Human Resources Strategies for Lateral Integration in High Technology Settings

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Susan A. Mohrman
Allan M. Mohrman
Susan G. Cohen
University of Southern California

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Center for Effective Organizations - School of Business Administration
University of Southern California - Los Angeles, CA 90089-1421 (213)740-9814

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Introduction

The literature on high technology management points overwhelmingly to the importance of lateral integration processes for successful performance. This chapter reviews the factors that make lateral integration so important, briefly discusses various approaches to achieving such integration, and then concentrates on the key organizational design factors and the characteristics of the human resources management systems that foster lateral integration.

The Importance Of Lateral Integration

High technology organizations exist in highly complex and turbulent environments. Such environments have been found (Lawrence and Lorsch, 1967) to pose requirements both for enhanced differentiation and for greatly increased integrative mechanisms to ensure collaboration of subunits whose tasks must be integrated around the completion of the global task.

High technology firms must process considerable information to cope with uncertainty stemming from environmental turbulence and inherent in the nature of high technology tasks. Galbraith (1973) developed a framework for understanding organizational design based on the organization's information processing needs. In an organization where the work is complex and uncertain, the standard coordinative mechanisms--goal-setting, hierarchy and rules and programs--must be supplemented by other approaches. Two of these, the creation of self-contained teams and the use of lateral coordinating mechanisms, are lateral in nature. The third approach, the development of vertical information systems, bolsters the ability of the hierarchy to integrate by providing decision makers higher in the organization with more timely information. The fourth, the creation of organizational slack (performance slippage) happens by default when coordination is not fully achieved. These approaches to integration are not mutually exclusive; rather, a complex organization that cannot allow performance to slip has to rely heavily on lateral coordination mechanisms to supplement vertical integrative approaches.

The extreme performance pressures that confront high technology firms require lateral approaches to integration. The competitive environment in fields such as electronics, pharmaceuticals and biotechnology places demands on firms to keep up in rapidly developing technological arenas, achieve breakthroughs, and rapidly introduce new products that are of high quality and can be manufactured efficiently. Slack is no

longer an option: companies are required to compete on schedule, cost, quality, and technology development in order to survive.

A great deal of work has been done that points to the need for greatly increased lateral integration in order to address these performance pressures. Pressures for quality have led to widespread implementation of quality improvement frameworks (Deming, 1986a, 1986b; Juran, 1964, 1988; Juran and Gryna, 1980; Crosby, 1979). These approaches emphasize the need for breaking down both vertical and horizontal organizational boundaries that serve as barriers to the lateral, cross-functional collaboration necessary to improve organizational processes and enhance quality. They stress that quality is best defined as responsiveness to the requirements of both external and internal customers rather than to standards that emanate from the organizational hierarchy. This approach underscores the importance of close working relationships between design, manufacturing, and marketing as the organization struggles to remain in touch with and responsive to the external market, and as units orient their activities to meeting the needs of the internal customers who receive their work and with whom they are interdependent.

The quality improvement frameworks' emphasis on organizational processes that weave across different units of the organization and their orientation to customer force a lateral view of the organization and its integrative needs. These frameworks identify "continuous improvement" of organizational processes as the appropriate organizational goal. The systematic analysis of processes and introduction of changes to improve them is accomplished by the people actually carrying out the processes. This continuous improvement process itself introduces substantial information processing requirements into the technical core of the organization and increases the needs for lateral integration.

The performance pressure for speed manifests itself in demands for significantly more rapid new product development and time to market cycles, and for on-time delivery (Stalk, 1988). Most treatments of new product development mention cross functional teamwork as a key element in achieving fast cycle time (eg., Takeuchi and Nonaka, 1986; Bower and Hout, 1988; Souder, 1988), not only because of the need for parallel processing such as simultaneous engineering and for real time resolution of coordinative needs, but also because of the learning that is required by organizations in order to introduce new products quickly.

The pressures for speed also exist at the strategic level, where a quickly changing competitive environment requires highly effective teamwork at the top. Top executive teams must be capable of making rapid decisions using extensive real-time operational and environmental data. In the "high velocity" high tech environment, effective top executive teams use decision processes that enable key stakeholders to contribute to strategic decisions, but maintain the ability of the CEO to make timely decisions (Eisenhardt, 1989). Executive team members need to quickly define the implications of strategic decisions for their areas and begin implementing them. Thus, the lateral integration process begins at, and is modelled by, the top executive team.

Cost pressures require that organizations implement a number of "breakthrough" manufacturing techniques (Haas, 1987), many of which require interfunctional collaboration. The effective utilization of CAD/CAM, for example, promotes information processing across the various units involved in the-design-to production process, but also requires collaboration among these units in the development and implementation of the CAD/CAM system itself and its day-to-day utilization (Adler, 1990).

In addition to the market driven performance pressures being experienced by high technology firms, the technology of these firms requires extraordinary amounts of information processing in the technical core of the organization, and cries out for lateral integration (Mohrman et al., 1990). Technical organizations tend to involve numerous technical specialties whose work needs to be coordinated in service of an overall product. Rapid technological advances in the tools that these organizations utilize in doing their work, in the work processes they utilize, and in the products they produce, introduce a great deal of technical uncertainty that requires on-line problem solving. These very tools include powerful cybernetic, information processing mechanisms that make possible levels of real time lateral integration that permit parallel processing and interfunctional problem solving that were heretofore unthinkable. Network technology simultaneously improves both centralized control and decentralized lateral decision-making (Applegate, Cash and Mills, 1988). The development of computer software to support group and cooperative work is burgeoning (Johansen, 1988). This very capability has created its own demand, a fact which will no doubt change the nature of organizations irreversibly and move us toward a highly lateral image of organizational functioning.

Both technological complexity and relentless competitive environments place constant demands on high technology organizations for innovation, the solving of complex problems, and organizational learning. Literature on these processes stress that they are the product of teams. They involve novel combinations of perspectives and the application of various knowledge bases to issues, problems, and needs that cannot be effectively addressed within one existing frame of reference (eg., Kanter, 1983; Pinchot, 1984; Mohrman, Mohrman & Worley, 1989). Addressing today's performance challenges, for example, requires a simultaneous juggling and resolution of the logics that have dominated how organizations think about cost, schedule and quality, generally requiring collaboration between various functions that have historically been tasked with "ownership" of one of these concerns. As organizations find that simply becoming more efficient in their current processes is an insufficient response to the challenges that they face, they will increasingly need to learn new ways of operating--innovative breakthroughs that go beyond incremental improvements. Both the conceptualization of these breakthroughs and the implementation of change entail lateral integration.

Organizing For Lateral Integration

Lateral integration is required in a high technology organization, not only for effective performance of the core technical tasks, but also to successfully link the organization to its marketplace and to ensure that it can successfully adapt to a rapidly changing technological and commercial environment. Organizations that exist in such a fast paced environment cannot rely on relatively slow movement of decisions through hierarchical levels to determine appropriate operational responses to environmental and market changes, to resolve technical uncertainties, or to mediate disputes between units that must collaborate in order to produce a product. Even with the existence of sophisticated vertical information systems, the time it takes for an overloaded upper management to process the information and draw and communicate appropriate organizational implications is a bottleneck in organizational operations. The useful contribution of rules, standards, programs, goals and targets, although not unimportant, is diluted by rapid change that requires their continual reassessment.

Since slack is not a competitive option, high technology organizations must rely on a combination of the use of self-contained teams and sophisticated lateral integration techniques to extend their information processing capabilities (Galbraith, 1973). The former bound information processing by including all necessary functions in teams with well delineated tasks. Examples include product development, project and program, and customer service teams. The latter approach creates a network environment in which widely dispersed individuals and organizational units are connected by techniques including face-to-face (or technologically facilitated) interaction, the creation of special integrating roles, task forces and temporary teams, and the creation of structures such as matrix organizations that build in lateral coordination. Network environments are flexible and adaptable, permitting connections to be made or broken, strengthened or weakened, in response to change in business conditions and strategy (Savage, 1990). Network members must be able to cooperate across organizational boundaries as they apply their specialized expertise to cooperative tasks. Teamwork is an extremely important success factor in organizations that rely so heavily on lateral processes.

Extensive interviews that we have conducted in studies of high technology organizations (Mohrman, Mohrman & Worley, 1990) have shown that organizational members generally appreciate the importance of these lateral processes. Indeed, these organizations tend to utilize lateral integrating devices more frequently than their low technology counterparts. On the other hand, much frustration exists about how well lateral integration is actually achieved.

The lack of teamwork and cooperation has been cited as a competitive disadvantage in American firms (Birnbaum-More & Nadler, 1989; Dertouzas, Lester & Solow, 1989). For example, quality improvement proponents such as Deming (1980), innovation scholars such as Pinchot (1985), and students of time to market such as Bower and Hout (1985) have all advocated that organizations overcome the obstacles to

effective performance that are inherent in the rather strong boundaries between functions in American organizations. Even in high technology organizations, where there is an intuitive sense of the need for integration, there appear to be powerful factors in the way we organize that work against teamwork and integration and promote suboptimization.

Two design approaches that form the underpinnings for the traditional American way of organizing work against lateral integration. These are the proclivity toward analytical images of the organization and the emphasis on hierarchical control. Although it has been recognized that the nature of the environment and the work in high technology firms is not fully amenable to these approaches (Dornbush and Scott, 1977; Anderson and Kleingartner, 1987), as high technology firms have grown and become more complex, these organizing principles have come to predominate.

Organizations have typically been structured analytically, separating different expertises, specialties and ways of looking at the world into different units, which are further broken down into like groups to provide easily supervised units with a critical mass of people performing similar work, and into jobs, which specify the particular set of tasks an individual is responsible for. The process of taking complex technical problems and breaking down the work and assigning pieces of it to units and then to individuals, often called "work breakdown" is core to the organization of most technology firms. Primary emphasis is on breaking apart and making work manageable rather than on integrating diverse perspectives. The creation of specialized staff groups is one manifestation of the analytical model.

The emphasis on hierarchical control is embodied in the distinctions between the technical core of the organization which performs the work, the top management group which addresses strategic directions and sets targets, objectives and policy, and the often sizable group in the middle whose responsibility is to control the work of the technical core, and translate the strategic direction developed at the top into goals and processes for the technical core (Thompson, 1967).

Both the analytical organizing framework and the emphasis on hierarchical control work against lateral integration. The more work is packaged for highly differentiated units, the less easy it is to achieve integration and to bring to bear multiple perspectives in real-time on-line problem-solving and coordination. The more the control function is vested in a special hierarchical group, the less those performing the work will be able to make on-line adjustments and to take responsibility for the iterative coordination processes that are required to work out complex interdependencies.

The argument here is not that analytic breakdowns and hierarchical control are unnecessary. Rather, it is that such design approaches have been inadequately tempered and offset by systemic design mechanisms, resulting in dysfunctional segmentation of the organization (Dertouzos, Lester & Solow, 1989; Kanter, 1983; and Ackoff, 1981). Analytic and hierarchical organizational and human resource management approaches have been well developed both in literature and practice. Less attention has been

paid to organizational approaches to the synthesis of various parts of the organizational system and to building lateral processes by which people can control themselves.

Achieving the lateral integration necessary to address stringent performance requirements, effectively integrate a myriad of technical expertises, and solve complex problems that require the application of multiple frameworks requires ways of organizing that emphasize systemic approaches and that foster ongoing self-design by units throughout the organization that have to change their activities continually to adapt to strategic redirections and to marketplace and technological change (Mohrman and Cummings, 1989). The next section addresses some of the organizational design factors that contribute to the integrative and self-designing capabilities of organizations. The last section examines the human resources practices that are congruent with and promote integration and self design in organizations, and that support the necessary design features.

Key Design Features Required To Manage Laterally In Dynamic High Technology Environments

The design features described below are required to enable the integrative and self-designing capabilities of organizations. They foster a systemic approach and more reliance on self control and less on hierarchical intervention.

Proliferation of Teams and Teamwork

Team design approaches are a key structural embodiment of lateral integration of interdependent employees, and the need for them has been discussed in some detail earlier. What needs to be emphasized here is that teaming mechanisms take many forms. Some are permanent work units; others are temporary structures such as product development teams that reconfigure as projects end and others begin; still others, such as quality improvement teams, are temporary improvement structures whose function is to analyze and improve work processes. An increasingly prevalent phenomenon are hierarchies of teams, in which cross functional management teams provide a strategic umbrella and an efficient approval process for cross functional work teams whose members may have diverse functional reporting relationships. Finally, there are task focussed networks: constellations or matrices of people that may lace throughout the organization and beyond and which are linked together by having a contribution to make to a common task. Such networks are characterized by teamwork but they are not teams with known or well-defined boundaries.

Executive Team Leadership

Individuals and units within an organization have difficulty integrating their activities if there is not a clear strategic direction and well articulated goals and priorities that provide criteria for multi- functional

decision making (Eisenstat and Cohen, 1990). Because of the changing environment, organizations must be nimble--able to change strategic direction as needed, and to quickly commit the various parts of the organization to these new directions (Eisenhardt, 1989). This requires executive level teamwork. Executive decision-making defines the context for lower level cross-functional decisions. Top management makes strategic choices about what products to produce, technologies to develop, how to structure the organization, how to allocate resources, and how to approach the competition (Ancona, 1990). Without the capacity to integrate different functional perspectives and to resolve conflicts at a strategic level, sub-optimization will occur at lower levels. Collaboration and integration at the top provides an umbrella and model for such activities throughout the organization, and provides broad decision guidelines and criteria.

Unencumbered Decision Making: Flatter Organizations, Empowered Teams

Lateral mechanisms can effectively reduce uncertainty only if they are empowered to make decisions within the broad strategic direction, guidelines and priorities specified by the executive team. If the decisions that emerge from lateral interactions must travel through multiple levels of several functions for approval and/or to arrive at a tie breaker, then the need for vertical information processing has not been reduces. Thus, a flat organizational structure, with readily accessible tie breakers is a requisite to speedy response. Teams may have to report to teams in order for approval of team decisions by all necessary stakeholders to occur in a timely fashion. Wherever possible, all necessary resources and authority should reside within or close to the operational levels that are continually altering their course as they work out uncertainties, interdependencies and respond to change.

Less Compartmentalization

Traditional organizations have segmented parts of the organization that house different knowledge bases and perform different steps in the work flow. People who are housed in different functions are often highly interdependent, despite their organization segmentation. In organizations excellent at new product development and rapid cycle times, the organization is both flatter and less compartmentalized (Dertouzos et al, 1989). This has been achieved in some organizations by the creation of "super functions" (Galbraith, 1990) that house previously separate disciplines such as design engineering and manufacturing process development in a "New Product Development" function.

The segmentation of staff expertises such as human resources, planning, and quality break apart aspects of functioning from the core operations of the organization. Quality becomes the responsibility of people who are not performing the operations whose quality is in question. Human resource management becomes the responsibility of people who are not managing people. This violates the systemic quality of an organization and leads to rather absurd situations where "managers" feel responsibility for operations but not for managing the people who are performing them, or for productivity but not for the quality of the goods produced. It also leads to debilitating conflict between functions, each of which is suboptimizing

around its own limited set of criteria. Restoring the systemic nature of the organization's work not only requires better lateral relations between functions, but also requires the recombination of responsibilities that cannot be broken apart. The current trend to return quality responsibility to the operations people is one manifestation of such combination of staff and line tasks.

Organizing Around Processes

Organizational structures that group people doing similar work and "separate out" specialties from the operational core of the organization often cut across the natural processes of the organization for reasons of efficiency and administrative control. Quality improvement experts point out that this makes it difficult to integrate the various components of a complete process and introduces error into the process flow. For example, one of Deming's 14 points is to "break down barriers between departments" (Deming, 1986b). Process integration is essentially lateral integration, and requires that people and units involved in different aspects of a process collaborate in the improvement of that process. Collaboration not only enables waste and inefficiencies to be identified and eliminated, but helps to create synergy and increase motivation for continuous improvement.

Rich Information Environment

If operational units are to be able to cooperate laterally to effectively integrate work, make good decisions, and make adjustments in the way they function, they must be privy to relevant information. A rich information environment is required, including both global shared data bases and local data bases that provide data pertinent to particular processes, products and customers. Teamwork requires real-time, credible data (Gupta and Wilemon, 1988) that enable team members to transcend their own opinions in order to make criterion based decisions, and to learn together how to improve their operating results and adapt to changing circumstances. Faster and more effective decision-making occurs when more, not less, real-time information is used (Eisenhardt, 1989).

Rich Linkages to Customers, Suppliers and other Stakeholders

Key competition in the marketplace has led increasingly to the recognition that the health of the firm depends on meeting the requirements of customers, the ultimate recipients of the products or services produced. This same concept has been extended internally, where it has been recognized that failure to meet the requirements of internal customers--those who receive the products and services of other parts of the organization--causes costly delays, expense rework, and poor quality as well. In a complex network, such internal customers may not be easily conceptualized as the next person or unit in the process: rather, complex patterns of interdependence mean that there are stakeholders throughout the organization who are affected by decisions, products and services of any person or unit. Rich linkages, opportunities for mutual influence, and smoothly working interfaces are required for integration.

Computer mediated network technology permits links to be formed between interdependent contributors who are geographically dispersed. Electronic mail and videoconferencing capability enable networks to be rapidly formed as "virtual organizations" without having to invest in physical space or administrative support. These virtual organizations can be rapidly dissolved when work is completed (Savage, 1990). However, more effective collaboration will occur if the network builds upon the informal organization. People are more likely to collaborate with those they know, respect, and trust. Advice will be sought from those who are known to be influential, knowledgeable, and supportive. Personal relationships are the glue that solidify network links.

Ongoing Redesign

Organizational design has typically been hierarchically determined. Changes in design have been labelled "reorganizations" and are seen as discontinuities in the life of an organization. In a laterally integrated organization, interdependent people will be continually rearranging their tasks and the way they do business as they adapt to the task at hand and to changes in market and technology. In a rapidly changing environment, building in this flexibility is key to the adaptive capabilities of the organization (Mohrman and Cummings, 1989). Successful high tech firms have been found to be able to rapidly and frequently change their structure and to be able to communicate new structures effectively so that organizational members can quickly readjust their activities (Schoonhoven and Jelinek; 1990).

Flexibility requires authority to be distributed widely throughout the organization. Self-managing contributors become responsible for self-design by forging new links with other self-managing contributors, discontinuing other links, and making sure that appropriate problem-solving and information exchange occur. Those with expertise are not only empowered to make business decisions; they become responsible for designing the forums within which decisions are made.

Although organizations and the organizational literature recognize that increased lateral integration is needed and that the design factors listed above are desirable, our studies suggest that there are powerful forces working against managing organizations in this manner. One key issue is that careers of individuals are greatly influenced by human resource practices that do not support lateral integration and change. Often teamwork is perceived as antithetical to self-interest as shaped by the functional and hierarchical systems of the organization, and by the human resources systems that conform to their logic. The next section will enumerate the qualities of human resources practices that support a systemic, dynamic view of the organization.

What Human Resource Practices Are Required to Manage Laterally?

The wide reaching study of productivity and competitiveness of American industry by the MIT Commission on Industrial Productivity identified the need for the introduction of innovative human resources approaches as a key focus for productivity improvement. Also recommending various restructuring efforts and the introduction of technology innovation, they concluded that "...without changes in human-resource practices, the benefits of the other restructuring efforts will remain elusive"(Dertouzos et al, 1989, p. 126). The key importance of human resource practices also characterizes the quest by high technology organizations to establish structures, introduce technologies and improve processes of lateral integration.

Much press has been given to non-traditional human resource practices in start-up high technology firms. It has been our observation, however, that as these firms grow in size, the need to "rationalize" human resource practices emerges, and often the formal human resource systems of high technology firms begin to resemble those found in larger, more staid corporations. The danger in this comes from the fact that these traditional human resources systems were designed to meet the needs of organizations dominated by analytical and hierarchical logic and structures.

This section attempts to answer the question: What kind of human resources systems optimally fit the emerging designs that promote the lateral integration necessary to meet high technology performance demands? The human resources systems that we consider are typically designed and administered by the Human Resources function, but of course their execution depends on the behavior of the employee base at large.

One set of systems are the "performance management" practices--i.e., the various ways by which the performances of people, whether individuals or groups, are defined, planned, and reviewed, and the processes by which performance capabilities are developed and improved. Performance management systems include goal-setting, appraisal, and training and development. Another set of systems guide the movement of people through various roles in the organization. These include career progression, succession planning, placement, selection, and development experiences that prepare people for their next jobs. A third set, reward systems, address the mechanisms by which value of contribution is established and rewarded, and equity perceptions are developed. Finally, we discuss the human resources information system, including data bases and tools to facilitate the administration of the other H.R. systems.

In traditional organizations, designed analytically and bureaucratically, and embodying principles of hierarchical control, formal human resource systems are based on these same principles. Clear job descriptions and job evaluations based on market worth and position in the hierarchy form the basis for rewards and performance management practices in which the individual is the main focus. Performance

management cycles conform to the calendar year, and individual performance is assessed independently of the natural cycle of work or the performance of the interdependent network in which the performer is enmeshed. In fact, elaborate systems such as ranking procedures are often used to discriminate among performers who perform similar jobs. Responsibility for the execution of the performance management systems lies with the supervisor. Training and development activities are designed to provide particular skills and knowledge bases to perform specific jobs.

These practices are inadequate for the fast paced, highly interdependent world of high technology firms (Mohrman et al, 1990). They are not well suited for organizations dealing with the performance pressures described earlier that require organization designs that foster lateral integration, a more systemic view of performance, and self-designing capabilities.

Dimensions of Integration

In high technology settings achieving integration is extraordinarily difficult because the organization is at the same time highly differentiated (Lawrence and Lorsch, 1967) and highly interdependent. Thus, although the organization can and must be broken down into parts, the interdependence assures that it is not safe to assume that if the task of each part is done to specification then it will integrate into the whole smoothly. Essentially this means that all human resource practices at the level of the part, instead of being designed as if in a vacuum, must be done in the context of the whole.

Achieving synthesis, or integration, involves several dimensions. First, there are various systemic levels. At each level, the performing elements are nested in higher systemic levels. The sine quo non of managing synthetically (as opposed to analytically) is a notion of what the whole performance is toward which the parts are being managed. There are several levels of parts and wholes within an organization, from individual employees, through teams and larger organizational units (departments, product lines, programs, divisions), to the organization as a whole. Each level is a social entity made up of human resources. At each level it is possible to conceive of managing the human resources at that level of aggregation. In high technology settings the importance of synthesis mandates that it be done explicitly.

To acknowledge the systemic qualities of an organization, human resources must be managed at all levels: individuals, teams, larger units and organizations. Practices must be developed that take the management of human resources in units larger than the individual seriously and that place the management of each level in the context of higher systems levels in which it is embedded.

One complication in managing multiple systemic levels is that there often is not a strict hierarchy in the nesting of individuals, teams and the organization. Teams of people may overlap with one another, people may belong to more than one team, teams might even stretch beyond organizational boundaries but include only part of the organization. This complicates the human resource management task, but underscores the importance of the next dimension, the management of lateral interaction between elements in the system.

The management of interaction between elements in the system is in essence a lateral process. Human resource management in high technology must reflect the criticality of interactions of various performing elements (individuals, teams, departments) with a potentially very large lateral role set, including customers, suppliers, and other interdependent performers. Traditional assumptions that the knowledge, skills and responsibility for managing people lie primarily in the hierarchical reporting relationships are outmoded. Performance information lies in a lateral role set and human resource management practices must actively involve these other elements of the system. A possible complicating factor with this dimension is that lateral role sets cut across systemic levels and across hierarchical levels. An individual may deal with other individuals at the same or different hierarchical levels in the organization, with other teams, or with entire customer or supplier organizations. Teams may deal with other teams, with individuals, or with larger units.

The other dimension of integration is time. The dynamic external market environment and rapidly changing internal and external technological environments mandate ongoing learning and change. Human resource management practices must be flexible enough to respond to changing conditions; they must establish an expectation in people that change will occur.

Traditional human resources practices are not flexible. They are based on an analytic breakdown of the organization into jobs and responsibilities that may need to rapidly change, and on goals and objectives that may become irrelevant to a changed environment. Furthermore, the cycles of execution of the human resource practices generally reflect administratively convenient time-tables such as the calendar year. The time cycles for interdependent high technology tasks are frequently more rapid (or much longer, as in the case of complex programs). Human resources processes should be designed to occur as needed in order to be responsive to the rate of change and the natural work cycles of the work that is being performed.

Having identified these three important dimensions of integration, we will next examine their implications for various human resources management systems. In the following sections we treat the major leverage areas of performance management, career development and human resource planning, rewards and compensation, and human resource information systems (HRIS). We describe each in terms of how the practices fit the central design problems in high technology organizations: systemic vs. analytic practices, lateral vs. hierarchical practices, and dynamic vs. static practices.

Performance Management

Performance management is a set of human resource management activities that are aimed at directly affecting performance. There are three main components of performance management:

-defining and planning future performance,

-developing performance capabilities, and

-reviewing performance (Mohrman, Mohrman, and Worley, 1990).

These components to performance management can happen at any time, whether or not performance is simultaneously taking place, and in any sequence, but most often the components are thought of as taking place in the order just listed. Reward systems are an integral part of performance management, but because they also serve other functions, they will be discussed in their own section of the chapter.

The high technology organization of the future will have to manage performance at several systemic levels:

-the organization itself,

-teams and focussed networks within the organization, and

-the individual employee.

The key to successful performance management lies in how well the organization is able to integrate the processes that occur at these various levels.

Presently, most organizations focus their performance management efforts at the individual level and conduct them in a hierarchical manner. Individuals are assigned goals and objectives, individuals are trained and developed (organization development is the exception here), and the performances of individuals are reviewed and evaluated by their supervisors. There is an analytic assumption that managing the performance of individual employees will aggregate automatically to positive performance at the organization and team levels. There is not much evidence for this. Our research in high technology firms indicates that these individual performance management practices do not even significantly lead to individual performance (Mohrman, Mohrman, and Worley, 1989). They have at best no effect at the team level and sometimes even have negative effect when they work to pit interdependent team members against one another (Deming, 1986; Mohrman, Mohrman, and Worley, 1989).

Traditionally, performance management has been a hierarchical responsibility--i.e. supervisors have been responsible for managing the performance of their subordinates. Research evidence has shown that hierarchical performance management of the individual does not affect performance. In the high technology organizations we studied we found that when team members participated in self management of their team's performance, higher performance at both the team and the individual member level resulted. In other words, performance management at the team level set the stage for productive performance management at the individual level. Team self-management of performance affected at least three things that were related to better individual performance: the amount of teamwork, the development of necessary individual skills, and the understanding individuals had about how their roles fit into the bigger picture of the team's task and mission.

Other research that we are presently doing on high technology teams indicates that there is a similar need for the team's performance to be managed within a process of performance management at the organization level. When teams, such as new product development teams, focus solely on their own performance abstracted from organizational issues, they frequently find their efforts drowned out or counteracted by developments at the organizational level. Lack of performance management at the organizational level most often results in uncoordinated functional decisions that impair cross functional team performance. Changes in organizational direction and priorities that are not articulated with team performance management can overnight turn projects on the road to success into wastes of resources, or can result in crucial resources for one project being diverted to another without proper planning at the team level and without proper input from the team level.

Performance management at any lower level will not have an effect at that level or any level above it unless it is done within the context of performance management at the next higher level. The converse of this proposition is that when performance management is done in a participative way at a higher level it can have a positive effect at both that level and the next lower level providing that its own performance context

is clear. Successful high technology organizations will have to create performance management processes that operate at these multiple levels and integrate them.

The next stage of performance management is to develop the performance capabilities. Again, development of team capabilities sets up demands for organizational development and will set the stage for necessary individual development. Creation and maintenance of cross-functional teams involves development of the larger organization such as: organizational role arrangements, behavioral norms, application of distributed information technologies like CAD systems, and the like. These have implications for the capabilities that team members must have or develop. Several firms we have worked with have mentioned that these organization development tasks can't be done once and for all, but require revisiting as new teams with new needs are formed.

Just as importantly, cross-functional teams at the operational level work best when higher level cross-functional management teams create a laterally integrated context of support for the project teams. It is this organizational level structure that helps accomplish the organizational level performance planning mentioned above, and that makes contextual decisions such as the funding of capital expenditures required for development of distributed information technologies to support operational self-management. These higher level teams must also be developed as effective performance units.

Performance reviews also must occur at multiple nested levels of analysis. We have noticed that if a team looks at its own performance as a team and discusses it in a problem solving way, an unavoidable byproduct is increased awareness of the contributions of the team members. Therefore, team performance review contains individual reviews within it. Similarly, both team and individual performance reviews invariably uncover contributions to performance beyond control of the target performers that stem from the larger system to which the performer belongs. In a sense, performance reviews at lower levels always contain reviews of the performance of the whole system to which it belongs. An engineer's failure to meet a scheduled milestone might be due to the fact that the team had communication problems, for instance. These realizations that come from multilevel reviews are the kind that Deming (1986) sees as necessary starting points for continuous performance approval.

The high technology firm of the future will not only manage performance as nested systems but it will actively involve lateral role sets in the process. Most high technology work is done laterally. Traditional supervisors often have only a vague idea what the performances of employees are (Von Glinow, 1988). Individuals will link directly with those who are interdependent with their work. It is these people who have the necessary information for judging performance. For this reason lateral performance management practices will come to rely heavily on input from teammates, peers, customers, and suppliers. This argument applies to both team and individual levels of performance management. Teams will use customer needs and expectations as inputs to plan their performance and customer assessments to judge it.

The dynamic nature of the high technology organization puts demands on the performance management practices. Practices that rely on the assumption of stability will not work in these environments. We have found that fixed performance standards and goals have no effect on performance in high technology organizations (Mohrman, Mohrman, and Worley, 1989). People resist having their performance managed by them and see them often as irrelevant. Goals are effective in facilitating performance when employees have ownership over them and when they are seen as redefinable as changing circumstances warrant. When strategic direction of the organization changes it will be important for teams to manage their adjustment to those changes. These things imply that performance management in high technology will be an ongoing process, as needed, rather than occurring on a predetermined administrative cycle.

The high technology company must also use performance management practices that are driven by the natural performance cycles of the tasks that teams are doing. Various phased project reviews for new product development cycles provide a model for review processes that are timed by naturally occurring subcycles rather than according to a predetermined calendar cycle. Recent research on the performance cycles of project teams indicates that the halfway point of a project of fixed time duration is almost invariably a point of transition (Gersick, 1988) and that review of performance at that point will generally lead to helpful process changes. If ongoing performance management practices are in place that are multilevel and lateral in nature then these practices will allow transition points to occur in a productive way.

Movement of People

The movement of people through a succession of jobs or assignments is regulated by career ladders, succession planning, job posting, application, selection and placement systems and practices. Much of this has not been done in a very planful way in many organizations (Von Glinow, 1988). The models that exist have generally been hierarchical both in terms of the locus of control for job movement and in terms of the desired direction of movement for careers. The assumed interest of the organization has been to place the most qualified people in positions of greater responsibility and authority, which has generally meant higher in the organization and with more authority over the allocation of resources and decision making. Status and reward systems have conformed to the notion that higher is more valuable, and consequently most employees find it in their self-interest (even if not their personal interest) to pursue "linear" (upward) careers.

This hierarchically oriented paradigm has always had its dysfunctional consequences, particularly for technologically oriented employees, who quite literally may have to leave their professional interests in order to make a career for themselves, generally in the ranks of management. They may not be suited for nor interested in managerial responsibilities (Miller, 1986; Bailyn, 1982). The success of dual and even triple ladders has been mixed. The concept of choice is viable, but the implementation often falls short of

expectation because of failure to attach parity between the ladders either in pay or in recognition accorded to the importance of the positions (Raelin, 1987; Riggs, 1983).

As organizations become flatter, self-regulation becomes the norm, cross functional teams and networks manage processes that cut across the organization, and temporary structures become the norm rather than the exception, a new model for people movement and for matching people and assignments becomes even more imperative.

The new model must address the needs of all levels of the system. Ongoing opportunities for learning, growth and development, leading to increased intrinsic motivation as well as opportunities for growth in salary and status are the interests of the individual. Company interest is in optimal deployment of its core skills and competencies to tasks critical to the execution of strategy, for continuous improvement in its performance capabilities, and for employees to develop the necessary base of expertise to perform effectively in self-regulating lateral structures. The need of teams is for adequate resources, and for continuity of membership as they go through the various stages of a project so that the project does not suffer from the loss of the cumulative learning that contributes to its effectiveness. In addition, the trends toward parallel processing such as are inherent in simultaneous engineering and quality functional deployment models, push the organization in the direction of early and ongoing multi-functional dedication of resources. This need works against a purely commodity theory of technical hours whereby people with expensive skills are "carved up" and parcelled out without regard to team or project dynamics.

The high technology company of the future may be shaped quite differently, with fewer levels, and smaller numbers in higher management. Operational management will be pushed down to teams and mini-businesses, and top management will be composed of people with interests, propensities and expertise in strategic leadership. There will be a greater amount of upward influence on and participation in strategic decision making, so that the skills for executive leadership will be learned as individuals in various product-line, program or product oriented teams develop first hand knowledge of the "bigger picture" (Resnick-West and Von Glinow, 1990) and manage their own adaptation to organizational strategy.

Lateral movement will become a more predominant career image based on various job rotational schema and knowledge-acquisition oriented sequences of developmental assignments. Choice is key, offering paths able to accommodate differences in orientation toward breadth or depth (the organization will continue to need in-depth technical experts), and acknowledging that orientations can change at different stages in a person's career. At the operational levels of the organization, managerial functions may become one of many skill blocks, permitting employees to move back and forth between technical and managerial responsibilities without threat of losing status or salary. This enables many more employees to be able both to continue to contribute technically and to develop an in-depth understanding of the business and managerial imperatives and of the big picture.

The team level of analysis will be the locus for a great deal of career definition and for the intersection of individual and team requirements. As cross functional teams go through stages of a project, individuals are exposed to issues of many disciplines. Assignments within a team can be individually negotiated among team members to include interesting combinations of responsibilities and provide growth, development and motivation. Careers will increasingly be thought of as a succession of position descriptions that are tailored to the current needs of the individual and the organization/team. Individuals will, in a sense, become "contractors" to the organization, taking responsibility of developing the skills and expertise to contribute as needed, and being recognized, rewarded and given responsibility based on the extent to which they are able to demonstrate that value within the lateral network.

It is critical to this model that a placement and succession planning system be based on an information system that enables the organization to keep track of its skill pool and to assure deployment of critical skills to tasks of critical strategic impact. Likewise, the information system has to provide individuals with information concerning opportunities that will allow them to pursue their interests and to develop their skill base to ensure that they can continue to contribute. The team level in the organization is where execution occurs and it is where those two needs are fused. Teams will not only require the talent and expertise, but they will also provide the enforcement of performance norms and standards and will be the ultimate arbiters of an individual's value to the organization.

In the flatter organization, providing psychic rewards will be critical to the retention of key technical talent. Retention will depend on providing choice: multiple valued (recognized and rewarded) routes through the organization, operational autonomy at the team level, and the opportunity for access to strategic decision making and input to key decisions. In return, the individual will have to continually keep in mind his/her need to demonstrate value to the enterprise.

Reward Systems

As with other human resource practices the tradition in reward and compensation systems has strongly been to design these systems for individuals. Much of the reason lies in analytic approaches to organizing that lead to paying people based on the particular job they do. The problem is that this analytic logic works at odds with what high technology organizations demand. Job based pay locks the organization into job structures that may become obsolete due to rapid change (Lawler, 1990). If jobs earn differential pay then a status hierarchy of jobs exists that becomes an incentive to move up the jobs in the hierarchy. When there is no pay incentive to move laterally among jobs of approximately equal worth, or into jobs that have been "valued" lower, it often becomes a stigma to do so. Since management jobs have come to be paid more, the incentive is for technical people to move out of the technical realm and into the managerial. Dual ladders have been created to short circuit this tendency by creating a technical ladder of jobs parallel with the managerial one. But dual ladders do not address the need for lateral movement

among positions, rather they encourage individuals to stay in one discipline and get better and better (more and more specialized?) at doing it. If not combined with lateral "ladders", dual ladders of compensation reinforce the analytic and hierarchic approaches to rewards and compensation.

The high technology organization of the future will require a pay system that reinforces its needs for crossfunctional cooperation and understanding, and that reinforces the need for lateral cross-functional career paths. It must foster flexibility by encouraging employees to accept new roles, and must reinforce the need for individuals to develop new expertise as changes in organization and environment require. An approach with the potential to do these things is to base compensation on people's knowledge, skills and experience rather than on their job assignments (Lawler and Ledford, 1985; Lawler, 1990). Under this logic an individual acquiring more breadth of knowledge and skills would be seen as more valuable to the organization. For instance, an R&D engineer could assume a marketing role and as she added the knowledge and skills to perform in the marketing role to the engineering skills she already had then she would receive increased base pay to represent the increase in skill breadth. This kind of knowledge-based pay system has been used very successfully in team based environments in manufacturing settings (Lawler and Ledford, 1985) and in some professional settings (Ledford, 1990). Recently some organizations have begun to institutionalize the approach company-wide, including managers(Ledford, 1990).

While a pay for knowledge plan can reinforce individuals gaining cross-functional understanding, it does not necessarily focus people on the task at hand. To focus people on the task at hand requires a reward system that is contingent on the accomplishment of that task. These kinds of rewards generally are considered to be "performance based" (Lawler, 1990).

Performance based rewards can be applied to any level: individual, team, and organization. They can focus people on the task associated with the level at which they are applied. In programs like gain sharing and profit sharing, for example, the entire organization shares monetarily in the performance success of the organization. The formulas these programs use to measure performance and convert it into rewards are well specified definitions of what the organization's performance is to be. Gainsharing and profit sharing programs that pay out to all the employees are excellent examples of human resource practices that are aimed at entire organizations. They reinforce the processes used to synthesize the parts of an organization into a whole.

Something like gainsharing could be contemplated at levels below the entire organization, such as teams. In order to do so, however, the team members must be interdependent with one another and the team must be responsible for some measurable overall output to which basic performance numbers and monetary worth can be attached. High technology product development teams are potentially good examples, for instance. In defense or other contract oriented settings, the project members might share in the savings that result if the contract is delivered under cost or ahead of schedule. In commercial settings, project members might share in additional "profit" associated with a product by doing such things as getting

it to market earlier, using less development costs, accurately designing to customer desires, and designing for low cost manufacturing.

Team oriented special awards programs can be used to reward teams that have done notable work. These reward programs differ from target or formula driven incentive approaches in that they are used after the fact to acknowledge excellent performance. They appear to have positive results in high technology settings (Mohrman, Mohrman, and Worley, 1989).

The nature of gainsharing and profit sharing are to focus attention to the performance of the whole system, but at the present time and in the short term. There are other, complementary, organizational level reward systems that also offer a piece of the action to employees but that focus on the longer run. These include various employee ownership approaches such as stock option plans. These also have been shown to be highly compatible with high technology settings (Gomez-Mejia and Welbourne, 1990).

Organization level reward approaches, whether long or short term in focus, can successfully be used to foster organizational performance. But research shows that this only happens to the extent that the organization also contains an employee involvement culture and infrastructure that provide all employees with means to change the organization so that it can become more effective (Binder, 1990). In other words, organization level reward systems only work to improve performance if they provide employees with ways of changing the organization to improve performance. This is an extremely important point. Organization level reward systems, therefore, also reinforce continuous organizational development and change and the mechanisms to accomplish them. This is highly compatible with the required dynamic nature of high technology organizations.

Both team level and organization level rewards support the need for lateral organization in high technology settings. These reward systems highlight the superordinate goals that all the parts must share and therefore highlight the importance of the interdependent parts working together to achieve them. Conversely, performance based systems aimed at the parts (whether the parts are individuals or teams) can divert the focus of the parts away from the superordinate goals and onto those at their level. The trade-off is line of sight--the greater the level of aggregation that is rewarded, the less the component parts feel they can truly influence their outcomes. As we discussed in the section on performance management, individual performance must be defined in the context of group performance. This definition process helps the individual clarify the line of sight between individual performance and team outcomes.

It is risky to abandon individual reward and recognition altogether. Individual pay for performance practices are closely related to employee trust, satisfaction, and equity perceptions (Mohrman, Mohrman and Worley, 1989). In our strongly individualistic culture individual pay for performance may be necessary in organizations primarily to satisfy individually oriented perceptions of equity and of self-worth. Unfortunately, individual pay for performance systems are seldom seen as equitable because of the many factors in their administration that cause employees to perceive their merit pay as unfair (Lawler, 1990). In

addition, fixed pool merit pay approaches typically set up zero sum games in which those who succeed do so at the expense of their coworkers (Lawler, 1990; Deming, 1986). In high technology organizations that we have studied, individual pay for performance has shown no impact on group performance and in some cases it is negative. Individual pay for performance had no effect on individual performance either (Mohrman, Mohrman and Worley, 1990). The design and implementation of individual pay approaches must be done in such a way as to foster the linkages of the individual to the larger system. Current practices do not work.

The logic of pay equity needs to be altered and expanded beyond that of individual pay based on job defined performance. Both knowledge based pay systems and gainsharing are good alternatives. Knowledge based pay systems have been shown to be perceived as even more equitable than individual pay for performance systems (Ledford, 1991, in press). In addition, gainsharing has been shown to strengthen feelings of equity and satisfaction when used with knowledge based pay (Mohrman, Ledford, and Demming, 1987). As performance begins to be carefully managed at multiple levels, the logic of equity may begin to include the expectation that a total reward package should address the performance of the multiple levels in which an individual is embedded.

Because of the fast paced environment of high technology, and the speed at which organizations go through development stages and change their strategies, the best reward strategies allow ongoing changes in the design of rewards to reflect the current business direction of the organization (Schuster, 1984). The framework of the reward program must be flexible to accommodate diverse needs within the company, and must itself be tinkered with to ensure that the company has the reward tools it needs to reinforce its changing strategic and operating needs. If individuals are to feel rewarded by rather than victimized by such a dynamic approach to rewards, the development of the reward systems must be participative (Lawler, 1990), and occur in a context of rich, open information and understanding of the key performance values and business requirements (Schuster, 1984).

Human Resource Information Systems

Just as information technology is one of the forces driving the need and potential for lateral organizational forms, the development of integrated human resources information systems will be pivotal in supporting the human resources aspects of these organizations. The development of common corporate data bases and systems will enable the simultaneous management of human resources at all levels of aggregation. At the company level it will make possible a tracking and auditing of overall human resource capabilities--skills pools, experience pools, and demographics--as well as permit tracking and deployment of critical core competencies. Key executive placement and succession planning can be based on a solid foundation of longitudinal information rather than on limited data bases that describe the small pool that has emerged at relatively high organizational levels after years of opportunistic placement and selection based on

limited information on the part of the hiring manager and the employee. Common data pools will also allow the tracking and targeting of development opportunities.

Common data systems are equally powerful in distributing information to empowered units for use in selection, team composition and assembling the optimal mix of contributors from a skills and cost perspective. Opening up information about career opportunities to employees throughout the company enables more self direction and responsibility for careers.

Integrated human resources information systems allow the development and ease of administration of the kinds of multi-level pay and incentive packages that were discussed earlier and that result in a pay package tailored to the individual and based on a mixture of individual, project, and business performance. Likewise, performance feedback from a wide net of members of a person's role set can be collected and fedback for purposes of appraisal and performance planning and improvement.

Just as is true for other shared data systems, there will be many security and confidentiality issues that will have to be resolved. And yet the benefits of such a system in opening up information, supporting the ongoing, dynamic staffing needs of a dynamic series of performance units, and providing the simultaneous capability to individualize and at the same time to track and manage overall statistics and trends, will truly permit adaptive capability. The development of integrated and distributed human resource data systems is on the critical path to the establishment of the laterally integrated organization. Their use will be an underpinning of the emerging organizational forms.

The Challenge: Going Beyond Individualism and Control

Lateral integration challenges two of the fundamental values that characterize American organizations: individualism and hierarchical control. Individualism is a strong aspect of our society in general, and is instilled by a large number of societal factors, not the least of which are our educational institutions (Dertouzos et al, 1989). Technical training is no exception. The analytic work breakdown approach to organization is quite compatible with the problem-solving paradigms taught in educational institutions (Adler, 1990). Engineers may arrive at their first jobs with "lone ranger" images of their future work life. They certainly arrive with expectations for clear specifications and operational autonomy (Von Glinow, 1988). The resolution of the discrepancy between this societal tendency and the requirements of high technology organizations will be to find ways of managing that combine individualism and cooperation (Dertouzos et al, 1989), and that enable the management of human resources at multiple systemic levels.

Likewise, hierarchical control rather than self-control has been assumed as the underpinning of control in the essentially bureaucratic models of the organization. Entire organizational levels exist solely for this purpose--and have proliferated as organizations have tried to assure "manageable" spans of control. Although there is currently a societal awakening to the many costs of this form of control, the "controlling" interests of most corporations lie with those who have been taught their role is to control.

Like most large-scale change (Mohrman et al, 1989), the evolution to lateral, systemic approaches to management will be driven by environmental change--by the economic forces of the global competitive environment and by the potential that has been unleashed because of the advances in technology. Culture change it will be--but culture change it must be if our organizations are to be the leaders in the fast paced, high stakes arena of high technology.

Conclusion

This paper has addressed the need for increased reliance on lateral integration to address the extreme information processing needs of high technology organizations. Teams and networks will increasingly have to be managed. Whereas there is widespread recognition of the need for lateral integration, most organizations rely heavily on analytical and hierarchical organizing approaches. There is a need to develop organizational approaches that are more systemic in nature, and that build the ability to self design into the performing units of the organization. This will require a change in emphasis in human resource practices to acknowledge the different systemic levels of the organization (individuals, teams, networks and whole organizations), to rely more heavily on lateral management, and to assume change rather than permanence.

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