

**Key Human Resource Issues
For Management in
High Tech Firms**

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Today's independent global economy requires that U.S. high technology companies, like organizations in other industries, must deal with the reality of continual change. Global competition, America's recent sluggish economic performance, and the declining market share for U.S. products provide the impetus for change in U.S. management processes. International competitors that once relied on low prices to penetrate markets now produce products that are perceived by corporate and household consumers to be superior in service, reliability, and quality (Abernathy, Clark, and Kantrow, 1983; Koch, 1983). The search for effective alternative managerial strategies and practices is also motivated by dramatic shifts in the nature and structure of the U.S. labor force and American workers' desire for more influence in career and work place decisions (Kerr and Rosow, 1979; Levitan and Werneke, 1984).

To remain competitive in a constantly changing global marketplace, U.S. business managers are beginning to recognize the need to identify and implement new human resource strategies. Manufacturing and service organizations in high technology confront the challenge of global competition and technological change on a daily basis.

The pace of technological change can be overwhelming. An engineer becomes technically obsolete less than three years after completing a baccalaureate engineering program. Product life cycles in high tech are shrinking; new products often have to proceed through the design and implementation phases in less than a year if they are to reach the market in time to be economically feasible for the high tech corporation. Finally, project teams in many high technology companies remain intact for less than two years. These factors demand that teams of technical specialists and knowledge workers are effectively orchestrated by managers who (1) possess the skills to manage the business aspects of new product development; (2) are rewarded for collaborating with other teams throughout the organization; and (3) have acquired the knowledge to manage technological change.

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It is the nature of high technology businesses to change. High tech organizations themselves create the processes and products that change the industry. What exists in high technology that might not necessarily exist in other industries is the effect of this internal force of change; change in high technology originates from the firms' human resources, the "knowledge workers" or "high-talent" personnel. This internal force of change differentiates high technology industry from other industries. Constant, daily change has become the reality of life within high tech organizations. Human resource professionals can best contribute to the firm's success by acknowledging these aspects of change and by working with line management to identify and articulate an organizational perspective within which the knowledge workers can approach their daily tasks.

In what ways are human resource specialists called upon to facilitate line managers' identification, development, and implementation of strategies that will enable U.S. manufacturer's to handle competitive and environmental pressures effectively? How will human resource specialists' skills and contributions ultimately improve the organization's performance and enhance the high tech company's ability to compete successfully in the global marketplace? The effective acquisition, compensation, development, and utilization of human resources is critical to the organization's survival. In high technology firms – driven by innovation, science, and research – it is the acquisition, development, and retention of skilled human resources (particularly high-talent personnel or knowledge workers such as hardware and firmware engineers, computer scientists, statisticians, and material and mechanical engineers) that are paramount to the organization's success.

To assess their current role, we interviewed twenty-four human resource managers throughout the United States; seventeen work in high technology enterprises. 1 The interviews were exploratory and open-ended, averaging over an hour. Most interviews were conducted in person; however, several were conducted on the telephone because of geographic limitations.

The principal focus of the interviews was the human resource managers; perception of (1) relevant external environmental forces and (2) key personnel issues confronting their particular firms. The list of human resource managers is not random; hence, caution is needed in generalizing from the results. Time constraints, economic adversity in their firms, and employer policy prohibitions against publicly sharing information were among the main reasons given by several managers who declined to be interviewed. Overall, the responses of those who participated are quite consistent with our own employment and consulting experience and the literature reviewed for the study reported here. 2

Throughout the interviews, an array of current human resource activities were referenced by human resource managers: equal employment opportunity/affirmative action issues; wage and benefit costs; human resource planning issues; and performance evaluation processes and threats of increased litigation over employee rights. Three high-priority issues were emphasized consistently by the majority of interviewees:

Recruitment and staffing – the critical need to attract and properly place high-talent personnel, or knowledge workers, throughout the organization.

Training and development – the requirement for the firm to continually assimilate, upgrade, broaden, and deepen knowledge workers’ technical skills.

Organization design and development – the need to work closely with line managers to shape and maintain organizational conditions that support innovation, change, and employees’ continued high performance.

This chapter discusses these priority issues as they relate to knowledge workers, researchers, scientists, engineers, and business and technical managers in high technology companies. Except for minor variations, the responses from human resource managers in high tech and other firms were quite similar. Their responses are treated as a whole in the analysis.

Recruitment and Staffing

Human resource managers indicated the critical need to successfully recruit and effectively place high-talent personnel. Competition for knowledge workers is severe. The American Electronics Association (1981) estimated a compound increase in demand for hardware and software engineers in high tech firms of over 100 percent during the five-year period 1982-87. Besides high technology companies, academic research centers and manufacturers of automobiles, machine tools and equipment, aerospace equipment, and specialty steel are all competing for a limited supply of recently graduated talent. It has been projected that through the mid-1990’s the great majority of new jobs for technicians, information specialists, numeric-control operators, and computer programmers will be in non-high technology industries (Riche et al., 1983). Companies in these industries are undertaking enormous investments to retool their facilities, retrain their employees, and convert their manufacturing operations to computer-controlled and robotics-based manufacturing systems.

Some of the factors that graduate engineers consider when deciding to accept job offers include the geographic location of the firm; the company’s image as a technologically innovative organization; the particular project to which they will initially be assigned; the organization’s willingness to recognize the individual’s contribution; and the company’s compensation policy. In turn, high technology companies are aware of and responsive to the requirements of prospective job seekers. In particular, our interviewees identified the following important considerations as relevant to meeting high recruitment quotas.

Establishment and Improvement of the Firm’s College Relations

Several major high technology firms rely on aggressive college recruiting efforts, including equipment and monetary grants to leading engineering schools as well as financial support for faculty research (Fombrun, 1982, 48-49). Corporate-sponsored scholarships and internship/cooperative arrangements

for students to work on a company's challenging projects prior to graduation are becoming effective recruiting methods for several firms.

Geographic Location of the Firm

Although high technology employment is located throughout the United States and the search for talent is nationwide over half of the 13 million jobs in the early 1980s were concentrated in ten states.³ In addition to the established concentrations of high tech industry on the east and west coasts, there are new high tech areas developing in Albuquerque, Austin, Boulder, Chapel Hill-Durham-Raleigh, Colorado Springs, Dallas, Houston, Phoenix, San Antonio, San Diego, Salt Lake City, Tampa—Clearwater, and Tucson.

What accounts for the attractiveness of such geographic areas to high technology companies in general and to their human resources in particular? Herbert D. Lechner (1985), vice-president for computer resources and administration at SRI International in Menlo Park, California, identifies the following factors from Lyman Carlson's study of Silicon Valley's takeoff and success: an ample supply of key skills and talent, innovative incentives, and desirable geographic attributes in the proximity to an academic institution provides a flow of talented scientists, and the industry provides the employment challenges, opportunities, and rewards they seek. Lechner adds that availability of sufficient venture capital and a positive business climate in the local community, which encourages a relatively free exchange of ideas and numerous entrepreneurial opportunities, are also vital.

Geographic locations that afford favorable weather, diverse and readily accessible recreational outlets (for example, water sports, snow skiing), access to the arts (for example, museums, opera theater, symphony), cultural and ethnic diversity, and exceptional academic opportunities for advanced studies, workshops, and seminars are taken into serious consideration by prospective new hires.

Company Image

Several human resource managers stated that the image of the company is very important in recruiting and retaining good researchers, scientists, and engineers. They want to know if the firm is at the "cutting edge" in terms of its technology and research thrusts. Questions commonly asked are: Is the corporation innovative? Has it achieved solid financial growth?

If the company is perceived as a progressive, fair, and challenging place to work, current employees are likely to attract former school associates and colleagues from other firms. Some companies pay a finder's fee or bonuses for leads that result in new hires.

Job Challenge and Recognition of Contribution

In addition to company image and innovation, job challenge and the opportunity to be recognized as a

contributor to the organization's success are critical factors in the decision to accept a job and to stay with the company. Al Davis, vice-president of Molecular Computer Corporation has stated:

Job seekers almost always ask the same first questions: "What is it I'm going to do?" "How much responsibility can I get first?" "I want to have control over something. I want it to be mine." It's "what are you going to let me accomplish?" They want control over their own destiny, but they still want to be part of the best team. They don't want to be told what to do by the boss and be expected to carry it out robot-like, without participating in some of the decision. (Barnett, 1983, 171)

The recruit's perception of the organization's response to these issues is developed further in subsequent sections.

Compensation

As noted earlier and consistently emphasized by the human resource managers we interviewed, innovative compensation packages and inducements are required to attract and retain talented knowledge workers. High starting salaries for new college graduates and significant compensation increases for experienced workers, coupled with generous benefits, are essential. Among the benefits are relocation allowances, sign-on bonuses, front-end paid vacations and settling-in allowances at time of hire, graduate education tuition reimbursement, in-house educational opportunities, assistance with home purchase and sale, parallel promotion ladders leading to challenging and high-status projects, and retirement and health benefits packages.

Long-term equity arrangements have not appeared to be a key inducement for new college graduates to join a particular firm. However, short-term bonuses, incentives, and profit-sharing plans tied to individual and group performance is definitely favored. For example, IBM rewarded forty-eight engineers who helped develop their personal computer disk drive with a total bonus of \$1.8 million (Rozen, 1985). The use of longer-term stock ownership arrangements that might generate a high payoff if the company should go public is debatable. One of our respondents stated:

It's only paper! You have no insurance that it will increase in value. Nor is there any obligation on the part of the majority of owners to go public. So what do you have? A better approach is to pay a competitive wage to everyone and provide good percentage increases tied to performance. Profit-sharing, which pays periodically, is a good idea. It has to be carefully designed and the payout fair.

International Employment Opportunities

Several U.S. high technology firms have located manufacturing and data processing operations outside the United States in an effort to secure significant financial advantages in their manufacturing opera-

tions, develop new markets, and access highly educated and creative engineering talent. McCartney (1983) reports:

National Semiconductor . . . went to Israel, which has an abundance of engineers, scientists and technicians, and had Israeli engineers develop its 32-bit micro (computer). Control Data, Intel, Motorola have established research and development centers there . . . Burroughs . . . and Tao, the biggest industrial firm in India, have an agreement by which Tao will supply Burroughs with software (engineers). (p. 117)

The market for high-talent human resources is increasingly becoming a global one.

Although research and development are often retained in the United States, standardized high-volume production is taking place offshore. Buffa (1984) estimates that 85 percent of the 36 million people who enter the worldwide labor force annually are from Third World nations, where high-volume products are manufactured at costs significantly lower than U.S. production costs. More than seventy nations are currently competing to attract industry (Blanchard, 1984; Business Week, 1985; McCartney, 1983), including Korea, Taiwan, India, Scotland, Jamaica, Sri Lanka, Singapore, Philippines, Malaysia, and Barbados. Among the major U.S. firms responding are Apple, Digital Equipment, Storage Technology, IBM, GE, Amdahl, Burroughs, Ford, Caterpillar, GM, Alcoa, Dow Prime, Wang Laboratories, NCR, Hughes Electronics, Xerox, and Mattel. As the world grows increasingly interdependent, business firms from advanced industrial nations such as France, Japan, West Germany, and Italy, in turn, expand their presence in the United States. In 1981, direct foreign investment in the United States grew to approximately \$90 billion (Horowitz and McClenahan, 1982, 73).

It is estimated that about 400 U.S. firms are now located in Ireland and 650 in Mexico. Both nations provide extensive inducements to high tech corporations. Ireland, for example, offers grants for equipment purchases and plant construction, pays 100 percent of the cost of work force training, and provides a corporate income tax rate that tops at 10 percent, with generous allowances for deductions and depreciation. Equally important, producing in Ireland provides a “local presence” and greater ease of entry into the European Common Market (Amatos, 1985). Typical additional inducements are exempt from import duties on parts and materials and a modern infrastructure consisting of good roads, airports, schools, and telecommunications facilities. Opportunities for U.S. knowledge workers and technical managers to relocate for a period of time in foreign countries both to share their expertise and to learn from others can be offered as an attractive recruiting incentive by multinational high technology corporations.

Training and Development

The process of maintaining, upgrading, and expanding the firm's knowledge workers' technical knowledge and skills is of paramount importance to the human resource managers surveyed. The overall objective is to continually improve the technical skills of the firm's human resources in a deliberate, planned, comprehensive, and timely manner. An effective internal technical education program results in improvements in both the performance of individuals throughout the firm and the company's competitive position in the high technology marketplace.

As indicated earlier, competition for knowledge workers is severe; universities are unable to supply sufficient numbers of engineers to meet the growing demand for knowledge workers who possess state-of-the-art skills. As a result, high technology companies expend vast sums to facilitate acquisition of technical knowledge and skills by their internal labor force. A Carnegie Foundation Special Report (1985) cites a figure of \$700 million invested per year for internal technical education programs by AT&T. Similarly, at IBM, the \$200 million spent for technical education in 1982 more than tripled by 1984.

Four characteristics of training and development tend to be emphasized in high technology organizations:

State-of-the-art, new technology-oriented, in-house education efforts are taking place. In the high tech area, research tends to take place in industry rather than in academe.

There is a severe reduction in the product development life cycle; that is, there is less time between the investigation of the possible application of a new technology to a particular market and the actual introduction of the new product to the marketplace.

A variety of technical education methods and techniques are used.

Career expectations of knowledge workers – as they are influenced by organizational needs – are increasingly recognized by high technology firms.

State-of-the-Art Knowledge

Science and knowledge are the central forces that drive high technology industry. Ultimately, the end product is the embodiment of that knowledge and information in marketplace goods and services (for example, computer hardware and software, fiber optics, laser technology, biomedicine and generic improvements, ceramics, and new materials). To be marketable, these products must be manufacturable, reliable, functional, supportable, and user friendly. They must implement the latest technologies and meet customer expectations.

For the high technology organization's survival, it is imperative that state-of-the-art knowledge, concepts, and skills cut across the entire organization research and development, marketing,

quality control, and manufacturing. The firm's human resources must be continually upgraded to prevent obsolescence. At Hewlett-Packard Company (HP), it is estimated that because of the exponential rate of change in the electronic instrumentation and computation industry, knowledge workers become technically obsolete within three years following graduation from a baccalaureate-engineering program. Hence, engineers and technical managers are given opportunities to upgrade their skills in areas such as systems architecture, design methodologies, operating systems, programming languages, and so on.

Product Life Cycles

Given the intense nature of competition, knowledge workers in high technology companies must be capable of researching, designing, manufacturing, releasing, and supporting high-quality products that have been drastically reduced. To be economically feasible to the firm, the cycle for many products, from R&D to manufacturing release, is now a year or less. At the same time, the proliferation of new products is overwhelming. Thousands of high technology products on the market today did not exist ten years ago. Hewlett-Packard has more than 7,000 electronic measurement and computation products on the market, more than 80 percent of which have been introduced since 1980. To raise the knowledge worker's awareness level of new technologies, market demands and process improvement methodologies, HP provides education in the following areas: product and process development methodologies, market-focused engineer education, and HP specific product education. No single engineer has access to all the information or resources needed to determine the best place to begin learning new technologies or developing process skills; hence, a dedicated, organized approach to internal technical education is critical to the high tech firm's ability to adequately maintain and upgrade human resources.

Delivery Systems

As in other industries, high technology companies employ a variety of delivery methods for meeting their training and development needs. These range from individualized computer-based instruction to group instruction in classrooms, research labs, seminars, and workshops. Such instruction is designed and offered both by in-house training staffs, assisted by internal technical managers and knowledge workers, and by professional educators from local universities, trade groups, and professional associations. Many Silicon Valley firms provide graduate engineering education programs that are broadcast to company facilities from Stanford University MIT, the University of California at Berkeley, Chico State, and the National Technological University.

Career Development

It is increasingly recognized that individualized career development opportunities are essential both to attract and to retain knowledge workers. Such programs are typically integrated with performance

appraisals in which employees and their managers jointly examine the employees' strengths, future career options, relevant development needs, and alternative growth methods.

Alternative career growth methods may include individualized programs of study (computer-assisted instruction, special projects, self-paced study) as well as group experiences and formal education programs, with tuition reimbursement support. In addition, multiple career tracks, which include increased financial and intrinsic reward opportunities, are essential in high technology firms. These career tracks may include advancement to senior project engineer or scientist; major project leadership assignments; participation in major start-up projects; and upward managerial promotions and movement into technical marketing responsibilities.

High technology firms that are able to attract, retain, and continually improve their knowledge workers' skills tend to be successful on a long-term basis.

Organization Design and Development

Enabling line managers to shape and maintain organizational conditions that support innovation and high performance is the third trend reported by human resource managers in our study. Human resource professionals can help effect change in high technology industries and can help ensure that workers are prepared to meet the competitive demands of the industry. In principle, they must identify, articulate, and provide means for line managers and employees to understand the nature and requirements of changing work processes within the global marketplace. To do this, the human resource manager needs to understand and be able to (1) describe the organizational systems within which the technical experts and business managers are operating and (2) suggest ways for the organization and its workers to respond to new demands by breaking familiar patterns if necessary.

The organizational conditions that shape a company's ability to achieve its goals and respond to changing environments generally include organizational structure, culture or climate, and task design; worker and managerial skills; and required support systems, such as recruitment and rewards, communications, training and development, and conflict resolution. Each of these conditions may be viewed as a continuum, with "traditional" and "adaptive" systems representing the extremes of each (see table 7- 1). 4

Systems at either end of the continuum are not inherently better or worse than their counterparts. Regardless of the organizational system, the overall business objective remains the same – that is, to engender efficient and effective performance aimed at fulfilling the expectations of the multiple stakeholders in the firm (consumers, investors, employees, manager, vendors, government agencies, and so on). The challenge, as Miles and Snow (1984) point out, is to develop the system and the related organizational conditions that strategically fit each company's external environment and support the realization of its specific business goals.

Traditional Systems

For business firms in relatively stable environments, with mature product lines that may command significant market shares, traditional organizational systems may be quite appropriate. This is especially true where capital-incentive technology prevails and much of the work is routine, repetitive, and highly specialized. In this situation, the role of human resource managers is more maintenance-oriented. Human resource planning is short-term; the goal in compensation is typically to remain abreast with (not to lead) community practices; training for employees and supervisors is narrow and task-oriented; the organizational structure is hierarchical; and the climate emphasizes efficiency, cost control, centralized decision making and minimum risk taking. Interpersonal conflict is viewed as dysfunctional to predetermined personnel rules and is to be corrected by better employee selection, orientation, and training.

Under traditional system conditions, if the firm's employees are unionized, management's usual strategic response has been one of accommodation to minimize employee discontent and ensure uninterrupted productivity. If major changes should occur in the firm's environment (for example, an abrupt shift in consumer demand, an increase in lower-cost competitors, a shift in government policy, deregulation), a variety of strategic choices confront the firm. Depending on previous relationships, the gravity of the change, and managerial values, management may seek concessions to reduce labor costs; request greater work rule flexibility; threaten to establish nonunion subsidiaries or move offshore; or entertain joint union-management approaches to problem solving, such as quality of working life and quality circle programs (Kochan, McKersie, and Cappelli, 1984; Landen and Carlson, 1982).

The Need for Innovation

Research has consistently revealed that in highly competitive and dynamic external environments, flexibility and the ability to innovate are key factors in organizational success and survival. In *The Change Masters*, Kanter (1983), concluded:

The corporations that will succeed and flourish in the times ahead will be those that have mastered the art of change: creating a climate encouraging the introduction of new procedures and new possibilities, encouraging anticipation of and response to external pressures, encouraging, and listening to new ideas from inside the organization. (p. 65).

Similarly, in *In Search of Excellence* Peters and Waterman (1982) found that "America's best run companies" were not only good at consistently developing marketable products and services but were especially adroit at responding to changes of any sort in their environments. Peters (1984) adds that continuous attention to total customer satisfaction on the part of every organizational member, by providing product quality, services, and dependability, is the only effective source of sustainable, long-term competitive advantage.

Koch and his associates at the Federal Reserve Bank of Atlanta (1984) also found a major emphasis on innovation in their study of twenty-two high-performing firms located in the Southeast (including Nissan Motors [USA], Nucor Steel, Delta Airlines, Coca-Cola, Hayes Micro-computer, and Federal Express). Adoption of state-of-the-art production technology was paramount. Such firms work with their suppliers to design more functional equipment and continually seek ways to make their equipment more flexible through computerization. With respect to marketing, they actively pursue strategies that clearly define their comparative advantages versus the competition. And they aggressively develop new market niches or exploit proven or mature markets.

Adaptive Systems

Why are some companies more innovative and effective (high performance) than others? Studies reveal that regardless of industry or organization size, successful innovation can be a carefully planned strategy for survival, made possible by enlightened leadership and a consciously developed supportive environment (Drucker, 1985; Quinn, 1985). Koch and his associates (1983) concluded.

Those companies on the cutting edge of technological change are also on the cutting edge of behavioral change. Successful high-technology companies are led by enlightened managements. They are disillusioned with traditional corporate structures. They believe there must be a better way to operate a business. The model they provide is one of integrating people with technology to get results. (p. 16)

A spirit of entrepreneurship is pervasive throughout the internal environments of high-performance companies. Every employee, regardless of function (operations, marketing, finance, staff) or organization level (from operative to senior manager), is encouraged to actively seek and strive for opportunities to innovate, to contribute, and to be recognized for his or her contributions. The objective is the timely flow of ideas to enhance product value and to improve both product development and product manufacturing processes. The flow of ideas is not the sole responsibility of individual contributors or corporate staff. However, management must assume responsibility for managing and supporting these development processes. Improvement is achieved incrementally: through interactive learning, with many employees participating in various ways; by sharing ideas, experimenting, and learning from successes as well as failures; by measuring (through the use of statistics); and by continually improving product development and manufacturing processes (Deming, 1982).

The attributes of high-performance environments are summarized by Cooper (1984) in a study conducted by Hay Management Consultants. The study covered approximately 1,200 organizations with an employee population of 2.5 million workers. Based on the evidence, the Hay group was able to differentiate between faster-growth and slower-growth organizations and attributed the difference primarily to two distinct business cultures.

In faster-growth organizations (sales revenue and profits clearly above industry averages), more egalitarian and growth-oriented values prevailed. High performance was recognized with advancement and merit compensation. These organizations expected and received high-quality perfor-

mance. Employees believed that they were the most important asset and that they were respected by management. Reasonable risk taking and learning were encouraged. As a result, such organizations were more productive and responsible to market opportunities, and this tended to be reflected in their financial performance.

In contrast, in slower-growth organizations, power, control of information, and decision making were centralized among senior managers. Authority and threat of job loss were key levers used by managers to direct human resources. Consequently, resistance to change, adversarial behavior, and lower output frequently occurred.

Similar findings were reported in a 1983 national study of 845 working Americans conducted by the Public Agenda Foundation. Over 70 percent of the respondents strongly endorsed the Protestant work ethic and wanted to do the best job possible, but many said that their work environments were quite negative. William M. Ellinghaus, president of AT&T and a member of the Public Agenda Foundation executive committee, asserted that new managerial systems and new ways of organizing work are needed to reinforce employee effort. The report concluded that traditional work place structures – with clearly defined job descriptions, hierarchical authority systems, and sharp distinctions in pay and status – implicitly convey the message that individual workers are less important to the success of the enterprise than managers are.

The Role of the Human Resource Professional

Human resource professionals in many organizations play key leadership roles in helping line managers shape and maintain the organizational conditions that encourage innovation and high performance. At Motorola, for instance, the personnel staff is credited by their CEO, William Weisz (1985), for “helping to create the transition from a more traditional to a more participative philosophy and approach to management” (p. 33). Weisz adds that this change has been intrinsically and financially rewarding for everyone and has led to improved product quality, reliability, delivery, and reduced cost.

In a similar organizational change at Honeywell, Kanter worked with the director of human resources in their Defense and Marine Systems Group, Avionics Divisions (Kanter and Buck, 1985). They combined extensive data-gathering techniques (questionnaires, interviews, open sensing sessions) with activities – such as employee orientation, training, minority affairs, and labor relations – were given greater visibility and were further decentralized to the field. Cross-functional task and participative teams were created to more effectively integrate desired organizational conditions with long-range business planning.

These cases serve as backdrop to a third study involving a major provider of technical research and consulting services to both national and international clients, high technology and otherwise. The human resource manager at this firm, which we call Res/Con Services (RCS), was interviewed in depth by Miljus.⁵ Even though RCS is in the initial stages of change, the case is most instructive, since it reveals the compelling need for transformation and the role of the human resource professional.

The RCS work force is composed of high-talent research and scientific personnel backed up by a large number of technical and staff employees. The quality and reliability of its services are

considered excellent. In recent years, two major changes have forced RCS management to rethink company strategies:

- a. Higher-quality competition – national and international – is entering the market with aggressive price and service tactics. Competitors possess top-notch talent, state-of-the-art research technology, and strong research orientations.
- b. Consumers are changing. They still demand quality results on complex projects, but they also want quicker turnaround time at lower cost. At times, they also demand timely assistance on very specialized, narrow projects.

In response to these challenges, the principal issues confronting RCS management is how to effectively transform a highly creative but relatively relaxed, informal, campus-like work community into one that is more responsive to business realities – that is, the need to provide timely and reliable services at competitive costs to clients. Management recognizes that it must preserve reasonable autonomy and project decentralization while concurrently introducing professional business principles. As the human resource manager stated:

Our traditional industrial base is drying up . . . We no longer are the sole source provider. Bidding for R&D projects is becoming more competitive. We need to be more sensitive to the survival needs of our clients. We no longer are in the mecca; we no longer can sit and wait for projects to come to us.

RCS management further recognizes that many current managers and project leaders will need to be retrained and develop new skills. No doubt, some employees – managers and researchers alike – will resist work role changes and additional accountability requirements. Therefore, a comprehensive incentive package is being developed to support those who may elect to leave (outplacement, buyouts, early retirement provisions) and to induce many others to remain to carry out ongoing projects and to help shape and implement the transition.

At RCS, a classical organizational change effort is under way (see Beckhard and Harris, 1977; French and Bell, 1984; Beer, 1980). The human resource manager, in a major change agent or leadership role, chairs a transition committee composed of key line and staff managers. The major responsibilities of the committee mandated by the CEO are to design future organization conditions and to spell out transition stages, schedules, costs, communications methods, and a methodology for monitoring and controlling the transformation. Recommendations are to be made on a timely basis to the RCS executive committee for final consideration. Company leaders visualize a three-to-five year time span for making the required changes, and they are optimistic about the process.

Summary

Based on our interviews with human resource professionals, a careful review of the literature, and our own employment and consulting experiences, three human resource issues stand out in high technology industry: (1) recruitment and staffing; (2) training and development; and (3) shaping and implementing organization conditions that support change and innovation.

High technology firms are driven by their knowledge workers. It is the knowledge workers who create the products and processes that change the industry; and as technologies change, high tech firms are challenged to continuously maintain, upgrade, and expand knowledge workers' skills. Currently, many human resource professionals in high tech companies anticipate an almost unlimited demand for computer scientists and electrical engineers through the 1980s; however, meeting the increased demand for greater numbers of engineers does not appear to be the central issues for these companies. When examined more closely, the demand appears to be for knowledge workers who consistently demonstrate their comprehension, application, analysis, synthesis, and evaluation of technological changes and/or new scientific discoveries in their daily professional tasks.

A variety of compensation and organization-based inducements to attract knowledge workers have been discussed. Various individualized and group-centered development strategies to prevent skill and knowledge obsolescence have been presented. Finally, several additional organizational conditions that support innovations have been presented, including adoption of egalitarian work place values, organizational reward for collaborative leadership, open communication, creation of risk-oriented environments, joint problem-solving approaches in task groups and project teams, and the value of implementing continuous process improvement methods.

Human resource professionals must build the same level of credibility that line managers and controllers enjoy within organizations by demonstrating the bottom-line advantages of effective management of their firms; human resources. To do this, human resource professionals must acquire knowledge and skills in the areas of business management, product or service improvement, group process, and the deliberate, planned, collaborative process of organizational change. As his or her participation in company planning grows, the human resource person must not expect a "red carpet" from line management; line managers and engineers may be reluctant to throw out work methods for which they have been rewarded in the past. Ultimately, however, line management must have confidence in the human resource professional's ability to frame the system or organizational context within which work is being performed. The role of the human resource professional in high technology organizations should be to facilitate the passage of the organization's human resources through the processes of continual change.

Notes

1. The organizations participating in this study were:

Accuray Corporation	Bank One Corporation
Actavision Corporation	Battelle Memorial Institute
American Electric Power	Compass Computers, Inc.
Anaconda Advanced Technology, Inc.	Digital Equipment Corporation
Anheuser Busch, Inc.	Dresser Industries
Ashland Oil, Inc.	Gelzer Systems Company
AU-Tech, Inc.	General Electric (Specialty Materials Department)
Hyatt Hotels Corporation	Ross Laboratories
NCR Corporation	Schuler Corporation
OCLC (Online Corporation Library Center, Inc.)	Transamerica Corporation
RCA, Astro Electronics	Transmet Corporation
Rockwell International	Westinghouse Corporation

2. Professor Miljus has conducted workshops on organization change and management development with such organizations as American Electric Power, IBM, Lear-Siegler, Rubbermaid, Transamerica, United Telephone, and Westinghouse. He especially acknowledges the contributions to this study of Dr. A. Lad Burgin, Director of Management Training, Transamerica Corporation, San Francisco.

3. Percentages were distributed as follows:

California, 20% (1.5 million jobs)	Michigan, 9%
Texas, 14%	Pennsylvania
New York, 12%	New Jersey, 7%
Ohio, 9%	Massachusetts, 6%
Illinois, 9%	Florida, 5%

4. Adaptive systems are also referred to as “high involvement work organizations” by Lawler (1982) and as “new commitment models” by Walton (1984).

5. Because the firm plans to work through its transformation with minimum fanfare and public attention, anonymity was requested.

Table 7-1
Organizational Conditions and Systems

<i>Organizational Conditions</i>	<i>Traditional Systems</i>	<i>Adaptive Systems</i>
Structure (shape and design)	Hierarchical/functional	Flatter; project-oriented; task group; matrix
Job and task design	Specialized; standardized	Enriched (do and think); empowerment
Individual skills and expectations	Limited job scope; repetitive	Cross-training; joint problem solving
Managerial skills and style	Directive; centralized	Participative; team building
Culture/climate	Rational; formal; “one best way”	Egalitarian; entrepreneurial; collegial
Support systems		
Recruitment and reward systems	Extrinsic rewards; job security	Merit; intrinsic rewards; professional recognition
Communications	Downward	Multidirectional
Training and development	Task specific	Career oriented
Conflict resolution	Conflict dysfunctional	Pluralism; conflicts negotiated