity increases. If the workforce trusts its management, Maccoby noted, it will be more receptive to the implementation of new ideas within the organization .(8–9) Usilaner concurred. He testified that innovative companies, those with policies and practices based upon "mutual respect and commitment," have shown that productivity can be significantly improved. "Management style," Usilaner maintained, "is critical to improving human resource productivity since it creates the environment which allows productivity to flourish." (49)

The economic situation in the United States has forced management to look at its traditional approach to managing. As Usilaner indicated, management is only now beginning to recognize its responsibility in the productivity problem. (59) He noted that:

> There is now a growing consensus, both at home and abroad, that the performance of American management of late has been sorely lacking; that to some extent, management techniques developed by Americans are being ignored here. Further, American corporate leaders have been slow to adapt to the rapidly and profoundly changing workforce. (49)

At this point, management must stop blaming Government and the economy for all its problems.(53) William Abernathy's statements support this. He maintained that a significant part of the innovation problem ". . . can be largely laid at the feet of . . . management's own rule of thumb and practice, and their lack of long-term incentives that has become a self-fulfilling prophesy" (711).

Past management practices generally have been autocratic and hierarchical. However, Maccoby argued, "hierarchical, policing style management causes resentment, sabotage, costly absenteeism, and a negative attitude toward business, particularly in a new era with values of self-affirmation." (8) Traditional patterns of management are no longer sufficient to ensure productivity. (9) Brooks also took note of the ". . . worldwide trend toward disenchantment with bureaucratic organizations with highly fractionated job responsibilities and elaborate systems of hierarchical controls." (81) The hierarchial approach which has been developed to assure efficiency of production has tended to thwart this efficiency, according to Metzger. Concurring, Sheehan testified that "the factory culture is often an autocratic one [and] this has created an antagonistic work environment that often results in poor quality and restrained production." (304) Organizations must be designed, Metzger stated, so that techology is advanced while simultaneously meeting the human requirements. (360)

The development of new reward structures is necessary to encourage people to work and to be creative and innovative. Often, Maccoby noted, a company's reward systems are set up with incentives such that certain levels of management can gain personally only at the expense of the firm as a whole. (21) The situation now, Metzger asserted, is ". . . a fragmented or splintered approach to motivation." (360) The "players" within the corporate structure are divided into groups, each with their own self-interest and separate goals, but without mutual targets and a common language. (361) According to Metzger, the corporate structure mitigates cooperative motivation; what is necessary is the development of incentives which create "organizational bonds" throughout the company on all levels. (361)

Management tends to emphasize short-term results and financial gains over long-term development. Such activities have imposed barriers to the implementation of new managerial techniques and improved productivity, according to Dr. Maccoby. (20–21) This is, in part, a result of various elements which Balzer identified, including the predominance of lawyers and financial experts in top corporate positions and the fact that most companies are owned by stock holders concerned mainly with short-term dividends. (114) As Abernathy observed, "there is a great tendency on the part of American management to act like capital brokers. Everything can be bought or sold . . ." including technological development and productivity. (711)

However, the traditional managerial theories are now being questioned. As an example of this, Dr. Brooks identified the debate going on at the Harvard Business School. The problem is that the philosophy of the school, as with many business schools, ". . . places too much emphasis on short term profitability, a very formal return on investment analysis, and quantitative criteria for investment. . . ." (89) Balzer argued that the preference for immediate answers had led to a "fadism" in managerial styles. Management seeks the quick fix rather than developing an understanding of where the firm should be going and how to get there. (112) Like Brooks, Balzer asserted that a long-term perspective in policymaking must be institutionalized and reward structures which promote this must be developed. (113)

Innovative management is necessary in order to deal with many of the factors associated with increased productivity and, as Maccoby noted, a commitment by the organization is essential to a creative managerial approach. (19) The typical adversarial relationship between management and unions no longer is beneficial to either the company or the employee. However, several witnesses commented that cooperation is not being taught or encouraged. While Maccoby contended that management generally gets the union it deserves, he suggested that unions must go beyond these adversarial positions and develop capabilities for teamwork, cooperation, and problem solving. (15) Currently, union leadership is based upon collective bargaining skills, not technical or managerial expertise. It is now imperative that the latter two be developed. (19) Metzger concurred with this assessment and urged:

> * * * that we really take a look at this adversarial relationship. It must be dramatically changed toward a cooperative collaborative relationship. We do not get needed support in

our schools. Our schools do not teach labor-management cooperation; they teach management-labor conflict—how to resolve conflict, how to mediate, how to arbitrate, how to negotiate, how to fight. They do not teach labor and management how to work together toward mutually satisfying goals. That is a crying need in our country today.

Nobody has trained or taught people how to collaborate. (370)

V. EFFORTS TO IMPROVE PRODUCTIVITY

A. Approaches

Once the various issues associated with productivity are identified, the question becomes one of what activities can be taken to alleviate the problem. The approaches to labor/management cooperation and increased productivity described throughout the hearings are based generally on a sharing of decisionmaking within the company between the employees and management—founded upon the idea that the worker with experience can contribute practical ideas for improving productivity within his or her working environment. As Balzer noted, all the worker participation programs described during the hearings should improve productivity because they "are aimed at giving greater autonomy and flexibility to blue collar workers, allowing people to participate more and more, which seems to be a concern according to our data of the vast majority of the workforce in America." (95) Several of these approaches, their underlying philosophy, and the benefits derived from their implementation are summarized below.

These hearings provided comparisons between countries which afforded some interesting insight into alternative approaches to work and the utilization of human resources. However, there was general agreement among witnesses that, while the United States can learn from its competition, there is a need for, as Mr. Lundine noted, "... American solutions to American problems of the workplace ..." (4) Thorsrud concurred with this assessment and observed that pure "... replication will not work." (26) Each nation has its own capabilities and resources and must choose its own solution according to its particular values and culture. (28) Keiske Yawata also provided a note of caution. After describing the Japanese experience, he stated that it would be "... dangerous to transplant the same thing from Japan into the United States, where the environment is entirely different." (69) As Japan studied and modified U.S. methodology after World War II, so the United States must study and modify the Japanese approach to adapt it to the U.S. work environment. (74)

Robert Cole noted that "... borrowing from a foreign culture is not a one-to-one relationship. ..." (704) Balzer pointed out that one of the reasons why uniquely American mechanisms to stimulate productivity must be developed is that the United States is a far more heterogeneous society than Japan and, therefore, the motivations must be different. (110) "The egalitarian nature of this homogeneous society," Joji Arai explained, "especially enabled the Japanese to maximize the effects of various human inputs resulting in the high performance of Japanese corporations." (256) Chris Wada remarked that, in Japan, the family

is the most important and influential unit. The development of a respect for vertical relationships that this has engendered is transferred to management-employee interactions. (676–677) Dedication to the company is reciprocated by job security and concern for the worker: "this cultural heritage surely helps productivity through dedication and loyalty rendered in exchange for genuine concern and care by the responsible head." (677)

The Japanese utilize consensus management, which emphasizes an attitude that, as described by Yawata, "what was good for the company was good for the employee." (67) The rationale utilized is that:

> Japan does not have many mineral resources. The only natural resources it has are people. . . . Perhaps it is this threat that drove Japanese companies to continue to increase their competitiveness in the international marketplace. (67)

Arai testified that the Japanese success can be attributed in part to ". . . management systems that place heavy emphasis on the harmonious involvement of managers and workers in attaining strategic goals of their organizations." (256) There is, however, in the United States a more competitive relationship between management and employees. This, Wada suggested, must be terminated:

> The innovation we need today depends on cooperative team efforts and in that regard vertical adversarial relationships should be replaced by a cooperative and harmonious one . . . a greater emphasis upon human factor is imperative. Money cannot buy dedication and loyalty. (679)

The most important step, according to Metzger, is that management create a climate of cooperation whether through quality of working life programs, quality circles, financial participation programs, or stock ownership efforts such that ". . . an individual turns on within himself. He turns on and maintains his own motivational engine." (361) Each environment must be studied to determine which approach would be the most successful. But the crucial factor is participation. Metzger argued that ". . . what we need today are cohesive incentives that cut vertically through the organization and pull the company together." (361)

Maccoby suggested that the success of Japanese ". . . participative management and the GM/UAW Quality of Life program have dramatized the fact that properly organized, workers today can manage themselves, raising the level of performance and reducing the costs of administrative overhead and waste as they also find work more satisfying." (8) He identified two styles of management which can achieve this participation: one being similar to Japanese paternalism in which companies guarantee job security and respect of the individual, and encourage continued education and the other which ". . . is to be found in those unionized companies which are able to work cooperatively with a strong and progressive union . . ." where management works in a "limited partnership" with the union, gaining both cooperation and flexibility. (9)

Activities to improve human resources productivity must include, Usilaner maintained, ". . . the development of a nonadversary relationship between management and labor the sharing of the benefits of productivity improvement and a thorough change in management

style based on trust." (53) The use of labor/management committees, he commented, is an effective mechanism because these groups ". . . enable employees to feel more involved in the firm and more in control of their own work; draw on 'on the job' knowledge of workers; and allow labor and management to solve many problems in a non-adversary environment." (59) Usilaner also pointed out that GAO studies have shown that workers do not want to participate in all company decisionmaking, but only in those aspects which directly affect their jobs. (60) "That," he specified, "is what productivity sharing is all about, whether you are talking about impro-share programs, the Scanlon plan or the Rucker plan, all of these plans involve participation on a limited basis in terms of the workplace" (60)

Joint labor/management committees also were identified by White as a widely used ". . . vehicle for employee involvement . . ." (259) Other initiatives which are being utilized include activities to improve communication between labor and management, and group problem solving. However, White reiterated, the most important factor is the participation of the people in their work:

> Appropriate and well-managed methods for involvement and participation can increase overall organization effectiveness by broadening the input to decisions. At the same time these methods help earn employee commitment to successful implementation of those decisions. (259)

What must be achieved, he argued, is an atmosphere within which to develop a common interest between all participants in the process. (259) The success of the Jamestown Labor/Management Project and the GM assembly plant in Tarrytown show that this approach works. (260) These and other success ". . . illustrate what can be done when courageous individuals decide to take the first steps in identifying and working toward common goals, instead of the win/lose approach which inevitably turns to a lose/lose situation for all parties." (260) In this situation, the results of labor/management cooperation bring benefits to workers, management, the company, the industry, and the communities in which they are located. (261)

Metzger identified several conditions necessary for successful motivation programs. These include a commitment from both management and labor, recognition of the individual, and economic incentives so that workers can share in efficiency gains. (369) The idea of compensating workers for improving their productivity and allowing them to share in the increased profits resulting from improved productivity was a factor in many of the programs described. Metzger argued that one of the crucial ingredients ". . . in the Japanese success has been their flexible compensation programs." (370) At Motorola, the approach used contains three components: participation, proprietorship, and entrepreneurship. (569) As described in Marshall's testimony, Motorola has a Participative Management program where regular meetings allow discussion of the work environment, questions, explanations of management decisions, and solicitation of employee's ideas for improvements. (571) In addition, the Motorola programs are tied to group incentive compensation plans which provide for financial rewards if the standards set by the group are exceeded. (571)

Similarly, Hewlett Packard has, in the past few years, "extensively" utilized quality teams which are based on the quality circle concept. (599) This program, reflecting the company's philosophy that motivated people are more productive than non-motivated people (580) consists of voluntary groups which meet to discuss problems in both manufacturing and non-manufacturing areas. They act to analyze the barriers to more effective work and try to improve operations. (605) The quality circle approach is also utilized at Westinghouse and Hanes noted that it is well received by the employees:

> The feedback, both from the workers and management, is quite positive about the worker participation, the worker suggestions, the quality of not only the ideas but also what you might call the improved quality of the workers themselves. They seem to be upgraded because now someone is willing to listen to them. (145–146)

Of importance is that upper management strongly supports the program, first-line supervisors receive training pertinent to the program, and participation is voluntary. (147)

The importance of top management support for this type of effort was also affirmed by Jonsson. (183) He testified that the Volvo strategy was devised according to past company experience and permitted ". . . more flexibility both from a technical and from a job-design point of view, [with] more responsibility delegated to the people—that is, increased participation." (184) It is a dynamic process, with different solutions for different contexts (185), but always with ". . . an active and positive management attitude toward change." (185)

Sheehan observed that a cooperative approach between labor and management is necessary for problem solving: "joint participation in solving these problems at the departmental level is an essential ingredient in any effort to improve effectiveness of the company's performance and to provide employees with a measure of involvement adding dignity and worth to their work life." (304) To accomplish this, in 1980 the United Steel Workers of America entered into an "experimental operation" called Labor-Management Participation Teams. (304) These teams handle job related problems which cannot be addressed through the grievance or arbitration procedures; those which require ". . . an effective channel of communications between workers and management that also would contribute to the efficiency of the enterprises as well as to the well-being of the workers." (304)

American Telephone and Telegraph Company and the Communications Workers of America (CWA) have, according to Straw, set up three joint projects to ". . . deal with day-to-day issues of the workplace" which could not be addressed by collective bargaining. (332) These programs include a technology change committee, a national quality of work life committee, and a national job evaluation committee. The committees act to network problems and information about the impact of technology between management and labor. (333) Based upon the CWA experience, Straw proposed several recommendations on how to approach labor/management problems. He testified that, in these efforts, (1) labor must be involved; (2) training is necessary to ensure the effectiveness of the program; (3) workers

must have access to information; and (4) management must keep labor informed about closings, new technologies to be introduced, as well as other activities which affect the worker. (334–335).

Balzer identified first-line supervisors as the most resistant to programs which provide increased participation by the workers. (113) Similarly, Noller maintained, these programs change the fundamental behavior of management and labor (653), thus attitudinal impediments are quite prevalent. (654) Traditionally, labor/management interaction has been adversarial. However, Metzger argued, this role may be anachronistic:

> There is a time to fight and a time to cooperate. The inordinate cost of labor-management conflict will no longer be borne by consumers or by the public. The principal victims in the struggle are management and labor—the parties themselves—who suffer lost markets and jobs as conflict drives costs up, up, up. The only beneficiaries are overseas competitors. (369)

Training and education are necessary to reduce this conflict. But, in the long run, Richard Rahn maintained, competition will determine the success or failure of the concept. The organizations

> * * * that are more progressive in terms of getting to the understanding of causes of productivity growth and finding ways to work together to make sure that both workers and management are on the same wave length and path—will succeed. Those firms and those unions which lag behind and end up with lower productivity growth will meet their fate, as determined by the market. (655)

B. Introduction of New Technology

Change in the workplace is an important factor in productivity and one which involves various human factor considerations, primarily participation in decisionmaking. The involvement of the employees in decisions allows for technological choices to be made ". . . with reasonable control over the consequences economic as well as social consequences," according to Thorsrud. (28) "A fundamental problem of the introduction of new technology," Brooks noted, "is that its benefits and adverse effects are unequally distributed." (79) Part of this is due, Brooks stated, to the situation where the institutions which are developing the technology are separate from the organizations where it is being applied. (85) To counteract this, the evidence suggests that, as Jonsson explained, "to ensure lasting effects, initiatives for change must come from the line rather than from the staff or from experts. . . ." (185) Thorsrud stated that "we are losing a lot by not using the worker, directly affected, the technician and the foreman of the department affected in the adaptation and future utilization of new technology." (41)

New technology has both positive and negative impacts on the work environment and productivity, according to the testimony presented at these hearings. Hanes highlighted the positive aspects of the adoption of new technology which, he asserted, when combined with concern for human resources, ". . . may well result in our resurging in terms of the capabilities of the United States." (123) New technology,

according to Hanes, will provide for improvements in worker status and pay, and will result in the development of markets for new skills. (123) Similarly, Demere maintained that automation can improve the quality of worklife if handled correctly. As an example, in one Hewlett-Packard office in California the number of employees necessary for one task was reduced by five, but subsequently four of the five people displaced moved to jobs with greater responsibility. (581) "Much of the tedious work has been eliminated and people are proud of their increase in productivity." (582)

Straw acknowledged that there are numerous benefits to be derived from the introduction of new technology:

> Decreased costs and improved productivity that results from technological change can supply a much-needed boost to our lagging economy. New technology can lead to our improved standard of living, enabling us to enjoy a greater number of improved products and services.
>
> Technology can bring us everything from time-saving gadgets for the home to life-saving medical devices and can even prevent the world from running out of energy and natural resources.
>
> In the workplace developments in technology can improve working conditions and open up new jobs. (329)

However, he cautioned that along with these benefits are potential costs:

> Businesses generally promote new technology in a short-sighted attempt to decrease costs, paying little attention to the human effects of innovation.
>
> Advancements in technology can have strongly adverse effects on workers by reducing skill requirements, eliminating jobs, fostering mental and physical stress, creating health and safety problems, and fracturing jobs.
>
> Workers are heavily monitored and controlled by management and by machines—causing a dehumanization of the workplace. Employees begin to feel like mere appendages to the machine, and not like individuals. (330)

Judith Gregory also identified the negative aspects of the introduction of new technology. While acknowledging that innovations in office technology have great potential to upgrade jobs (179), she stated that ". . . the way computer technology is being introduced in many offices today not only causes suffering among millions of office workers, but also does not necessarily serve the goal of furthering productivity." (116) Office automation, Gregory maintained, permits increased discipline, standardization, and work monitoring which ". . . undermine potential gains in effectiveness, cause new inefficiencies, and take a great toll on people." (446)

What appears to be the determining factor in whether the introduction of new technology has a positive or negative impact is the implementation mechanism—whether or not the worker has an input into the relevant decisions. The amount of increased productivity engendered by new technology, Straw observed, is partly dependent on how it is accepted by the employees and this is influenced by the amount of

involvement workers had in the decisionmaking process. (352) According to White, many new technological systems fail because workers were not willing to adapt to their use: "the impact of scientific and technological innovation is still largely dependent upon people . . . to be successful a technological system must be understood and accepted by the people it affects." (259) Metzger concurred. He remarked that permitting the worker to participate in decisions concerning new technological choices results in a situation where there is ". . . a readiness among the people who work with these machines to accept the equipment, to be trained on it quickly, and to get it on line." (390)

Driscoll stated that the cause for many of the problems which have arisen from office automation stem from the manner in which the technology is implemented. He noted that, in most instances, the process by which the technology is introduced ignores the principles of "participation, identity, and equity." (424) Office equipment is being designed in such a manner that little skill is necessary for operation, jobs become highly specialized, and there is an emphasis on providing information to a few key decisionmakers based upon the assumption that that will improve productivity. However, according to Driscoll, "those principles are just the opposite of the ones [which are necessary] . . . so you have the technology being designed and implemented in a way that contradicts everything that we know about how to make people productive and innovative in offices." (427)

The examples provided by William Koch of the Federal Aviation Administration and Ruth Schimel of the Department of State demonstrated that, in both practice and theory, when employees participate in the implementation process there are significantly fewer costs and a willingness to accept, utilize, and integrate the new technology. The project Koch headed at the Federal Aviation Administration ". . . focused on the interaction of human organizational needs with the introduction of new technology in the workplace." (393) The results of the project affirmed the importance of field input into any technology changes or research and development programs: "The recommendations of the people who will use a new system must be considered during its development. The benefits are simply that there is much less chance of something being overlooked and the field [of aviation] gains a valuable resource." (396)

Similarly, Ruth Schimel testified that, in selecting new office equipment, the human factor was given equal consideration with the machine's technical capability. (549) This allowed for the selection of an effective technology, one that would have no, or little, disadvantages and allow for job enrichment. (551) It is necessary that, in Schimel's words:

> * * * the people who have to actually use the equipment are the ones perhaps who are the most important in the whole decisionmaking process, not only because they make the equipment work effectively but also because introduction of equipment affects their commitment and productivity. (551)

C. Social Science Research

The absence of reliable, quality information concerning the impact of human factors on increases in innovation and productivity was reiterated throughout the hearings. Hanes asserted that more research is

necessary to understand the results of industrial participation programs. The activities within the United States, as well as those of foreign competitors, must be studied to develop a comprehensive knowledge base. According to Hanes, "we need to set in place mechanisms that can identify what works and what doesn't work; what are the important factors within a program that makes it result in higher productivity and more innovations." (121) U.S. competitors, especially the Japanese, are so productive because their management practices are based upon an understanding of the behavioral sciences, as Abernathy noted. (710)

The National Science Foundation (NSF) has responsibility for this type of research activity within the Federal Government. According to Larsen, the Foundation utilizes an approach which is ". . . multifaceted . . . [and] involves support for all science fields, both disciplinary and multidisciplinary, applied and basic . . ." (149) However, Larsen indicated that there are organizational concerns since there is not a systematic approach to research in NSF, partially ". . . because the Foundation's mode of operating is to respond to the research community and its interests." (150) There are at least 12 programs in three different research directorates which relate to human factors in innovation and productivity and "someday," Larsen testified, "all of these various elements within the organization may even begin talking to each other and find that we have greater strength than we had realized." (149)

Despite the various programs which NSF conducts in this area, there are questions as to its commitment to social and behavioral sciences, as opposed to the physical sciences. Larsen agreed that it is not often recognized that social science is a source of important social innovation. (149) He testified that:

> * * * a major part of the uncertainty about the future of economic growth of the United States seems to be due to our inadequate understanding of the processes that determine the rate of investment, whether private or public, in knowledge production, the productivity of investments in this, and how such knowledge gets utilized in the process of technological change. Knowledge has the properties of a public good, but it is also produced privately. I think we need better measures and more useable models to encourage and reflect the involvement of both sectors in the production and use of knowledge. (152-153)

Yet, despite the need to understand better the behavioral and social sciences, Larsen conceded that the funds to support this type of inquiry have been drastically reduced:

> * * * if you look at basic research and social and behavioral science from the period 1980 to 1982, three years—there has been a reduction across all agencies of about 28 percent. * * * Now, there have been some variations within that, for economics in agriculture and so on, specialized missions. But within the Foundation for that same period, the reduction for social and behavioral science is even more pronounced, about 65 percent. That also continues, unfortunately, in my view, if you take it in constant dollars, a downward trend for a decade preceding that. (169)

This situation is, in Chairman Walgren's estimation, one of utmost concern given the impact of human factors in U.S. innovation and productivity. (19)

Many witnesses identified those areas where information is scarce, inaccurate, or non-existent, but which is vital in providing input into efforts to improve productivity and innovation. The operation of organizations was given as a prime example of an area where knowledge, through research, must be expanded. Koch testified that work must be done on the relationships between system performance or productivity and human attitudes and behavior. (398) He proposed that additional study is necessary in the area of

> * * * organizational placement and integration of socio-technical projects. Credibility, participation, and acceptance is greatly affected by where and how in the organization the function is placed and conducted. (398)

The National Science Foundation funded a study on the introduction of robotics in U.S. industry in which Hanes participated. In its report, the study committee on robotics identified areas in which further research is necessary. These, while specifically addressing the area of robotics, can apply across the board to other industries. The suggested topics include: (1) socio-technological studies of new equipment; (2) retrospective organizational studies; (3) case studies of experiences including analysis of implementation activities; (4) future manpower needs; (5) identification of worker selection criteria, training needs, and methods; and (6) human factor issues. On a more comprehensive level, there is a need for research in the measurement of administrative services and knowledge of worker productivity levels as well as research on the relationship between worker participation in decisionmaking and productivity levels. (138–139)

Noller agreed that there is much not known about the relationship of productivity and participation at the microlevel, that is, the level of the firm. (651) To expand the body of knowledge relevant to informed decisionmaking in this area, Larsen suggested that additional research be performed to better understand the interactions between social or managerial innovations (how organizations innovate); the innovation process itself; how innovations are implemented; the capital formation process; the rates of return from different types of research and development; and the effects of inflation on R&D expenditures. (151)

Given the various problems associated with organizations' handling of human resources, Balzer suggested that "... there would be a great opportunity for a field called organizational anthropology, which would be an effort to both understand organizations as cultures, and how cultures either adapt or reject programs." (115) This cross discipline approach also was advocated by Thorsrud. He proposed that "the segmentation of scientific disciplines and professions is a serious constraint." (28) in that it interferes with the evaluation and utilization of the results of cooperative efforts. He proposed that more "untied money" be made available for problem-oriented, rather than discipline-oriented work. (43) The problems are not limited to one type of science; the research should not be either. (43)

The key role of the social scientist, Maccoby stated, is to assist people to learn to be social scientists themselves. Their goal should be "... to develop the capacity for those workers, those managers, those union leaders to be able to study, evaluate, understand, do social science." (16) He pointed out that social scientists are partly to blame for the lack of research in this area. It has been the case that "... social scientists can make themselves a nuisance by their compulsion to measure everything, including the unmeasurable." (11) To complicate this, Balzer noted that some of the "trendy" notions which social scientists advocated (that is, "Q" groups) have not been successful and have caused ill feelings. (115)

To rectify this, Koch asserted that there is a need for a closer relationship between theory and concept and field implementation and application. (398) Thorsrud agreed that "research needs to maintain very direct, collaborative relationships with real life situations, to insure that previous knowledge is still relevant under the new conditions, and even more [importantly] to stimulate new thinking, new approaches, and new results relevant to the futures we are already living in." (24) Concurring, White proposed more applied, experimental work as opposed to concentrating on "learned" empirical papers:

> * * * we can get much more bang from our buck by putting money in the hands of local people who are trying to experiment, to simply learn, as opposed to tremendous sums of money in documenting and reporting out things. (293)

VI. ROLE OF THE FEDERAL GOVERNMENT

The human factor issue in innovation and productivity is a new area of investigation for the Congress. As such, traditional forms of Government activity need to be examined within its context. It was the committee's intent to identify, through these hearings, possible congressional activities which could address effectively the problems and concerns raised in the testimony. However, this was tempered by a recognition that, as Driscoll observed, societal changes cannot be legislated. (442) The issue remains one of determining what the proper role of the Federal Government is in this area.

A primary problem, as discussed at the hearing, was the lack of a central focus within the Government for innovation and productivity issues. As Representative Brown acknowledged:

> Our Labor Department, which nominally should have the responsibility, is not organized or programmed to do that; and that we even have a National Productivity Council established by law, which is ignored and is carrying out no function. It may even be abolished in this Administration.
>
> The question is whether the importance of mobilizing or stimulating improved national economic productivity is such as to justify a stronger Federal role centered in the Labor Department or in some other appropriate organization. Apparently we just have not given this very high priority in this country. (46)

Similarly, Usilaner expressed concern over this lack of focus within the Federal establishment. While not advocating Federal intervention in the economy, he asserted that ". . . the Government should better plan and focus its own efforts to encourage private sector productivity growth." (52) Without leadership, the agencies cannot adequately determine priorities and make programs and support decisions.

Part of the problem encountered in determining the relationships between, and effects of, human factors and productivity is that the traditional measures and definitions of productivity often do not apply to the new work environment. The problem, Balzer indicated, is how to measure the productivity of a "knowledge worker" who does not produce a tangible product such as the factory worker who produces widgets. (95) The traditional definition of productivity, as presented by Hanes, is ". . . the output of goods and services produced by a given input of resources which includes the human labor, the capital, material, and supplies." (119) This concept is generally used in the manufacturing sectors, but transferring this to the service sector has not proven successful. The difficulties, as Hanes articulated, include quantifying the output and assessing effectiveness, since productivity is characterized by both efficiency and effectiveness of operation.

> Efficiency is the extent to which the outputs are achieved with minimum resources or inputs. Most of the traditional productivity measurements have been concerned with efficiency. The effectiveness of an operation, however, may be of the utmost importance. (119)

Similarly, Thorsrud asserted that a change in the definition of productivity should be made from "simple measures of worker output per hour to overall effectiveness of productive units." (26) Special measures may be needed for each individual firm. (48)

Rahn acknowledged that there is some uncertainty and a lack of understanding of

> * * * the specific factors that result in rapid rates of productivity growth. We do know that productivity growth is a function of capital investment per worker. We know it is a function of the organizational structure of institutions. We know it is also a function of both worker and management attitudes toward productivity growth and the incentives provided to both. (648)

The traditional measurements for productivity are not sufficient for the evolving service sector. In pure manufacturing firms it is relatively easy to measure productivity by knowing the number of workers and the number of outputs. "But," Rahn queried, "how do we measure the productivity of an attorney, of an economist . . . or a Congressman?" (652)

Despite the problems, the General Accounting Office, Usilaner explained, does not advocate tampering with productivity as a measure, but proposes that other factors be looked at. (58) There is a tendency to read more into productivity than there is—which is simply ". . . input related to output, or the efficient utilization of resources." (58) The GAO prefers to use

> a total performance measurement system in which one part of that measurement pie is something called productivity. There are other types of measurements, such as quality, and effectiveness . . . [and] social costs. (58)

Human resource productivity has received low priority because, as Usilaner noted, there is no legislative mandate to perform work in this area. (52) The National Productivity Council, established in the Carter Administration, has been ineffective primarily because of the lack of a congressional mandate and the absence of accountability to Congress. (62) It is generally believed that the Council will be abolished by the current Administration because, according to Usilaner, "this Administration now wants to reinvent its own wheel." (62) However, this is not a situation particular to the Reagan presidency—there has never been, in Usilaner's opinion, any follow through on making the National Productivity Council a viable organization. (62)

The productivity issue must be addressed by the Government. There is, according to Usilaner, a need:

> * * * for an effort to coordinate and guide existing Federal productivity programs and provide a productivity perspective in economic and budgetary decisionmaking.
>
> Such an effort should be established by law, have clear and realistic functions, and be devoted to developing and monitoring a productivity plan and coordinating the national productivity effort at the Federal level. (53)

An Executive order is insufficient, as demonstrated by the failure of the National Productivity Council. Legislation is a necessity. According to Usilaner, the lack of institutional organization is partly the result of the absence of accountability to Congress and the fact that the direct allocation of funds is not involved. Each Administration tells ". . . the Congress we established this and we are doing all these great things" but in essence, nothing actually is implemented. (62)

While it was suggested that the Government serve as a focus for productivity efforts, caution was expressed in using any reference to "planning." Representative Lundine indicated that the idea should be accepted that industry, labor, and the Federal Government can pursue common objectives without threatening people with the notion that the Government is going to plan their lives. (296) What is important, White replied, is that ". . . to the extent the Government becomes a partner willing to seek solutions to problems with industry . . . trust begins." (296) Similarly, Sheehan maintained that the Government can help create an atmosphere where productivity can advance. (322) The massiveness of U.S. industry and the problems it faces necessitate a Federal role. (322) The Government, he stated, can assist in determining ". . . where are the public policy aspects . . . that might help alleviate [this problem] or help move foward so that we can protect the jobs and protect the industry and the country." (326)

Several witnesses stated that the Government also has a role to play in supporting research in the area of human resources and productivity. Cole contended that ". . . Federal support for the social sciences is critical. . . ." (707) Similarly, Maccoby testified that Government should support research into new approaches to this problem. (11) The National Research Council (NRC) could be used to ". . . develop

a basic evaluation instrument, including key variables and different methods of measurement. This would be made available to companies and unions with the request that they make the results available to the National Research Council." (11) Maccoby also suggested that the NRC and the National Academy of Sciences be used as a forum to bring people together to perform social science research and to formulate decisions as to what type of research is essential. (12)

Hanes concurred with this assessment. He stated that the Federal role is one of providing ". . . funding for research programs that cut across a given company." (141) Support should be forthcoming for the kind of research that goes beyond the near-term interests of the individual organization, that which individual companies are unlikely to undertake but which have a significant impact on the productivity issue. (142) Driscoll added that the Government should fund research which looks at societal innovation and documents the social codes. (427) This work is necessary and it is not being done. (439) Straw argued that the Government should fund research projects by nonprofit organizations and universities. (353)

The Government, Maccoby testified, should highlight successful models to modify the resistance to socio-technological change. (13) The Government also can lend support for work to develop these important models ". . . that will not be developed or studied by the private sector alone. Particularly . . . projects including unions with goals that are social and human as well as economic." (13) He noted that, in the past, the Government has stimulated and supported pilot programs which have encouraged unions and management to be more willing to take risks and participate. (11) Similarly, while acknowledging that the Federal role is understandably limited, Usilaner observed that "the Government, however, can and has been instrumental in the development of some labor-management committees through the provision of seed money, information, and technical assistance." (50)

Other alternatives involve the utilization of traditional economic strategies to encourage certain activities in the private sector. To improve productivity of the workforce, Straw stated that the Government must maintain "an economic policy to promote full employment, an equitable income distribution, and strong economic growth." (335) Rahn testified that Government economic policies, such as the tax measure passed at the beginning of the 97th Congress (P.L. 97-34), will result in an improvement in productivity: ". . . we have no doubt that that [the tax law] will result in reducing the impediments to capital formation, which should greatly increase our productivity growth." (648) Similarly, White suggested that changes in the tax laws might help attract increased funding for research and development programs. (291)

Of particular concern was the fact that the Economic Recovery Tax Act of 1981 (P.L. 97-34), while permitting tax credits for most types of research, specifically exempts research in the social sciences and the humanities. (726) Title II provides, in part, for a tax credit of 25 percent of the qualified research expenditures of a corporation for the taxable year over the base period research expenses. Qualified expenditures include in-house expenses (wages, supplies, and the amount paid for use of personal property in research) and contract expenses (65 percent of any paid or incurred to any person for qualified research).

The base period is the three taxable years immediately preceding the taxable year for which the determination is being made, with the exception of the transition years. The minimum base period research shall not be less than 50 percent of the qualified research expenses for the determining year. The bill also permits the 25 percent tax credit for 65 percent of all payments to universities to perform basic research.

Responding to Mr. Lundine. Mr. White asserted that tax credits for social science research could help encourage companies to undertake human factor-related research and to utilize the results. He testified:

> Were those investments in changing and redesigning their [a company's] work relationships eligible for tax credit I think that could provide a very reasonable incentive for corporations to look more favorably at that front-end investment, particularly when there are industries such as auto, steel, the electronics industry, which are in very tough shape right now and are having to look at their investment costs very seriously. (292)

Mr. Weber concurred. He pointed out that the retraining of personnel and use of consultants, which can assist in effecting productivity improvement, are not given favorable tax treatment. Instead, when ". . . they buy a piece of equipment they can take an investment tax credit, but all of the nontangibles that they'd invest in in real productivity improvement, efficiency improvement, and technology is not applicable." (292)

The issue of retraining was one which was raised in conjunction with possible initiatives which the Federal Government might initiate. As Yawata noted in his testimony, automation was accepted in Japan when the workers were assured that unemployment would not result. The Japanese thus were able to improve productivity without labor-related problems because of retraining and education which ensured that workers would still be able to perform under the new systems, either in an expanded or a new capacity. (67) Yawata explained that ". . . productivity improvement was understood by the workers as an opportunity rather than as a threat, because they never lost the opportunity for employment." (67) Similarly, Brooks testified that ". . . job security can only be achieved in practice if there is the opportunity for high mobility and rapid acquisition of new skills by existing employees." (80)

To address this situation, several witnesses suggested that the Federal Government become involved with, or encourage the retraining of, workers in the private sector. Straw asserted that the Government should provide manpower training programs for people displaced by technology. (356) The General Accounting Office has found that:

> * * * the Government places little emphasis on retraining in its employment programs. For example. CETA focuses primarily on the structurally unemployed. Only a small percentage of available funding is allowed by law to be used for retraining workers threatened with layoffs. (51)

The Government also does not attempt to ascertain training and educational needs in relation to the type of skills both created and

made obsolete by new technology. As White argued, the Government does not become involved until there is an unemployment problem; there is little activity to anticipate problems prior to their formation. (292) As an alternative, White suggested that:

> * * * if there were ways in which the Government could support through a tax-credit basis the massive retraining in terms of new technology that's going to be required in a lot of our major industries, . . . that could go a long way toward getting out ahead of the problem as opposed to trying to fix it after we're already there. (212)

The California Worksite Education and Training Act (CWETA) program is an example of a mechanism by which Government and industry can work together to provide retraining for workers. As described by Congressman Dymally, the CWETA program ". . . increases the productivity of those who are unemployed and of those who are underemployed." (623) It is an effort by which the employment needs of California industries can be met by retraining. According to Ben Munger, the CWETA effort began when:

> A close examination of the then available data also revealed that not only were there many entry level jobs not being filled due to the lack of basic skills on the part of the applicants interested in those jobs, but also there was a significant number of good-paying jobs, particularly in the health and the electronics field that were not being filled or were being filled through out-of-state and overseas recruitment. (624)

This necessitated a program which provided ". . . a narrower specific skill development rather than a general skill training approach" which was already being provided by a number of Federal- and State-sponsored job activities. (625)

The law which created CWETA allowed for financial support (stipends) for trainees to offset lost wages while in the classroom. In addition: ". . . work-site training efforts so as to provide the most efficient and effective means possible for the employee to successfully advance in his or her chosen career." (626). Thus, an entry-level employee could move up the career ladder and meet the more skilled requirements of industry, while creating a new opening at the entry level for another unemployed worker. This program has succeeded because, as Steven Duscha maintained, a partnership was forged among business, labor, Government, and educators. (628) The State pays for the educational portion of the effort while the employer pays for the work the employee does while in training and promises a job upon successful completion of the program. (642) This mechanism, as developed in California, could be, in the estimation of its sponsors, adapted to the Federal level.