Performance Management in the Highly Interdependent World of High Technology

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PERFORMANCE MANAGEMENT IN THE HIGHLY INTERDEPENDENT WORLD OF HIGH TECHNOLOGY

ABSTRACT

A research study in aerospace corporation reveals that high technology settings work against traditional performance facilitators such as job specification and the setting of goals. Performance effectiveness is caused primarily by group level and lateral performance management processes. Traditional supervisory processes do not lead to, and somewhat detract from effectiveness. Traditional human resource management practices bolster only the traditional supervisory processes. Group level HRM practices are necessary for enhancing lateral and group oriented performance management processes.

INTRODUCTION

One of the key challenges facing companies in the highly competitive high technology is how to manage the performance of employees to attain the necessary levels of performance and to shape that performance so that it is aligned with organizational need. High technology firms offer special management challenges. They are constituted largely of highly trained technology professionals, who value autonomy and are strongly driven by their own career needs. The complexity of the technology demands complicated information processing and coordination between individuals of many technical specialties. High technology firms exist in a rapidly changing environment. This rapid pace of change brings with it extremely high performance demands, and underscores the inherent interdependence of high technoloyg work. These characteristics of high technology firms bring into question the suitability of traditional performance management techniques such as performance appraisal and merit pay that hinge on static job definitions, performance standards, periodic goal-setting, and the dyadic relationship between supervisor and employee.

This study examines performance management in a high technology aerospace firm that designs and makes sophisticated electronic systems, primarily for government. Specifically, it examines the effectiveness of various formal and informal performance management approaches, and it contrasts individual and team approaches. First, a framework for conceptualizing performance management is presented.

Performance Management

Performance management is the use of organizational processes and formal practices to align employee effort and performance with standards and types of performances needed for organizational success. The value expectancy model (Campbell, Dunnette, Lawler and Weick, 1970) offers a framework for understanding performance management as a motivational process. Simply stated, it posits that individuals will be motivated to expend effort to accomplish performances if they understand what performances are expected, have the knowledge and abilities to successfully achieve them, and believe that successful performance will lead to valued outcomes. Thus, performance management can be viewed as the practices and processes by which a firm clarifies expectations, ensures that employees have the adequate skills and information to accomplish them, and links valued outcomes to successful performances.

The job of supervision can be described using performance management terms. In order to manage the performance of subordinates, a supervisor must engage in processes to ensure that the task is well defined, understood by the subordinate, that the subordinate has adequate skills and knowledge to perform well, and that good performance is reinforced by outcomes valued by the subordinate (House and Mitchell, 1974). In fact, a great deal of the literature examining leadership has focussed on the relationship between supervisor performance management processes (eg., structuring, consideration, and administering performance contingent rewards and punishments) and performance effectiveness.

It can also be posited that performance management processes

must occur, but that persons other than the supervisor may perform them. Co-workers, customers, human resource professionals and even subordinates may engage in activities that help "manage" employee performance.

The role of the group in managing its own performance is particularly important to consider. In many organizations, the group is a performing unit. Variables that are believed to contribute to a group's effectiveness include the effort it exerts (its motivational level), its possession of necessary skills and abilities, and its utilization of appropriate performance strategies (Hackman and Morris, 1975). Various studies have found a relationship between group goals and standards, group cohesion, team building processes and the performance of the group (Buller and Bell, 1986; Keller, 1986; Berkowitz, 1954). Such studies lend credence to the notion that team processses are important in managing performance.

Formal human resource systems are practices that are implemented to help manage performance. These include: job definition and goal-setting practices to make sure that employees understand what is expected of them; performance appraisal and feedback systems to ensure that employees are aware of the quality of their performances; training and development systems to keep skills and abilities commensurate with needed performances; and reward and recognition systems to reinforce desired performances. These formal practices promote a uniform organizational approach to managing people and consequently are believed to contribute to equitable treatment of employees and to a legally defensible personnel system.

Formal practices are tools that help the supervisor manage performance. For instance, a well-defined objective setting and pay for performance system may enhance the impact of the day-to-day processes employed by the supervisor. Formal practices also shape the performance management behavior of supervisors by providing direction, guidelines and constraints.

Most formal performance management practices operate primarily at the individual level: that is, they are focussed on the management of individual performance and generally rely on the dyadic relationshiip between the supervisor and subordinate as the locus of the performance maangement process. The theory, models and practice of human resource management have been built on the foundation of scientific management, according to which tasks are grouped into individual jobs. These jobs are analyzed, described and evaluated, providing the basis for personnel practices such as selection, compensation and development (Mahoney and Deckop, 1986).

Lately, however, there has been an increase in group-oriented approaches such as productivity gainsharing and profit sharing plans that attempt at a level more comprehensive than the individual to tie valued financial oautcomes to accomplishments that contribute to organizational success (Lawler,1986). In project-oriented technology companies, program reviews are utilized at least partially to measure and provide feedback to program teams regarding their collective progress toward program goals. Recently, various kinds of improvement processes such as quality and productivity programs have focussed on groups and

teams as a vehicle for improving performance (Ledford, Lawler and Mohrman, 1988).

At the extreme, teams can manage their own performance almost completely, as in self-managing work teams that are often found in manufacturing plants that have been designed using a socio-technical systems approach (Cummings and Srivastva,1977; Pasmore et al,1982). For these teams to manage their own performance, the processes of self-management must be congruent with the formal practices that determine how work is appraised, rewarded and assigned (Mohrman et al, 1986).

The appropriate mix of individual and team oriented performance management practices depends at least in part on the technological context. Organizing work in teams, for example, makes sense when tasks are highly interdependent, requiring a great deal of exchange of information between people (Cummings, 1981). Rapid changes and high uncertainty require task flexibility, communication and ongoing working out of team performance strategies (Gladstein, 1984). In settings that have these characteristics, individually oriented formal practices such as individual incentives or merit pay may actually work against effective performance at the team level. Group effectiveness in working out task interdependencies depends on team members having outcome interdependence as well (Shea and Guzzo, 1987). In such settings, leader determined contingent rewards may actually be counterproductive (Podsakoff and Todor, 1985). Furthermore, performance management practices based on job descriptions and cumbersome job evaluation systems do not fit in contexts where requirements change rapidly (Lawler,1985).

The above discussion leads to the conclusion that the appropriateness of particular approaches to performance management depends on the context in which performance is being managed. Such issues as whether performance management should focus on teams or individuals, the relative importance of the supervisor as agent of performance management, and the relative importance of formal, structured processes or informal, flexible processes depend on contextual issues such as the technology and the rate of environmental change.

High technology settings pose special performance management challenges. This paper presents a study that begins to investigate what approaches to performance management contribute to effectiveness in such settings. The next section describes the contextual framework of the high technology firm, the nature of the work that is done, and makes some predictions about the relative effectiveness of various approaches to performance management in contributing to organizational performance.

High Technology Settings

High technology settings are characterized by four major factors that have implications for the way performance is managed. First, they are populated by highly educated and skilled employees who are performing tasks that develop and apply advanced technological knowledge. These employees expect and value autonomy, and collegial standards and control are seen as more legitimate than hierarchical control (Von Glinow, 1988).

Second, change occurs at a very rapid pace (Miljus and Smith,

1987; Eisenhardt and Bourgeois, in press). Part of that change is driven by the rapid unfolding of technology through time. The tasks that people do and the tools they use change quickly. In addition, the global competitive environment and short life-cycle of new products drive a shorter and shorter cycle from conception to delivery of product (Kleingartner and Anderson, 1987). Thus, performance standards change rapidly. Performance management techniques must provide flexibility in such contexts.

The third characteristic is related to the second. High technology firms must house continual invention and innovation. Shortening the new product development cycle can not be accomplished without invention. Competitive costs can not be achieved without continual improvement and process innovation. In short, people are continually being asked to do new things and to find a better way to do the same thing; therefore, jobs cannot be completely specified.

Finally, and perhaps most important, high technology organizations house tasks that are highly reciprocally interdependent. The design of the product has direct implications for manufacturing, testing and marketing. Process constraints limit design. In a world of limited capital, decisions to invest in new manufacturing technology to improve process may take money away from development of more sophisticated products. Hardware and software must match one another's capabilities. The interdependencies in high technology organizations cut across discipline lines. Furthermore, the rapid pace of change and pressure to reduce product development cycles demand effective mechanisms to work out these interdependencies quickly. Managers

and others spend a great deal of their time coordinating laterally in the organization. Results depend on the coordinated performance of teams of people.

In short, the technology of high technology organizations is complex and uncertain. It is therefore impossible to pre-program much of the work, which means that a great deal of information must be processed by the people doing the work and interdependencies must be worked out as they go (Galbraith, 1973). Tasks are non-routine and often require a great deal of search behavior (Perrow, 1967). Previous work has found that when there is high task uncertainty and interdependence, horizontal communication and group meetings are key to enabling the mutual adjustments required for the organization to function effectively (Van de Ven, Delbecq and Koenig, 1976). Non-programmed means of coordination such as general guidelines and ongoing mutual adjustment are more effective than programmed approaches such as rules, standard operating procedures and scheduled meetings (Argote, 1982).

We can predict that these issues have key implications for the kinds of processes and practices that are effective in managing performance in high technology settings. They must be suited to the management of professional employees in a rapidly changing environment. Teamwork is key to the successful performance of the highly interdependent tasks; consequently, performance management practices and processes must foster team performance.

The study reported below explores the effectiveness of various approaches to performance management in three operations of one high technology firm. The next section describes the setting for the study.

The Setting for the Study

The study was conducted in the growing avionics division of a large midwest corporation. The government is the primary customer for the division. The division consists of three operations, each of which designs and produces complex electronic systems that are components of larger avionic systems. Each operation consists of multiple programs or projects, in various stages of maturity; at least some of the projects in each operation are in early development and pushing the frontiers of the technology.

A preliminary set of interviews with 35 key managers and technical employees yielded the following picture of the organizational context. The environment of the organization is changing radically. More stringent government contracting and reporting procedures and performance demands are requiring the company to adjust to new ways of doing business and to perform much more efficiently. The competitive environment is becoming more difficult and requires a greatly shortened development to production cycle. Product, process and administrative technologies are all advancing at a rapid clip.

The company was searching for ways to improve its performance management practices. At the time of the study, it had a performance appraisal process that included the specification of individual objectives for the year, and resulted in a rating that placed each employee into one of five categories. For pay

purposes, the distribution of people in the pay range for each grade in each job family was controlled. The performance appraisal rating was the basis for the merit increase. All this was rationalized with a totem process that aligned all people in the same job family.

A number of additional reward systems supplemented this basic merit pay plan. A few of the managers in the division were on a corporate incentive plan that included individual, divisional and corporate performance measures. Several special award programs were in place that could be utilized to acknowledge special accomplishments of individuals or groups. At the group level, formal program reviews were held for assessing progress against plan. Some, but not all projects and workgroups had regular meetings to talk about their team performance.

This study was undertaken to learn more about how the various performance management practices in the division related to one another and to effectiveness.

The Framework

We defined performance management as processes and practices to align employee effort and performance with needed organizational standards and performance. Consequently, in this study we assess the effectiveness of these practices in terms of their relationship to various performance effectiveness measures. In so doing, we do not deny that performance management practices are also related to human outcomes such as intrinsic or extrinsic satisfaction. In fact, in terms of the value expectancy model that underlies our notion of performance management, these valued human

outcomes reinforce effort and performance. This study will not examine this linkage directly, although in future studies it will be desirable to do so.

The contributions to organizational effectiveness of three aspects of performance management are examined. Performance management practices include reward and appraisal practices that are established to ensure that valued outcomes result from performance. Performance management processes are the interpersonal processes that manage performance on a day-to-day basis. Performance facilitators include standards, job specifications and training tha enable people to know what is expected of them in their job and how to do it.

The model in Figure 1 shows how these three aspects of performance management relate to one another and to effectiveness. Formal performance management practices can have three kinds of impacts. First, they can foster the interpersonal processes that constitute day-to-day performance management. For example, performance appraisal programs can foster better manager-subordinate communication. Second, practices can establish performance facilitators: for instance, goal setting systems such as MBO can create goals and standards that provide behavioral targets. Third, formal practices might impact effectiveness directly. A merit pay program, for example, might lead to effective performance if people believe that their perofrmances will lead to a higher pay raise.

Performance management processes, such as giving feedback and structuring tasks, can impact performance directly. They also can establish other means to facilitate performance: for instance,

through their interactions, supervisors and work groups can help to train people, set performance standards, and define the jobs to be done. Finally, the performance facilitators can contribute directly to effectiveness. Standards and job specifications enable a person to know what to accomplish and how. Adequate training provides the skills and information to enable the performance.

Predictions

Because the data come from only one organization, we cannot test hypotheses about the comparison of high technology organization to lower tech settings. We can, however, predict the patterns that we expect to find in this organization given its context and the nature of the work that is done. Because of the rudimentary nature of the study of performance management approaches that focus on the team and utilize lateral processes, we feel that this exploratory approach is justified. Our predictions are described below.

Because of the dynamic nature of high technology settings and the relentless pressure to perform quickly, performance management techniques that rely on pre-specification of work and formal programmed practices will be inappropriate. We predict the following:

1. Effective performance is positively facilitated by how well jobs are specified, how much peformance standards are clarified, and how well people are trained: however, the high technology context makes the achievement of these facilitators difficult.

2. Performance management approaches that are part of the ongoing and everyday behavior and processes of the organization will be more strongly related to effectiveness than formal practices and systems that are done on a periodic basis.

Because of the extreme interdependence of the tasks and the need for cooperative effort to work out interdependencies quickly and in an ongoing manner, we predict:

3. Lateral performance management processes will be as strongly related to effectiveness as dyadic supervisor-subordinate processes.

4. Performance management appproaches that are designed to impact group performance will be more strongly related to effectiveness than those that are designed to impact individual performance.

The Measures

All variables were measured using a questionnaire administered to a 10% sample, randomly chosen, of the exempt personnel in the division. The response rate was 80% (N=346). Data are from managers, supervisors and exempt personnel from engineering and the several administrative functions of the division.

Five broad categories of variables were measured: context, performance facilitators, performance management practices, performance management processes, and effectiveness. Each variable is briefly described below, and its mean, standard deviation and coefficient alpha is presented. Each scale is an average of responses to several items on a five point Likert scale that ranged from "Strongly Disagree" to "Strongly Agree". Several of the scales come from the Michigan Assessment of Organizations (Seashore, Lawler, Mirvis and Cammann, 1983). Others were developed for the study and were pretested in this organization prior to administration to the large sample.

CONTEXT VARIABLES: Four scales measure attributes of the task that in our experience have been found to be common to the environment of high technology firms."Change from the outside" (3 items, X=3.57. s.d.=.70, alpha-.64) measures the extent to which a person's work keeps changing because of changes that are made in requirements of priorities. "Need to Innovate" (3 items, X=3.74, s.d.=.57, alpha=.57) concerns the extent to which work is non-programmed and the individual must try new approaches. "Feedback lag" (2 items, X=3.46,s.d.=.93,alpha=.78) measures the extent to which there are long delays before a person learns if work is successful. "Interdependence" (3 items, X=4.40, s.d.-.66, alpha=.80) measures whether a person's task completion requires extensive work, meetings and dealings with other people.

PERFORMANCE MANAGEMENT PROCESSES: Supervisory processes are measured by three scales from the Michigan Assessment of Organizations. "Feedback" (2 items, X-3.26, s.d.=-.81, alpha=.73) refers to the degree to which supervisors let individuals know how well they are performing. "Structuring" (2 items, X=3.19, s.d.-.81, alpha=.73) refers to the degree to which supervisors set goals and standards. "Productivity Orientation" (3 items, X=3.64, s.d.=.65, alpha=.81) measures the extent to which supervisors stress high performance. Workgroup processes were measured by three scales whose items mirrored those of the supervisory process scales but ask the extent to which the workgroup performs each of these processes:

"Workgroup feedback" (X=3.24, s.d.=.74, alpha=.61), "Workgroup Structuring" (X=3.23, s.d.=.72; alpha=.70), and "Workgroup Productivity Orientation" (X=3.62, s.d.=.61, alpha=.76).

PERFORMANCE MANAGEMENT PRACTICES: Four performance manaagement practices are measured. "Pay for Individual Performance" (3 items, X=3.19, s.d.=.84, alpha =.74) measures the extent to which pay is perceived to be based on performance. "Formal group appraisal" (2 items, X=3.20, s.d.=.91, alpha =.63) measures the extent to which workgroups, project teams and program teams are formally appraised at regular intervals. "Group self-assessment" (4 items, X=3.31, s.d.=.76, alpha=.81) measure whether groups discuss their performance among themselves and look for ways to improve it. "Special awards" (4 items, X=2.99, s.d.=.71, alpha=.71) measure the extent to which there is perceived to be a meaningful special awards program.

PERFORMANCE EFFECTIVENESS: Five survey scales tap subjective judgments of different aspects of performance effectiveness. "Personal Effectiveness" (2 items, X=3.96, s.d.=.45, alpha=.57) asks for global ratings of one's own effectiveness and the quality of one's work. "Workgroup Effectiveness (2 items, X=3.76, s.d.=.60, alpha=.65) and "Project Effectiveness" (1 item, X=3.53, s.d.=.83) ask for performance ratings of the respondent's workgroup and of the projects or programs on which the respondent works. Two other scales measure the extent to which the work of the workgroup, project and program are "On Schedule" (3 items, X=3.15, s.d.=.79, alpha=.72) and "On Cost" (3 items, X=2.76, s.d.=.81, alpha=.75). Thus, the three important indicators of effectiveness in a high technology setting--quality, cost, and schedule--are measured. These five scales emerged as separate factors. Their intercorrelations range from .26 to .48.

Results

Context and facilitator variables were correlated with one another to provide evidence relevant to the prediction that the performance facilitators are difficult to achieve in high technology contexts (Table 1). Both Job Specification and Performance Standards are negatively related to Feedback Lag and Change From the Outside, providing evidence that for jobs in these contextual conditions, the traditional keystones of performance management are difficult to achieve. Job Specification and Training Adequacy are negatively related to the Need to Innovate. Interdependence, on the other hand, does not work against the facilitators, indicating that jobs that require more interaction are not necessarily poorly defined.

The remainder of the predictions concern the relationship of practices, processes and facilitators to each other and to effectiveness. To examine these predictions a series of regressions were performed reflecting the causal paths illustrated in the framework pictured in Figure 1. First, processes were regressed onto the practices. Second, facilitators were regressed onto both the practices and processes. Finally, effectiveness variables were regressed onto facilitators, processes and practices.

Table 2 shows the regression of the performance management process variables onto the formal practice variables. A substantial amount of the variance of the process variables is accounted for by the practices (between 15 and 26%). Group Self-Assessment is strongly related to all six process variables. The Formal Appraisal of the Group relates less stongly but

significantly to both Workgroup and Supervisor Feedback and Structuring. The opportunity to receive Special Awards relates to Workgroup Feedback, Structuring and Productivity Orientation, and to Supervisory Feedback. By contrast, Pay for Individual Performance relates only to the supervisory processes.

Table 3 shows the regression of the performance facilitators onto both the processes and practices. 28% of the variance of Performance Standards is explained, with Work Group Structuring and Supervisory Structuring being most strongly related and Formal Group Appraisal weakly but significantly negatively related. 21% of Job Specification is explained by the regression equation, with Work Group Structuring being strongly related and Pay for Individual Performance less strongly but significantly related. The processes and practice variables explain only 7% of Training Adequacy. Only Work Group Structuring is significantly related. Thus, the processes explain far more of the variance in these facilitators than formal practices do.

In the final analysis, displayed in Table 4, the effectiveness measures are regressed on the practice, process and facilitator variables. A significant amount of the variance of all five effectiveness measures is explained, ranging from 48% of Work Group Effectiveness to 9% of cost. Performance management practices have almost no direct impact on effectiveness. Supporting the second prediction is the fact that the processes do have a direct relationship with effectiveness.

Workgroup processes are particularly strongly related. Workgroup Productivity Orientation is very strongly related to

Workgroup, Individual and Project Effectiveness. Workgroup structuring is positively related to Work Group Effectiveness, Schedule and Cost. Workgroup Feedback is related to Workgroup Effectiveness. Supervisory processes, on the other hand, explain very little of the variance. Where they do achieve significance, the relationship is negative. Supervisory Productivity Orientation has a negative relationship to Project Effectiveness, and Supervisory Structuring has a significant negative relationship to Cost. The relationship of Supervisory Feedback to the effectiveness variables is not statistically significant, but generally is in the negative direction. This pattern of results supports the third prediction that lateral processes will be important; in fact it is the relative lack of relationship of supervisory processes to effectiveness that doesn't match our prediction. Of the performance facilitators, Training Adequacy has a significant positive relationship to Personal Effectiveness and Schedule. Contrary to the first prediction, Job Specification and Performance Standards have no significant relationship.

The fourth prediction was that performance management practices designed to impact groups would be more strongly related to effectiveness than those aimed at individuals. Although the practice variables in general do not have a direct relationship to effectiveness, they do have an indirect route through the process variables. Group self-assessment has the strongest relationship to both supervisory and workgroup processes. Individual pay for performance is related only to supervisory processes, which have no relation to the effectiveness variables. Special awards, which are given to both individuals and groups in this organization and

formal group appraisal are related to various supervisory and workgroup processes. These patterns provide some evidence in support of the fourth prediction that group oriented practices will be more effective.

Discussion

We started with the premise that formal performance management practices are at least in part established to stimulate effective performance. They can do this directly or through the processes and facilitators that they set up in the organization. Because of the interdependence inherent in high technology settings, we predicted that practices that aim at group performance and processes that allow lateral influence will be particularly effective.

Our findings confirm these predictions. Although in general the performance management practices that existed in this organization have little direct impact on effectiveness, they explain a considerable portion of the variance of the performance management processes which do have a strong relationship to performance effectiveness. In particular, group self-assessment practices contribute significantly to both supervisory and workgroup processes of feedback, structuring and productivity emphasis. Apparently, sessions where the group gets together to examine its performance enable the supervisor and workgroup members to influence performance. The important contribution of the supervisor may actually be as a group member or leader rather than through the dyadic supervisor/subordinate relationship.

Formal group appraisal, another group focused performance management technique, also contributes to the feedback and structuring variables. Strikingly, pay for individual performance (merit pay) contributes strongly only to the supervisory processes. This is not surprising since, as enacted in this organization, merit pay is a dyadic process between supervisor and subordinate. The group has no input into the appraisal or the subsequent merit increase of group members. It should be pointed out, however, that this is not necessarily the case in all organizations that have merit pay.

The importance of lateral performance management becomes especially clear when we examine the comparative relationships of workgroup and supervisory processes to effectiveness. Workgroup processes contribute positively to all the effectiveness variables. In some cases, the relationships are strongly significant. Supervisory processes have little impact, and there are some significant negative relationships to effectiveness. Thus it appears that formal practices such as merit pay that emphasize the dyadic relationship and promote dyadic processes may even negatively impact effectiveness in this organization.

The strong relationship of workgroup productivity orientation to all the effectiveness variables underscores the key impact of group norms and standards and supports earlier studies with similar findings (e.g., Berkowitz, 1954). Workgroup feedback and structuring are also important in this setting. They contribute to various effectiveness measures. Workgroup structuring processes also help establish performance standards and specify jobs. These results suggest the importance of the workgroup

spending time determining its performance strategies (Hackman and Morris, 1975). Workgroup feedback is a contributor to training adequacy. A team's processes contribute to its own skill level as well. Based on earlier work, it is not surprising that workgroup processes are so powerful; what is more surprising is the lack of influence of supervisory processes. Structured dyadic processes may actually work against the flexible communication patterns and consideration of alternative performance strategies that are required in groups performing complex uncertain tasks (Tushman, 1977, Hackman, Brousseau and Weiss, 1976; Cummings, 1981). Although supervisory structuring is related to performance standards, these are not in turn related to effectiveness in this setting.

Because of the dynamic nature of the high technology context, we predicted and found that ongoing processes are more effective performance management techniques than formal practices. Yearly or other periodic cycles and events do not match the pace of high technology contexts or the uncertainty of the innovation laden high technology task. Performance management must be an ongoing process that allows for readjustment and irregular cycles. We found that formal practices only promote effectiveness to the extent that they set up ongoing processes of feedback and structuring and lead groups to emphasize productivity in the organization. Our prediction that performance standards and job specification would positively relate to effectiveness despite the difficulty in achieving them in such a dynamic setting was not upheld. Although performance standards and job specification are

positive contributors to effectiveness when practices and processes are not in the same equation, they drop out in the large equation. Previous research has indicated that if jobs are not defined congruently with the technology of the organization, role ambiguity and conflict may result (Shuler, 1977). Approaches to performance management that rely on specifying jobs and individual performance standards may be incongruent with the uncertain and dynamic technical requirements of high technology work. This may be particularly true if they are determined in a dyadic interaction, without input from the workgroup. Of the facilitators, only training adequacy remains as a significant contributor to effectiveness, reminding us that skills and knowledge are key performance facilitators in a high technology firm. Overall, this pattern emphasizes the central role of ongoing structuring and feedback by the workgroup.

This study supports the general concept that traditional performance management techniques that place heavy emphasis on job definitions, individual goals and the dyadic relationship between supervisor and subordinate are not sufficient, and may even be counterproductive in a high technology setting. Organizations may spend countless dollars and hours defining jobs that are going to change anyway, setting goals that quickly become obsolete, and hounding supervisors to measure and compare the contribution of various individuals. They may even establish performance systems that put interdependent individuals in conflict for personal outcomes. Approaches that utilize the group as the unit of analysis, set standards for it, encourage processes within it, and reward its performance may be far more effective. Standards and

task specification will then be determined by the group in relation to the task itself rather than by a static job description. Outcome interdependence is then congruent with the task interdependencies (Shea and Guzzo, 1987).

These findings raise interesting questions regarding the appropriate role of the supervisor in a high technology setting. At least in this organization, traditional supervisory performance management does not contribute to effectiveness. One rationale for this may be that it is being done poorly. It also may be because the inherent interdependence of the technology and consequently of the jobs demands that the prevailing influence direction in the organization be lateral. If this is the case, it would have profound implications for the appropriate hierarchical structure of high technology organizations and for the role of the supervisor.

We should not jump too quickly to a universal recommendation for the supervisory role in high technology settings, however. Previous studies (e.g., Allen, Lee and Tushman, 1980; Allen, Tushman and Lee, 1979) have indicated that the role must vary depending on whether the work that is being done is basic research, development work or providing technical services. Different kinds of R&D tasks demand different patterns of communication among group members, between groups in the firm, and with external groups such as suppliers, customers and other scientists and engineers. This has implications for the sharing or concentration of both intra- and inter-group communication and direction, and consequently for the supervisory role. Clearly

more empirical research is needed to more fully understand supervisory roles in high technology organizations.

In general, the use of group oriented practices is not as well understood or heavily studied as are traditional hierachical, dyadic practices that focus on the individual performer. In part this is because the logic of the bureaucratic organizational form has been closely tied to notions of chain of command, clear specification of jobs and the use of reward and appraisal for hierarchical control. In addition, an individual orientation characterizes Western society in general. Managers are frequently quite disturbed by the notion embedded in team oriented practices such as gainsharing or other forms of team incentives that weak team members may receive the same outcome as stronger members.

Although interdependence is central to the logic of high technology tasks, even high technology workers are generally steeped in an individualistic orientation. Engineers, for example, are trained in the analytic processes of breaking a complex problem into separate components which enables individuals to work separately on their own pieces of the puzzle. The ability to get things done through other people and to work in a team is often much less valued than individual creativity, specialized knowledge and autonomy (Adler, in press).

Seriously designing around the concept that groups are the main performing units in an organization would require changes in performance management, in the roles and structures of organizations, and in the attitudes of employees. Nevertheless, the task has begun. Gainsharing, team incentives, team-based

continual improvement processes and self-managing work teams are some of its manifestations. Young high technology firms have found a variety of ways to reward team performance by linking outcomes directly to organizational performance (Shuster, 1984; Gomez-Mejia and Welbourne, in press). More work is needed to flesh out a comprehensive model of team management.

Much more work is needed on the management of performance in dynamic, highly interdependent and uncertain settings. High technology organizations are prime examples of organizations with these characteristics, but other kinds of organizations increasingly have to deal with these same issues of change and uncertainty. As many of our smaller entrepreneurial high technology organizations grow larger and experience a push toward more bureaucratic, hierarchical modes of functioning, they would do well to consider alternatives that emphasize process and lateral relations. Otherwise they may find themselves locked into static systems that do not fit the nature of their work or their environment. Researchers and practitioners in the field of Human Resources must vigorously explore alternatives in order to help these organizations implement performance management practices that fit their technology and allow them to remain adaptive in their environment.

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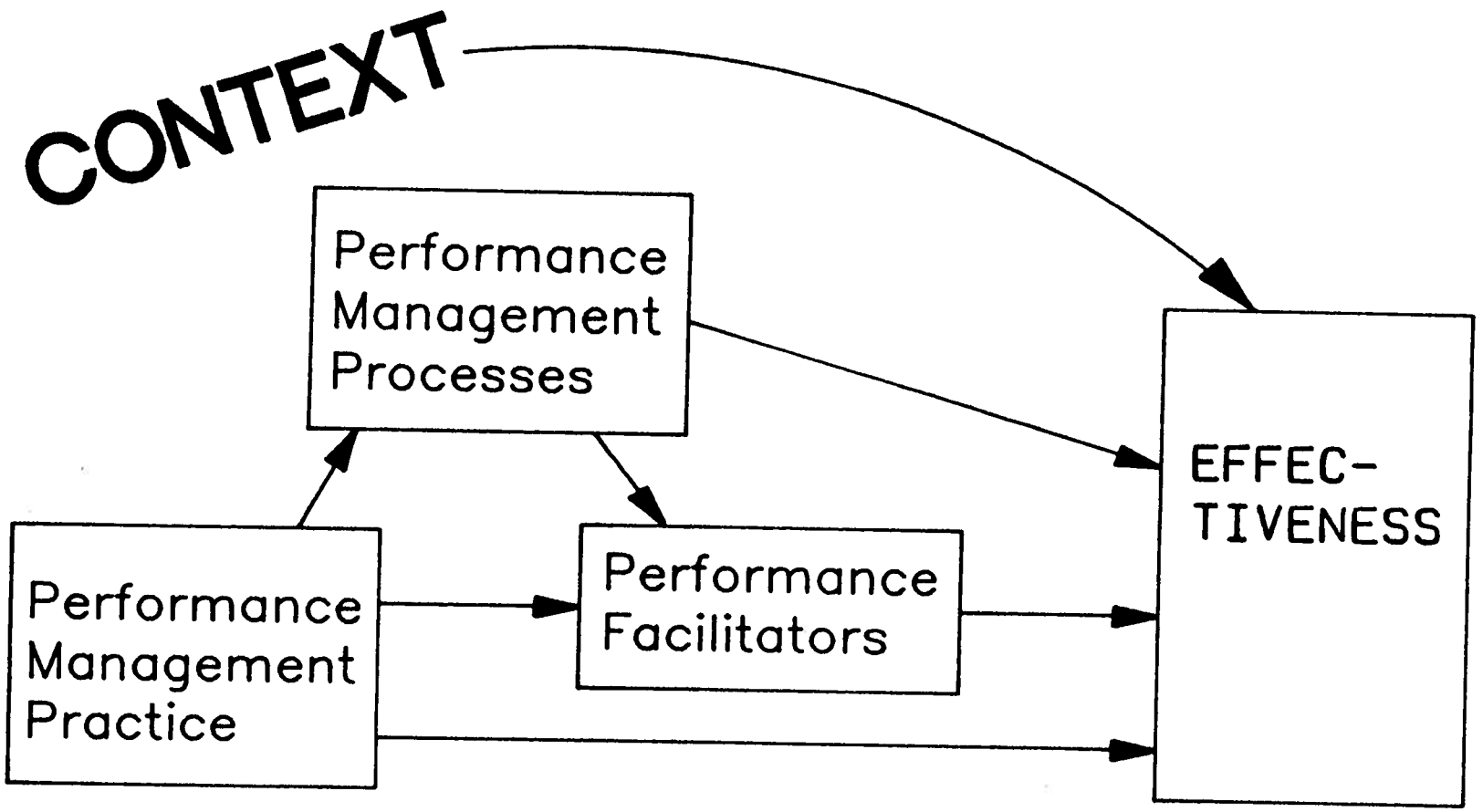

FIGURE 1

TABLE 1

ZERO ORDER
CORRELATIONS BETWEEN
PERFORMANCE FACILITATORS
AND
CONTEXT

	Training Adequacy	Job Specification	Performance Standards
Feedback Lag	-04	-13**	-19***
Change From Outside	-07	-25***	-23***
Need To Innovate	-14**	-18***	-05
Interdependence	12**	01	-07

N = 390

* p< .05
** p< .01
*** p< .001

TABLE 2

IMPACT OF PERFORMANCE MANAGEMENT PRACTICES
ON
PERFORMANCE MANAGEMENT PROCESSES

Formal Appraisal of Group	Group Self Assessment	Special Awards	Pay for Individual Performance	R^2	
14**	22***	19***	03	18***	Work Group Feedback
14**	21***	13*	26***	26***	Supervisory Feedback
11*	28***	15**	03	18***	Work Group Structuring
11*	28***	11*	20***	24***	Supervisory Structuring
03	28***	17**	-00	14***	Work Group Productivity Orientation
05	22***	09	18**	15***	Supervisory Productivity Orientation

* p< .05
** p< .01
*** p< .001

N = 346

TABLE 3

IMPACT OF PERFORMANCE MANAGEMENT PRACTICES AND PERFORMANCE MANAGEMENT PROCESSES ON PERFORMANCE FACILITATORS

	Performance Standards	Job Specs.	Training Adequacy
Work Group Feedback	.07	.09	.12
Supervisory Feedback	.02	-.06	.04
Work Group Structuring	.20**	.33***	.15*
Supervisory Structuring	.25***	.14	.12
Work Group Productivity Orientation	.11	.03	-.10
Supervisory Productivity Orientation	-.06	-.04	.01
Formal Appraisal of Group	-.11*	-.01	-.03
Group Self Assessment	.07	-.08	-.02
Special Awards	.05	.02	-.05
Pay for Individual Performance	.07	.11	-.02
R^2	.28***	.20***	.07**

;*p< .05 ;**p< .01 ;***p< .001

N = 346

TABLE 4

IMPACT OF PERFORMANCE MANAGEMENT PRACTICES AND PROCESS AND PERFORMANCE FACILITATORS ON EFFECTIVENESS

	WORK GRP. EFFECT.	PERSONAL EFFECT.	PROJECT EFFECT.	ON SCHED.	ON COST
Work Group Feedback	.21***	.07	.06	.10	.06
Supervisory Feedback	-.08	-.05	.04	-.12	-.03
Work Group Structuring	.12*	.08	.07	.19**	.15*
Supervisory Structuring	.03	-.01	.10	-.08	-.16*
Work Group Productivity Orientation	.48***	.33***	.38***	.11	.12
Supervisor Productivity Orientation	.04	.02	-.23***	-.02	.01
Formal Appraisal of Group	-.08	-.05	-.08	-.01	.06
Group Assessment	.03	.04	.11	-.02	.00
Special Awards	-.00	-.11*	-.01	-.01	.00
Pay for Individual Performance	.06	.06	-.03	-.02	.07
Performance Standards	-.09	-.05	.10	.07	.09
Training Adequacy	.01	.17***	.09	.11*	.01
Job Specs	.06	.03	-.00	.09	-.01
R^2	.47***	.21***	.27***	.15***	.09**

;*p< .05 ;**p< .01 ;***p< .001

N = 346