

CROSS FUNCTIONAL TEAMS: BLESSING OR CURSE  
FOR NEW PRODUCT DEVELOPMENT\*

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The popular literature is often prone to lambasting U.S. management practices as the culprit responsible for the trade deficit, the loss of technological leadership, and the lag in U.S. competitiveness. The cry has gone out to revamp our organizations; to move away from specialized jobs to broader work responsibilities; away from narrow functional perspectives to an enterprise-wide view; and away from rigid hierarchies to more fluid, flexible structures that can be more reactive to technological, market, and competitive change (Drucker, 1988; Kanter, 1989; Mintzberg, 1988).

In partial response to these demands organizations have set up cross-functional teams in areas such as new product and new process development (Ancona & Caldwell, 1990; Tyre, 1989). These teams are designed to react quickly and nimbly, from a broad perspective, and to do in parallel the tasks that used to be done sequentially. The payoff is presumed to be improved time to market, lower costs due to rework, and improved innovation and quality. In short, cross-functional teams are viewed as an important strategy for addressing productivity disadvantages U.S. firms are believed to have in moving quickly from concept to marketplace.

Yet, despite the prescriptions and increase in team activity, there is little empirical research that directly tests whether, in fact, the creation of functionally diverse teams improves new product development. The evidence that does exist comes from anecdotal case studies (Kidder, 1981) from settings outside the U.S., or from process rather than product teams (see Clark & Fujimoto, 1987; Kazanjian & Drazen, 1988; Tyre, 1989). In contrast to this optimistic scenario, theory exists suggesting that diversity may actually impede new product development.

Indeed, there are theoretical reasons to believe that simply changing the structure of teams (i.e. combining representatives from different functions) will not improve performance. While it is predicted that functional diversity will improve a team's ability to communicate and coordinate with external parts of the organization on which it is dependent (Ancona & Caldwell, 1989; Pfeffer, 1986), this same diversity can adversely affect internal group processes. Diversity has been shown to increase conflict, reduce cohesion, complicate internal

communications and hamper coordination within the team (Dougherty, 1987; Kiesler, 1978; Shaw, 1971; O'Reilly & Flatt, 1989; Wagner, Pfeffer, & O'Reilly, 1984). The conflict literature predicts intensified intragroup conflict when interdependence exists among parties with different goals, such as members from manufacturing, marketing, and engineering (Schmidt & Kochan, 1972). The small groups literature points to the difficulty of merging different cognitive styles, attitudes, and values (Bettenhausen & Murnighan, 1985; Shaw, 1971), such as those found on teams with diverse members. If not managed effectively these internal processes may slow decision making or result in compromise solutions rather than truly creative problem solving. Thus the question is whether diversity actually impedes or facilitates team performance.

This paper summarizes the results of a study of team diversity, process, and performance in 45 new product teams in five high-technology companies. This study is part of a broader, on-going research effort aimed at understanding team performance within new organization structures. The results show that the emerging consensus around the desirability of cross-functional teams may be too simple. Diversity appears to have contradictory, complex effects that sometimes facilitate, and sometimes hinder, innovation and success. In order to turn this diversity into an asset mechanisms need to be put in place to accentuate the positive, and overcome the negative effects of diversity. The final section of this paper, therefore, outlines a series of strategies for managing functionally diverse teams.

### A MODEL LINKING DIVERSITY TO PERFORMANCE

This study investigates the impact of a new product team's diversity on its performance. Diversity is predicted to affect the internal process of a group and the way its members communicate with outsiders. In addition, both internal and external processes can influence the performance of new product groups. Finally, group researchers have long noted that team diversity can have direct, as well as indirect (through group process) effects on group

performance. Figure 1 illustrates the various links from diversity to performance. The remainder of this section provides evidence to justify each link.

## DIVERSITY

In examining the relationship between team diversity and group process and performance, many researchers have used the research tradition of demography. This tradition suggests that the demographic characteristics of cohorts within a population can significantly influence a wide range of variables. When applied to organizational phenomena for example, the demographic composition of groups has been related to turnover among university faculty (McCain, O'Reilly, & Pfeffer, 1983), top managers (Wagner, Pfeffer, & O'Reilly, 1984); and nurses (Pfeffer & O'Reilly, 1987); to performance ratings of subordinates (Tsui & O'Reilly, 1989); to executive succession (Pfeffer & Moore, 1980); and to innovation in organizations (O'Reilly & Flatt, 1989). All of these studies suggest that it is the distribution of people within a group across variables such as age or tenure that influences behavior, rather than simpler descriptions of the same variables, e.g., the mean age of the group or the proportion of the group with a particular tenure.

Many studies of group demography have used both age and tenure measures; time of entry into the firm is thought to shape communication patterns and values while age shapes the pattern of cohorts that develop (Ryder, 1965; Wagner, Pfeffer, & O'Reilly, 1984). Because we are most interested in communication patterns and values, we shall look at tenure diversity in new product teams.

Although not part of the demography research tradition, the most important diversity variable for development teams may be functional mix. Teams may differ in terms of the proportion of individuals from each functional area. At one extreme, a team might be made up entirely of individuals from research and development. At the other extreme, one-third of a team's members might be from research and development, one-third from marketing, and one-

third from manufacturing. An entropy-based diversity index (Teachman, 1980) that captures this continuum from single function to equal proportions of members is used in this study (see Ancona & Caldwell, 1989 for more detail on measurement).

The use of cross-functional teams has been proposed as a method of speeding the product development process (cf..Calantone & Cooper, 1981; Cooper, 1979; Voss, 1985). These teams offer two potential advantages. First, the team has direct access to expertise and information that would not be available if all team members were from the same area. Second, since the team includes representatives from the manufacturing and marketing areas, product design and transfer will be facilitated. Despite these advantages, teams made up of individuals from different "thought worlds" may find it difficult to develop a shared purpose and an effective group process (Dougherty, 1988).

These two lines of research suggest that the design of the team as defined by the tenure and functional diversity of team members may be important variables for understanding both the group's processes and performance. This study examines both variables and their effects.

#### PROCESSES THAT MEDIATE THE DIVERSITY-PERFORMANCE RELATIONSHIP

Although numerous studies have examined the relationship between diversity and individual outcomes such as turnover, fewer have examined the processes through which diversity has its effect. Recent studies provide evidence that diversity influences both internal processes and external communication. O'Reilly, Caldwell, and Barnett (1989) demonstrate that within a sample of work teams, homogeneity of tenure on the job is positively related to the group's social integration. They further show that the aggregate social integration of the group is related to individual turnover. This suggests that at least one process by which diversity has an impact is through the development of cohesive groups. Although not part of the model they tested, O'Reilly et. al. speculate that tenure similarity facilitates social integration by increasing both the opportunities for interaction and the attractiveness of

members to one another. They propose that people with similar entrance dates may undergo similar experiences and develop a common perspective.

Although the demography literature most often specifies group cohesiveness or social integration as the mediating group process, for work teams the argument has been made that processes related to task accomplishment may be more important to performance than those reflecting affect within the team (Goodman, Ravlin, & Schminke, 1987). In this study rather than looking at the cohesiveness of the team, we examine the team's effectiveness in defining goals, developing workable plans, and prioritizing work. Diversity is predicted to influence performance through these intervening internal processes.

Zenger and Lawrence (1989) offer further evidence of the process by which diversity affects outcomes. Theirs is the only study that has investigated the effects of demographic composition on research and development teams. In that study, Zenger and Lawrence (1989) observed that age similarity was positively related to the frequency of communication among members of the teams. They observed a different pattern for communications with engineers outside the team. Here, similarity of tenure was more highly related to frequency of communication than was similarity of age. Thus, in addition to influencing internal processes, tenure diversity also influences communications between the team and outsiders.

Functional diversity brings together different "thought worlds" reflecting different orientations toward the product, the market, and work itself (Dougherty, 1987). While having representatives from different functions as team members is predicted to facilitate communication with non-team members from those functions, this structure may also create internal conflicts. Members of similar functions share a common language and orientation which makes communication easier (Kiesler, 1978). Yet the conflicts that inevitably exist between functions get brought into a cross-functional team and may interfere with defining goals and priorities. In sum, we predict that both tenure and functional diversity will have an impact on new product team performance through internal task processes and external communication.

## PREDICTING NEW PRODUCT TEAM PERFORMANCE

Thus far we have been rather vague in defining exactly what is meant by performance. In this study we include ratings of performance made by both team members and top division managers since many previous studies have shown little relationship between the two sets of ratings (Ancona, 1990; Gladstein, 1984). Team-member scores are an average of ratings made on eight dimensions of performance including efficiency, quality, technical innovation, adherence to budgets, adherence to schedule, coordination, work excellence, and ability to resolve conflicts. For top managers analysis showed an underlying pattern of two factors or dimensions by which performance was judged. One dimension is efficiency and quality of technical innovation while the other is adherence to budgets and schedules. Based on this analysis (see Ancona & Caldwell, 1989 for more detailed statistics) we are left with three measures of performance: team-rated performance, and two dimensions of managerial-rated performance.

Again, we predict that diversity influences internal process and external communication, and they, in turn, influence all aspects of performance. New product development teams are particularly dependent on communication patterns and processes both within the group and with outsiders (Allen, 1984; Katz, 1982; Tushman, 1977, 1979). These teams must obtain information and resources from other parts of the organization, interact internally to create a viable product, and transfer their work to other groups who will build and market the product (Ancona & Caldwell, 1987; Burgelman, 1983; Quinn & Mueller, 1963). Thus, in order to successfully complete a product team members must be able to communicate with outsiders and to be able to work with one another.

Yet diversity may not act solely through internal process and external communication. Group researchers have long noted that group composition, e.g., diversity, can have direct, as well as indirect (mediated by group process) effects on group performance (Gladstein, 1984;

Shaw, 1971). Just having the appropriate mix of skills, experience, or knowledge, may influence performance. Similarly, diversity may have its effect through some process that has not yet been identified, but manifests itself through a direct influence of diversity on performance.

This study thus investigates two things: the direct effect of group diversity on new product team performance, and the indirect effects of diversity attributable to group process and to external communication. Diversity consists of the variability of tenure among team members and the degree of representation of multiple functions, e.g. marketing, manufacturing, and engineering. Group process refers to the team's ability to define goals, develop working plans, and prioritizing work. External communication is the average amount of communication team members had with marketing, manufacturing, engineering, and product or division management over a two-week period. Performance consists of team-member overall ratings and division management ratings of innovation and achieving budget and schedule.

## COMPLEX RELATIONSHIPS

The link between diversity and performance may not be straight forward, since we have complicated its examination by considering two aspects of diversity - tenure homogeneity and functional diversity - and two mediating process variables - internal processes and external communications - across multiple performance indicators. For example, a high level of homogeneity within a group is likely to increase the cohesiveness and communication within the group (Festinger, 1954; Hoffman, 1985; Newcomb, 1961; Ward, LaGory & Sherman, 1985), but this same homogeneity may act to retard external communication (Ancona, 1987; Katz, 1982). If both internal and external communications are positively related to performance, then homogeneity may be simultaneously improving and dampening performance. Similarly, functional diversity may positively influence performance through its impact on external communication, but simultaneously have a negative direct impact. Finally,



variables that have a large impact on one aspect of performance. such as achieving budget and schedule, may have no impact on other performance measures, such as innovation. We examine these relationships while controlling for group size. The results provide greater insight into the complex impact of diversity.

## NEW PRODUCT TEAM CHARACTERISTICS

Before reporting on the study results we describe the new product teams that made up our sample. The study involved the leaders and members of 45 new product teams in five high-technology companies in the computer, analytic instrumentation, and photographic industries. All of the teams were actively working on the development of new products as opposed to basic research. Each was responsible for developing a prototype product and transferring it to the groups responsible for manufacturing and marketing. For example, one team was developing a product to automate the sampling process used in liquid chromatography, and another was developing a new publishing device that combined photographic and computer imaging processes. Thus, each team was actively engaged in technological innovation, yet responsible for ensuring the manufacturability and marketability of the new product.

Each organization was asked to provide access to a set of teams that had the following characteristics. First, all the teams had to be working on new product development (defined as a major extension to an existing product line or the start of a new product line). Second, to ensure some broad consistency in the complexity of the products, all teams had a development cycle of one and one-half to three years. Third, all the teams had to be located within a single division to assure comparable performance evaluations. Finally, organizations were asked to provide teams that ranged from high to low in performance; however, company executives did not reveal how teams were initially classified until all other data had been collected. Once the

sample of teams was identified, a list of teams members was obtained from company records and verified with team leaders. The average was approximately 10.

Of the 450 questionnaires distributed to team members and leaders, 409 were returned, yielding a response rate of approximately 89 percent. Response rates were approximately equal across companies. In the final sample the average age was 38.6; 88 percent were male; and 75 percent possessed at least a four-year college degree. Approximately 77 percent of the sample were engineering or research and development; the remaining 23 percent were primarily from manufacturing or marketing.

## DISCUSSION OF STUDY RESULTS

The increasing reliance on teams to develop new products raises a variety of questions. One important set of questions relates to how teams should be formed. For example, should they be formed completely of engineers, or should they include a range of specialists from other functional areas? Similarly do teams perform best when they are made up of people who have long tenure in the organization, or when they are made up of people who represent a wide range of experience? The results of path analysis applied to forty-five new product teams show that diversity influences performance both directly and through their effects on internal process and external communication. The results of the path analysis are summarized in Table 1 and the detailed statistical analysis from which the results are drawn are available in Ancona and Caldwell (1989).

### DIVERSITY-PROCESS-PERFORMANCE RELATIONSHIPS

Before discussing the relationships between group diversity and the other variables, the links between process and performance are worth noting. As in other studies of work groups, internal process is related to team ratings of performance (cf .. Gladstein, 1984). That is,

teams that rate themselves as having clear goals and priorities also rate themselves as innovative, efficient, good at adhering to budget and schedule, and as good overall performers. A number of explanations for this connection are possible. Members may be labeling their team as high performing if it exhibits the processes thought to be linked to performance (Calder, 1977; Gladstein, 1984). Alternatively, members who view their team as effective may attribute effective processes to it. This relationship between internal process and performance only holds for team-rated performance.

In contrast, top management ratings of achieving budget and schedule and innovation are related to the frequency of team members' external communications, although the overall model predicting budget and schedule was not significant. External communication may be of a technical nature, allowing the team to improve the quality of their product (Allen, 1984). Alternatively, they may be geared toward profile management, whereby team members try to influence key outsiders to promote and support their product (Ancona & Caldwell, 1988). Finally, it may be that teams that know they have the support of top management are more willing to communicate with outsiders than those without such support.

Although this study provides evidence that diversity influences performance through group processes, interestingly, each demographic variable seems to operate in a distinct way. The more heterogeneous the group in terms of tenure, the greater the clarity of the group's goals and priorities. In turn, this clarity is associated with high team ratings of overall performance. So although homogeneity of tenure is associated with greater cohesiveness in the group (Festinger, 1954; Hoffman, 1985) when it comes time to define goals and assess priorities, a group may do better with multiple experiences and perspectives that help it to define goals more in line with complex demands placed upon it. This is particularly likely with groups such as product development teams, which must operate in complex environments and respond to frequently conflicting demands.

In contrast to tenure diversity, greater functional diversity is associated with more external communication. The more external communication team members have with other

groups, the higher the managerial ratings of team innovation. When one brings representatives of different functions into the team one gets more contacts and greater ease of communication with members of those functional groups given their shared language, socialization, and worldview (Dougherty, 1987; Lawrence & Lorsch, 1969). In turn, this greater communication across internal organizational boundaries is associated with greater innovation.

Taken together, these findings show the complexity with which diversity can influence outcomes. Further, they suggest that in order to use the results of studies of diversity each situation must be diagnosed with respect to type of diversity--tenure or functional--the nature of a group's task--simple or complex--and the type of group process--cohesiveness, task work, or external communication.

#### DIRECT LINKS BETWEEN DIVERSITY AND PERFORMANCE

Although there is evidence of diversity's indirect effect on performance through group process, this study provides even stronger evidence of diversity's direct effect on performance. High levels of functional diversity were directly associated with lower levels of performance, particularly for management ratings of innovation and for team's ratings of their own performance. Diversity of tenure shows a similar, albeit less strong, negative relationship with performance. These results are consistent with those of O'Reilly and Flatt (1989), showing a direct relationship between homogeneity and an organizational measure of innovation.

What can account for this contradictory effect of diversity? On the one hand, it produces processes that facilitate performance, and on the other hand it directly impedes performance. One possibility is that diverse teams are able to develop goals and priorities, but not implement them because of the conflict different perspectives create. A second possibility is that diversity allows for high levels of external communication but also reduces the social integration to such a level that the group cannot effectively make use of the information and resources obtained from others. Third, the data from this study were all collected before the

product reached manufacturing. It may be that when diversity is introduced to a team activities that were once carried out later in the development cycle are now moved to an earlier point. Teams that are struggling with diverse inputs and greater activity may seem to management to be less innovative and behind on budget and schedule early in the development cycle, yet these teams may breeze through later stages more quickly. In addition these teams' products may better meet customer needs and have greater ease of manufacturability. Finally, diverse teams may have better processes and come up with better designs, yet because they have high visibility across much of the organization, they may be more prone to the political and goal conflict that often exists among functions. As such, diversity impedes performance by providing a forum for the rest of the organization to play out its conflicts. These conflicts impede innovation and cause numerous delays.

#### TURNING DIVERSITY INTO AN ADVANTAGE

The results of this study lead to two possible courses of action. Given that diversity has a larger negative, direct effect on performance than a positive, indirect effect through group process, we can go back to using single function, tenure-homogeneous product development teams. Or, we can try to implement in organizations those policies, procedures, and processes that will help to garner the positive effects of diversity rather than its detrimental ones. Here we advocate the second solution for several reasons.

First, given greater competition, consumers have come to demand the latest advances in new products coupled with high quality. These demands call for higher levels of coordination among marketing, engineering, and manufacturing than ever before. Theoretically a diverse new product team is the most efficient way to achieve such coordination. Second, organizations must find a way to do in parallel work that used to be done sequentially across functions and levels within the firm. Product development cycles must be cut dramatically in order to be first to market, and to benefit from the profits and market share gain of such a

position (Sasser & Wasserman, 1984). Finally, competitors from other nations, e.g. Japan and Germany, appear to have already harnessed the positive effects of cross-functional, tenure-heterogeneous, teams so the U.S. lags behind in this important area of human resources (Clark, 1988; Tyre, 1989; Westney, 1988). Training and facilitation, changes in managerial and evaluation practices, and changes in organizational norms are needed to exploit the potential of diverse new product teams.

## TRAINING AND FACILITATION

The results of this study suggest that clarifying goals and priorities, and communicating with external groups facilitate new product team performance while an inability to implement goals, high levels of conflict, and very low cohesion inhibit performance. Therefore, if diversity is to be well managed the team may require training in group dynamics. More specifically, key skills would be conflict management and negotiation skills that could be used both within the team and with outsiders. These skills allow for divergent views to be combined into joint decisions without ripping the team apart.

In addition to skill acquisition, rotation of employees across functions throughout their careers would allow people to acquire greater understanding and empathy for diverse perspectives. Exposure to those perspectives prior to a conflict situation permits a person to learn the language, time frame, and goals of other "thought worlds" so that there is more tolerance when conflict does appear.

Not only do team members need to learn new skills and perspectives, they also need to understand the complexity of team functioning. Training needs to include the teaching of models that let members analyze and understand team behavior. For example, members need to understand that both internal and external processes are needed for high performance. Yet, high levels of external communication increase conflict and may slow progress in the short term. If members can predict such phenomena they may be less frustrated with team progress.

Often, however, the team cannot manage without some help. Team members are selected primarily for technical, not interpersonal skills. Therefore, teams may need access to team facilitators who can translate among marketing, engineering and manufacturing representatives, arbitrate particularly difficult conflicts, provide observations of team problems, and teach team members those skills needed for current problems.

Thus, diverse teams need training in skills, perspectives, and models. To complement training facilitation helps the team through current problems. Yet the whole burden for improving product development should not fall on the team. Division and functional management and evaluation systems also contribute to team success or failure.

## MANAGEMENT AND EVALUATION

The results from this study suggest that there are many different evaluations of team success. Team-member ratings and managerial ratings do not correlate highly. Diverse teams that have difficulties and seem to be failing in the short-term may speed through later stages and be high-performing in the long-term. Finally, cross-functional team success may mean compromise and sub-optimal outcomes for specific functions. Management and evaluation practices are needed to reconcile these divergent views.

While team members see high performance resulting from smooth internal processes, management concentrates more on external communications and their impact on team output. Clearly both are necessary. Smooth internal team functioning without meeting organizational objectives is as costly as a team that meets objectives but results in all key members leaving due to their experience on the team. Just as team members must try to map and meet managerial expectations so management must recognize and reward teams that are able to set priorities and manage conflict. These rewards need to be in the form of monetary outlay and promotions. Similarly, rewards based on group, rather than individual, output need to be put in place to create a congruence between management's message and the reward structure.

Since diverse product teams may be tackling downstream design problems earlier in the process than was previously the case, the first stages of team development may appear to be slower and more disorganized. First, more research must be done to determine whether these teams catch up and overtake the old team form later in the process. If this is the case, management must police itself not to unfairly punish those teams whose early struggles have long-term payoffs. Other studies of team performance indicate that management often makes judgments early in a team's existence that label it as a success or failure (Ancona, 1990; Hackman, 1990). These judgments are then related to funding decisions, spread throughout the organization, and create self-fulfilling prophecies that insure the label is correct. Therefore, management needs to hold off on such judgments and to change some of the time frames used in formal evaluation procedures to conform to this new model of team development.

Finally, a solution that optimizes the team's performance may be sub-optimal for a particular function. If diverse new product team's are to work, then team performance must take precedence over functional interests. Unfortunately, salaries, performance evaluations, bonuses, and promotions are often determined by functional management rather than the product team leader. This situation promotes conflict within the team, and often results in sub-optimal decisions and products as team members strive to please functional management. Clearly we cannot set up a new structure of cross-functional teams and leave the old functional reward system in place.

## ORGANIZATIONAL NORMS

The context in which the new product team operates is also key to its success. Although not specifically reported in this paper, qualitative research from this study indicates that sometimes the whole organization must change in order for diverse teams to be a viable mechanism for product development. If a team operates in an organization where there is high conflict across functions at all levels, and where bureaucratic procedures specify transactions



across functions, then it is hard for the team to be different. This is one reason why some of the most successful new product stories come from teams that have been isolated from the rest of the organization away from interference and from the old ways of doing things. If new product teams are to be successful within the corporate context, then there must be a change in mindset. The iron curtain that often exists among functions needs to be lifted, and the adherence to existing procedures needs to change to allow for more creative, flexible means to create innovative products quickly. In short, teams are very hard to create, manage, and maintain. There are many reasons they might fail, so unless an organization is going to make a serious investment in supporting these teams, they should not be set up.

The promise of diversity exists, but our empirical evidence suggests that diverse teams are not now addressing productivity disadvantages U.S. firms are believed to have in moving quickly from concept to marketplace. Diversity does help teams to set goals and priorities, and it does help them to develop and maintain external communications. However, its liabilities overcome these assets. Only with changes in training, managerial and evaluation practices, and organization norms can these liabilities be overcome to improve the product team process.

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**FIGURE 1: A MODEL OF NEW PRODUCT TEAM PERFORMANCE**

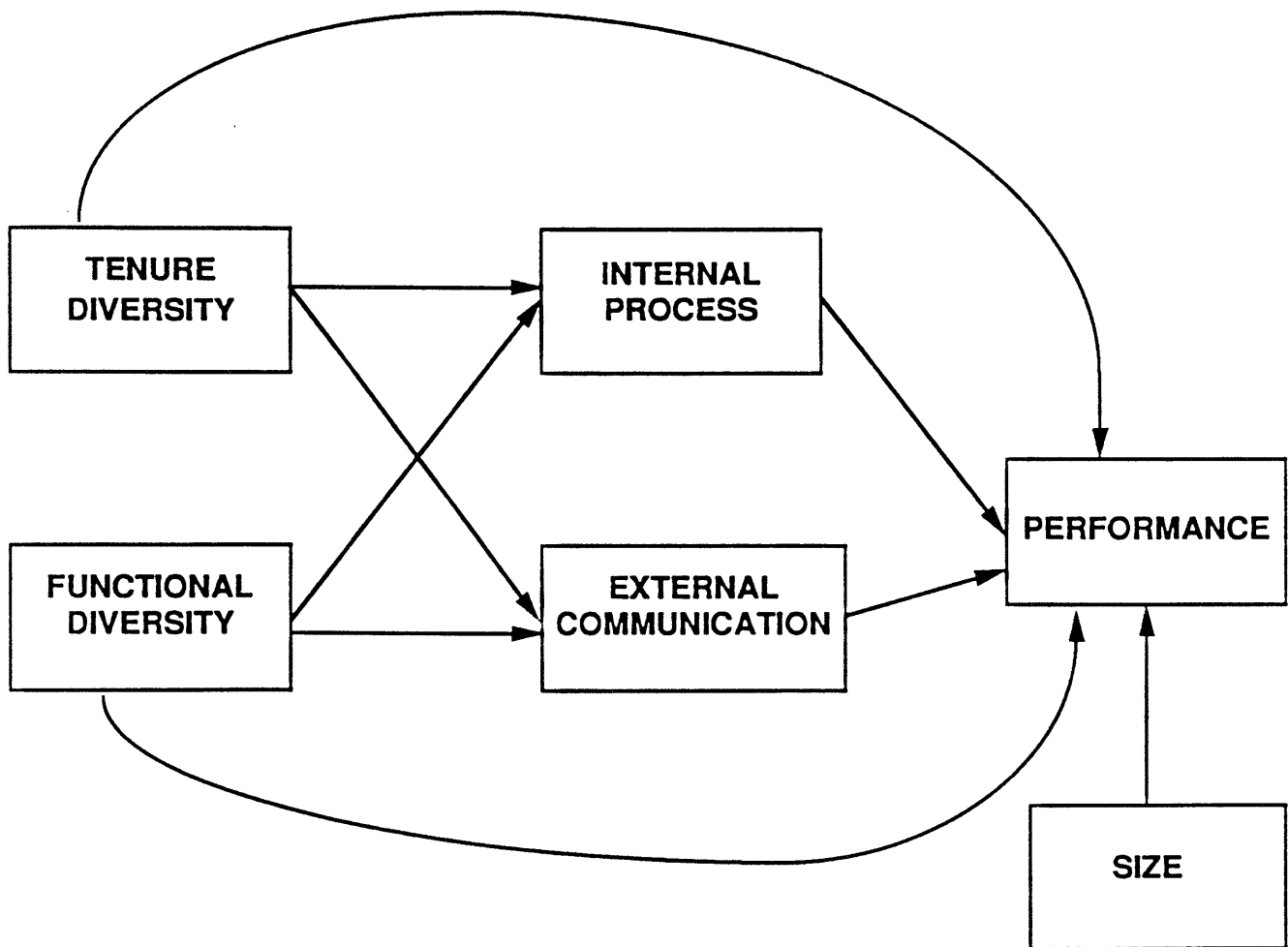


TABLE 1: RESULTS -- LINKAGES BETWEEN VARIABLES IN THE MODEL--DIRECTIONALITY AND SIGNIFICANCE

<u>VARIABLES</u>	<u>DIRECTION</u>	<u>SIGNIFICANCE</u>
Tenure Diversity--Internal Process	+	*
Tenure Diversity--External Communication	+	N.S.
Functional Diversity--Internal Process	+	N.S.
Functional Diversity--External Communication	+	**
Tenure Diversity--Innovation	-	N.S.
Functional Diversity--Innovation	-	**
Internal Process--Innovation	+	N.S.
External Communication--Innovation	+	*
Tenure Diversity--Team-Rated Performance	-	N.S.
Functional Diversity--Team-Rated Performance	-	*
Internal Process--Team-Rated Performance	+	**
External Communication--Team-Rated Performance	+	N.S.

\*  $\rho \leq .05$

\*\*  $\rho \leq .01$