



before, workers express negative attitudes toward highly fractionated job content, repetitiveness, and the unrelenting mechanical pacing of the conveyor. As shown also in the earlier study, workers holding repair jobs and other jobs with greater variety expressed less dissatisfaction than did regular line workers, with the latter aspiring to nonproduction jobs. Furthermore, job histories were found that show a tendency for workers to switch to such jobs as they gain seniority.

Such changes as have occurred in the technology of automobile assembly have not basically altered the kinds of social interaction patterns found among production workers on the job. There are few instances of men working interdependently in highly integrated work groups. However, there remain considerable variations in social interaction patterns characteristic of different jobs. Such variations were noted in the original study, but their implications were not fully explored. Data in the present study make possible a more detailed analysis.

At the time of the original study, the pay levels at Plant X were considerably higher than pay levels elsewhere in this particular geographical area. Today, the gap has been reduced considerably. Nevertheless, "good pay" continues to be the primary reason why workers say they chose employment at Plant X in the first place, and why they say they continue to work there.

The accumulation of seniority is an important factor in the perceived security of these assembly line workers and plays no small part in keeping some of them at Plant X, more so at present than at the time of the earlier study. Ironically enough, while expressing favorable attitudes toward the seniority system, workers with substantial seniority frequently express considerable bitterness at being "locked into a system" which effectively prevents them from seeking employment elsewhere. Seniority, therefore, tends to have the effect of holding workers at Plant X for the accumulated benefits they would have to give up if they left, even when they could earn comparable or better wages from other employers. For the workers so affected, this situation strongly reinforces the feelings of alienation and frustration resulting from the nature of the jobs themselves. Counterbalancing these negative reactions to some degree is the strong positive

reaction workers express toward insurance and other fringe benefits they presently enjoy. Such benefits were almost nonexistent at the time of the previous study.

The physical working conditions at Plant X have improved considerably over the past 20 years. Lighting is better; noise levels are lower; ventilation has improved. In short, the plant has been modernized. Such improvements are frequently and favorably noted by the "old timers." However, younger workers, without knowledge of what the plant was like in earlier years, make unfavorable comments about physical working conditions not unlike those made by the workers 20 years ago.

To Plant X workers, their labor union, in both time periods, is viewed as a necessary economic and psychological bulwark against the perceived pressures of management. The workers view the union as having greater strength today than previously. Many workers, particularly older ones, feel the union has done a great deal for them, even though they occasionally express some annoyance at union affairs. However, there appears to be less loyalty toward the union among some of the younger workers. Indeed, some of them make little distinction between union and management, viewing neither as being particularly supportive of their needs.

Although a major part of the research for this project was focused on off-the-job activities, such as home life, politics, and attitudes on a wide variety of social issues, analysis of this data has not yet been made. In the final manuscript, particular emphasis will be placed on relating this material to the views workers express toward their jobs, and to their life in the plant.

Michael Maccoby, "Technology, Work, and Character."

The goal of this study is to contribute to understanding of a social class—managers and development engineers of technologically advanced corporations in the field of electronics—which has great power to determine the quality of life of Americans and of people throughout the world.

These managers and engineers create new technology (such as computers) that affects working conditions of people in oc-



cupations seemingly far removed from high technology. They influence life styles through their production, marketing, and advertising activities. As managers of multinational corporations, they have direct influence on the cultures and economic and social development of other countries. By economic power and personal wealth, they directly and indirectly influence the national and international policies of the country. Increasingly, this group dominates community life in areas in which their employees live. It also exerts significant influence on foreign markets and on the international balance of payments, so that its needs and preferences must be given weight by government. In addition, the top managers are in a position to contribute large sums of money to political candidates who support their interests.

Within industry, finally, the "high-technology" managers have become models for other managerial styles. There are three principal reasons for this: 1. Their companies were among the first to achieve an organization able to adapt to technological innovation and to a constantly changing market. 2. They have been the first corporations able to employ large numbers of engineers and scientists and to organize them into the R and D teams that have spelled success in advanced technology. 3. They are seen by other industrial managers and workers as the class of managers who are expected to create greater prosperity, to solve the problems of hunger and inequality, to defend the nation, to reach the stars, and to become models for the young, thus influencing educational practices outside their immediate environment.

Who are these high technology managers? What is their work? What does it mean to them? What do they want? What do they care about? How does their character influence the direction of change? What kind of model are they for others? We have hypothesized that the character of highly successful managers is adaptive to their mode of work. This assumes that they want to do what they need to do to keep the organization moving smoothly and efficiently toward its goals (growth and profit). As some managers put it, they need to have the "right attitude," which means the emotional attitude that fits their

social role. There may be more than one character type that fits a particular role, but the possible types are limited. There are cases of otherwise brilliant and innovative engineers or scientists who nevertheless have a "wrong attitude" and who therefore fail in the industrial technostructure.

The major objective of the study is to discover the system of character traits that are adaptive to work in a high-technology environment. Two elements need to be distinguished: the concept of character and the concept of mode of work.

Character refers to the emotional attitudes that determine what satisfies or annoys an individual, what he finds attractive, exciting, or frustrating, and how he relates to himself and to others. Character is expressed in behavior; however, very similar behavior may be rooted in different character traits. One objective of this study is to discover how the manager's character and behavior influence his individual development, mental health, and experience of self.

Work—in its broadest meaning as human adaptation and creation—is difficult to define. When we have asked managers and engineers "What is your work?", almost all have responded in an abstract, highly conventional way: "I manage projects," "I'm in marketing," "I design memory systems," etc. We have found, however, that the "real" work of a manager in advanced technology encompasses such diverse activities as sensing an engineer's doubt and lack of enthusiasm about a project, stimulating confidence, dampening overenthusiasm, dramatizing a new idea, reading to keep in touch with the state of the art and the employees' state of mind, studying competitors' activities, planning, and even dreaming. The character traits of managers can be linked to the work they do only in the context of work understood in its fullest sense.

In analyzing technical-managerial work, we have found three interrelated factors that determine and color all work roles and activities. The first is the technology itself: The structure of roles and relationship to the total product are in large part determined by the type of technological product being developed, particularly by its size and by the division of labor required. The development of different electronic products calls for different



qualities of mind and emotional attitude on the part of those who work on them. This is partly because of differences in type of effort and amount of time involved. An electronic measuring instrument, a computer, and a semiconductor each requires a different attitude and implies a different time frame. For example, measuring instruments are typically developed over a one-to-three year period by groups of three to eight engineers working closely together. Each member of the group shares in varied craftsmanlike activities. Some may even spend time with their consumers, generally engineers, in order to understand their needs. This kind of work is best done by engineers who are centered, practical, and most satisfied when related to all aspects of a limited, concrete product with a well-defined market. In contrast, the development of a computer takes much longer and requires a large pyramid of highly specialized roles. Output is directed and integrated at various levels. Most of the engineers working on the development of a computer have little sense of the total product and its uses. Even the top development managers know relatively little, for example, about the bankers, scientists, military officers, school superintendents, or factory managers who will buy and use the product. High-level computer work thus attracts some engineers who are satisfied with a highly specialized role on the team. It also attracts some who are very ambitious, and some who like to speculate, in abstract terms, about the unlimited possibilities of their product.

These technological requirements are themselves dependent on the second factor, which includes the nature of the market and the structure of competition in the industry. The high-technology market has been dependent on government expenditures for military and space equipment. In the 1960's, ample federal funds for research and development allowed scientists and innovative engineers to work at the frontiers of their fields and to follow interesting leads without expectation of immediate applicability or immediate profit. With the cutback in federal funds at the beginning of the 1970's, the nature of the market changed, and the organization and conduct of research and development differ significantly according to the size, capitalization, and market position of a corporation. At one extreme, a

regulated monopoly can still afford to support scientists who work at the frontiers of basic science and are encouraged to follow their own scientific interests. By contrast, a company fighting for a smaller share of a highly competitive market needs to put its best minds to work on urgent technical problems.

These differences, too, have implications for the character of managers and engineers. For example, the semiconductor components business calls for executives who are highly imaginative and who also have a gambler's instinct. They must constantly weigh against each other two variables that determine success or failure: the level of design sophistication and the capacity to produce large numbers of components. Most components are sold to a few electronics firms which both buy them in large quantities and can always distinguish between the better and the worse design. Thus, a supplier company may have the most advanced design but lack the production facilities to produce the component in large quantities, so that it may lose out to a company with a less advanced design but adequate production capacity. The executive of the supplier company must thus decide how long to stay in the R and D process in order to improve the design of his product and when to stop development and tool up for quantity production. The overly cautious executive may produce an inferior component too hurriedly; the more scientifically oriented executive may hold off developing production facilities until it is too late, driven by the hope that he will soon have the "ultimate" design. The spirit of intense competition for high stakes thus pervades the whole industry, and is felt even on the lower levels of the technostructure.

The third factor influencing the nature of the manager's work is the culture of the corporation. Differences in corporate culture can be great. Many Japanese corporations, for example, are organized on a principle of total security; once hired, an employee is never fired. In some of the leading corporations in America, this principle is admired and even approximated, at least for professional employees. In one company we studied, during the recession of 1970, managers and engineers accepted a 20 per cent cut in salary rather than allow any member of the technostructure to be separated. Other elements in the culture



of a corporation are the degree of internal competition allowed, the quality of authority, the degree of self-management, the attitude toward dissent, concern for safety, and moral concerns, including attitudes toward hiring and promoting racial or ethnic minorities. In addition, the culture of the corporation is influenced by particular historical conditions. The style of the founders, or of a European parent company, may be important. A corporation developed by a single family and dominating a geographical area may have aspects of a feudal barony in the sense that loyalties are personal, meritocracy is constrained, traditions and rituals are important, and so forth. By contrast, a new company in the same technological area may be totally without tradition, meritocratic, and nonpaternalistic; it may thus allow bright young people to advance more quickly than in a traditional company, but it may also be more ruthless about firing nonproductive employees.

To date, interviews have been conducted with about 200 executives, managers, and engineers in a dozen corporations in various parts of the United States. The objective in the interviews has been to discover the key dynamic traits shared by the creator of new technology and to identify differences of character trait according to differences in work situations. Over one hundred of the respondents have completed an interpretive questionnaire which is divided into five parts dealing with work situation, attitude toward work, social-political attitudes, social and individual values, and family life. Seventy of those interviewed have taken Rorschach's test. The majority of the sample of 200 work at two multinational corporations; we have studied at least 50 people in each of these, including the presidents of the corporations and some of their top executives as well as representatives of all levels of the technostructure. In each corporation, we have studied people working on both large, hierarchically organized projects (such as a computer) and on small, more cooperatively organized projects. In addition, thirty managers and executives in four corporations in Mexico have answered the questionnaire interview. These are individuals who are closely involved in the process of economic development in that country.

The median man in our sample appears so far to be manager of development teams and a relatively satisfied member of a successful organization. He is 36 to 40 years old. (About 25 per cent are under thirty, and 15 per cent are over forty-five.) He has 3 children and has never been divorced. (Only 7 per cent of the sample has been divorced, and almost all the more successful managers report closely knit families.) He makes between \$15,000 and \$25,000 a year, and he considers the ideal income to be in that same range. He has a master's degree in electrical engineering from an undistinguished college or university. He has worked for about ten years at his present company, which he entered right after his service in the Navy. He considers his work to be "extremely important" in his life, and would rather do what he is doing than any other job he can imagine.

The median manager is two generational steps from the farm. He grew up in a small town in the mid-Atlantic states, and has inherited its values of hard work, self-sufficiency, and thrift. His grandparents were native American or Northern European. His family was middle class. His father was a manager, a nonprofessional white-collar worker (e.g., for the railroad), an engineer, or a salesman, generally in technical or technically-related work. His grandfathers were farmers, skilled workers, or managers, although many were independent professionals or semiprofessionals (contractors, clergymen, lawyers, or elected officials). His mother came from a working class background. In many cases, she worked for a while in a bureaucracy as a bookkeeper, secretary, schoolteacher, or nurse.

The median manager states that he works with advanced technology, either creating it or using it in new ways. His main functions are project responsibility, developing new products, and coordinating the work of others. He spends his time talking to both superiors and subordinates. He must judge others' work, and his work, in turn, is also judged. He works 40 to 45 hours per week, including a few hours at home. He may enjoy the pressures of a fast-paced work life, but he also wants to have a family life that is free from corporate demands. He needs time by himself to think, but he generally must find this time at home, since there are many interruptions at work. He dreams



about work. He keeps up with the "state of the art," and he participates in company retraining programs. He considers his work to be technically interesting, creative, important to the company, and not exceedingly supervised. Yet, he is nagged by thoughts of being merely part of a huge machine, of becoming technically obsolete, or of being bypassed for promotions. He doesn't think that he has much power to affect the policies of the company. (If they had the choice, over half of the sample say they would rather run a small company than reach a high level in a large company.)

The nuclear character of the median manager appears to be what is known technically as a "productive-hoarding" one. By contrast, the most successful managers and executives who head teams where there is great division of labor are more likely to have a "game character"; they are stimulated by the high-risk play that is a result of their market position, and are tougher and more ambitious than the median manager who is closer to the individual product. The most frequent emotional problems mentioned are those rooted in the hoarding character type, which tends toward obsessive/compulsive symptoms. The engineer-manager tends to keep his feelings to himself, to avoid people, to be overly anxious, and to have difficulty making decisions. Other problems mentioned point to the lack of centeredness experienced by many managers; i.e., they lack goals and feel mildly depressed. They also feel that they give in to others too easily, which may be a form of the related finding that some managers on the highest levels suffer from unconscious self-contempt.

Technical engineers experience their work as generating greater self-confidence, cooperativeness, open-mindedness, and flexibility. Also, the corporation and the demands of technology have tended to liberalize the political ideology of these individuals, who come originally from conservative, insulated, small-town backgrounds. The issues they consider most important at the present time include environmental pollution, black-white relations, the Indochina war, overpopulation, and crime. Despite the fact that their products are sometimes sold to the military or defense industries, they are not in favor of strengthening na-

tional defense. More than half were opposed to building the SST. They are not in favor of winning the war in Vietnam; nor do they support a crusade against communism.

However, the tendency toward liberalism does not imply a deep concern for human welfare or the community. The conscious goals of the manager are to be successful, to have the esteem of his colleagues and family, and to have interesting work. He rejects the exercise of business power or personal power as a goal. Indeed, he is touchy about the concept of "power," and would tend to repress any desire for it. His concern about his own self-development or scientific understanding is minimal. Managers are oriented toward personal success, interesting work, and a comfortable family life. Few are active in bettering their community. Few worry about the social effects of the products they create, even though a majority believe that advanced technology contributes to "dehumanization."

It is notable in this respect that although most of these managers report that their work stimulates cooperation and fairness, it does not appear to encourage compassion, generosity, or idealism.

In sum, it appears thus far that advanced technology is created by fast-paced teams of engineers who are intensely interested in their work and in winning. Their character is selected mainly from small-town, traditional backgrounds and then further liberalized and "opened" somewhat by the corporation. As much as any modern man, the top managers fit De Tocqueville's view that, "The whole life of an American is passed like a game of chance, a revolutionary crisis, a battle."

The Mexican executives and managers, by contrast, operate according to different goals and constraints, both culturally and technologically. Managers in Mexico, as in other less-industrialized nations, do not create the new technology. Rather, they adapt, employ, and market it. Their goal is to develop "technological enclaves" in their countries, and they believe that the prosperity and comfort which will at first be limited to the well-to-do will eventually spread to all sectors of the economy. However, their unconscious view, expressed in their dreams, is based more on fear than hope. They are frightened of the poor, the



peasants, and the slum dwellers. Thus, the technological enclaves—the “domed cities”—they dream of are expected to provide both comfort and protection.

While the Mexican managers dream of enclaves, many American corporations have already achieved something of the sort. Their managers live in a protected world. Although the internal competition may be fierce, the corporate manor is separated from the world of those with less interesting work and less substantial rewards. Living in suburbs and in new towns springing up near the corporation, managers and their families have little direct contact with the poor. Some support welfare measures. Some moralistically blame the poor for not working hard enough. They justify their own search for success, comfort, and interesting work in terms of the eventual benefit to mankind of increased productivity and economic growth. Many have gained substantial rewards from their hard work; for them the system has worked. They implicitly assume, uncritically, that it can work in the same way for others.

Paul Armer, “Technological Obsolescence.”

This study examines the hypothesis that obsolescence of individuals is becoming a serious problem prevalent in advanced technological societies, and explores measures by which the problem might be ameliorated. In what he calls the “Paul Principle”—an allusion to the recently expounded “Peter Principle” according to which individuals tend to rise in organizations to their “level of incompetence”—Armer hypothesizes that “individuals often become incompetent over time at a level at which they once performed well, because they ‘become uneducated’ (obsolete) for that level.” It used to be that individuals could, in later years, draw on intellectual capital built up in school and early job training without exhausting it prior to retirement. This now appears to be no longer possible in many positions, especially in professions and industries that are at the forefront of technological change.

Ideally, one would like to be able to develop statistics on the number of individuals who have an obsolescence problem, on their characteristics (age, occupation, etc.), and on a variety of other factors related to obsolescence. It would also be desirable to assess some of the costs associated with obsolescence, including the psychological and financial costs to the individual and his family, as well as the cost in organizational inefficiency. But no such statistics exist. A literature survey revealed several hundred articles related to the topic of obsolescence, but very few offered any data. Nor is there consensus on just what constitutes obsolescence, i.e., on its definition, characteristics, and symptoms. Such articles are often alarmist; they sometimes cite horror stories, and they almost always place the blame on the explosion of knowledge in many fields and on the increasing pace of change in today's world. Some articles argue, for example, that the half-life of an engineering education today is ten years, i.e., that for the engineer graduating this year, half of what he has learned will be obsolete in ten years. Otherwise put, half of what an engineer will need to know in ten years will not have been taught to him. Most articles call for continuing education in a variety of forms, from increased reading to a sabbatical return to a formal educational setting.

One of the few studies that gathered data on this subject presents an overwhelming case for the hypothesis that obsolescence among engineers is a most serious problem.* Data were collected on 2500 engineers and managers in several disciplines from six companies, of which three were primarily in the aerospace industry and three were in other representative technology-based commercial industries. The authors obtained management's performance evaluations of design and development engineers. A plot of average percentile ranking increases with age until the early thirties, drops slightly in the late thirties, and falls steadily thereafter until retirement. A comparison with data gathered by Pelz and Andrews thirteen years ago shows that peak perfor-

*Gene W. Dalton and Paul H. Thompson, “Accelerating Obsolescence of Older Engineers,” *Harvard Business Review*, 49 (September-October, 1971) 57-67.



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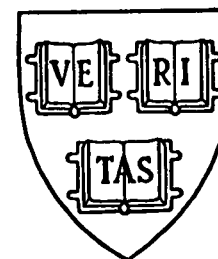
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HARVARD UNIVERSITY

PROGRAM ON TECHNOLOGY AND SOCIETY

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A FINAL REVIEW



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