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**A DELICATE BALANCE: THE ROLE OF MANAGEMENT COMMUNICATION IN NEW
PRODUCT DEVELOPMENT TEAM PERFORMANCE**

by

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**A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Psychology**

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ABSTRACT

This thesis used quantitative and qualitative methods to examine the role of Management Coordinator communication in the new product development process. The results contributed to our understanding of the importance of external communication in new product development teams. More specifically, the studies demonstrated that (1) a communication role in which team members communicate with managers for the purposes of gathering strategic and product related information should be added to existing schemes of external communication, (2) group process variables such as group cohesiveness and team member goals predict the amount and type of communication in which new product teams engage and, (3) engaging in communication with managers (especially for the purpose of strategy and context clarification) is associated with enhanced performance ratings, whereas limiting communication with people outside the team is associated with decreased performance ratings. Differences in the specific type of performance that were enhanced by Management Coordinator communication are also reported. Limitations of the present studies and directions for future research are also discussed.

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DEDICATION

To Craig.

My true companion. My kindred spirit. My partner. My love. We shall forever Moondance.

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INTRODUCTION

Over the last two decades, North America has seen a shift from a manufacturing to a knowledge-based economy. No longer can firms compete simply by building low-cost products; instead, the rapid introduction of innovations is the hallmark of success (Amabile, 1988; Pinto & Pinto, 1990). We see evidence of this change as research and development (R&D) efforts are being given more and more resources and playing a larger role in corporate profits (Ancona & Caldwell, 1987). As a result, influential voices are urging us to improve our innovative potential in order to survive in the global market (Peters & Waterman, 1982; Kanter 1983; Van de Ven, 1986).

From the outset, it is important to define what is meant by “innovation.” Although the two words are often used colloquially as synonyms, theorists are careful to differentiate innovation from creativity. Whereas creativity can be defined as the “production of novel and useful ideas by an individual or small group of individuals working together,” innovation is defined as “the successful implementation of creative ideas within an organization.” (Amabile, 1988, p. 126).

Organizing for innovation has never been easy. Traditional organizational structures used a serial product development process. Ideas were spawned in R&D, transferred to engineering and manufacturing for test production, then passed in “finished-form” to marketing and sales. Eventually, the inefficiencies of this system became clear: as an idea was passed down the line, problems were discovered that had not been obvious from other viewpoints. The necessity of several feedback loops for continuous fine-tuning lengthened greatly the time needed to get an idea from conception to product launch. As time-to-market

became an increasingly important factor in profitability, managers began searching for a more effective alternative to a serial development structure (Porter, 1985; Dingus & Justice, 1993).

The result of the search for greater efficiency was the advent of the self-directed new product development team. Although various definitions exist for new product development teams, in essence they are groups of individuals who co-operate to create, develop, and test market a new product, then prepare it for production (Ancona & Caldwell, 1987). Although team composition is quite varied across settings, teams most commonly comprise members from various organizational functions (e.g., engineering, marketing, manufacturing) in order to provide diverse skills and perspectives. Among the eleven strategic imperatives for the new product development process described by Schilling and Hill (1998) are the use of parallel design and the inclusion of a diverse range of functional specialties within the new product development team. Thus, the change to new product development teams aimed at increasing speed by taking a process that had traditionally been a serial one, and, by coupling organizational functions, making it run in parallel (Van de Ven, 1986, Rusinko, 1999).

Speed is not the only benefit attributed to new product development teams. Well-functioning teams are thought to entertain a wide variety of perspectives on a problem, to provide more information about alternative solutions, to make more reliable decisions, to show reduced impact of personal biases (Guzzo, 1986), to more readily accept a decision, and to be more satisfied with that decision (Jewell & Reitz, 1988). These potential benefits have led many organizations to alter their organizational structure to enable cross-functional, team development of new products.

With the growing number of companies using new product development teams, researchers have had increasing opportunities to evaluate the efficacy of teams' innovation efforts. Performance has been operationalized in several ways, but because of the difficulties associated with collecting objective measures of performance (see Hackman & Wageman, 1995 for a discussion), the majority of researchers have relied on subjective measures. Measures such as adherence to budgets¹, adherence to schedules, quality of the idea, creativity of the idea, and overall innovativeness of the team have been used (e.g., Damanpour, 1991; Ancona & Caldwell, 1992a; Scott & Bruce, 1994). Results of these studies have shown that factors such as functional diversity (Ancona & Caldwell, 1992a), team climate (Birmingham & West, 1995), champion support and leadership (Markham and Griffin, 1998); and external communication patterns (Tushman, 1977; Ancona & Caldwell, 1992a) are related to innovative performance.

The purpose of the present research is to examine the role of external communication in new product creation, development, and diffusion. It will do so by (1) extending current models of external communication by explicating a new type of communication (the Management Coordinator role), (2) exploring group process variables as potential antecedents to Management Coordinator communication and, (3) testing a model of how Management Coordinator communication and its antecedents affect team performance.

¹ Although these criteria could be objective (i.e., days past deadline, dollars over budget) instead, they have been measured using subjective ratings on Likert- scales (e.g., "How well is the team doing on adhering to budget.")

FACTORS RELATED TO TEAM PERFORMANCE

Communication

According to management theorists, frequent communication with people outside the team is critical for innovation success. Many have argued that teams who are able to manage their external relationships will be more innovative than those who neglect outside sources of information (Pfeffer, 1981). This external communication is thought to serve several purposes including securing resources, seeking task-related information, highlighting alternative courses of action, and garnering political support for the new product idea (Kanter, 1988; Ancona, 1990; Ancona & Caldwell, 1990).

Empirical support for the importance of external communication has been found in correlational studies of innovation efforts. In the Minnesota Innovation Survey, frequency of communication outside of the team was correlated with innovation effectiveness (Angle, 1989). Similarly, in a study of research scientists and engineers, Pelz and Andrews (1966) demonstrated that increased contact with people, not just outside of their team, but outside of their field, was related to greater creativity and productivity. In a complementary finding, Thamhain (1990) demonstrated that a lack of external communication was a barrier to innovation success. He recommended that management design work spaces and activities to facilitate communication with various groups. More recently, research has begun to examine the specific stakeholders with whom teams should be communicating. One of those studies showed that greater integration of R&D with the customer is related to innovation outcomes such as cycle time, technical effectiveness and commercialization effectiveness (Souder, Sherman, & Davies-Cooper, 1998).

(i) Communication Roles.

Frequency of contact is not the only important characteristic of external communication. Instead, researchers such as Tushman (1977) and Ancona and Caldwell (1990; 1992a; 1992b) have related communication outside of the team to the organizational boundary spanning concept (e.g., Allen, 1970) in which the direction and the purpose of communication are important. In their early typology of external communication, Ancona and Caldwell categorized team-member communications based on two factors: (1) whether the information is flowing into or out of the team and, (2) whether the communication is initiated within the team or outside of the team. Based on these two factors, Ancona and Caldwell (1987) described four different kinds of communication across the team boundary (see Table 1).

Table 1: Ancona and Caldwell's (1987) Typology of Boundary Roles in Teams

Direction of Information and Resource Flow		
Initiator of Transaction	In	Out
Team	Scout	Ambassador
External Agent	Sentry	Guard

Based on the two-by-two classification, there are four distinct communication roles. Two of these roles encourage communication, whereas the other two roles restrict information flow across the team boundary. One of the roles that encourages communication is the

“Scout.” When a team member engages in Scout activity, he or she is contacting people outside the team to gather information. One example would be when team members speak to potential customers to learn about desired product specifications. Another example would be two engineers discussing a new technology at a professional conference. The other role that promotes communication is that of **“Ambassador.”** In contrast to the Scout, Ambassador communication is characterized by people within the team sending messages about the team to outsiders. Often, the purpose of Ambassador communication is to promote the team’s activities or to seek out resources and allies outside the team.

As mentioned, the two other classifications are more aptly described as roles that restrict communication. A person taking on the **“Sentry”** role tries to minimize the amount of information coming into the team by filtering communications and allowing only relevant information to reach team members. An example of the Sentry role would be a person reading all the e-mails coming into a team and forwarding only the most relevant to other members of the team. The second role that aims to restrict communication is the **“Guard”** role, in which members try to prohibit information from getting out of the team. This is often the case when people outside the team are anxious to know details about a product design before the design is ready (before the **“bugs are worked out”**). A guard might set dates before which no one would be permitted to see detailed product specifications. In sum, Ancona and Caldwell’s scheme helps us to classify communications based on their direction and point of initiation.

Later work by Ancona and Caldwell (e.g., 1990, 1992a) included the creation of a questionnaire measure of external communication behaviours. Based on hours of interviews with new product developers and on log books kept by team members, the researchers

developed a list of 24 questions pertaining to a variety of communication behaviours. When reviewing the list of items (see Appendix A), it is clear that all four roles identified in their 1987 paper were represented in the questionnaire.

Unfortunately, after administering the questionnaire to a single sample of 409 product developers, the authors used the results of an exploratory factor analysis (EFA) as justification for creating new communication scales, which diverged from their earlier model. For some reason, Sentry activities (communication meant to restrict the amount of information coming into the team) loaded on the same factor as items designed to measure Ambassador activity (which is meant to encourage communication of messages to people outside the team). Based on their original typology, we would expect Ambassador and Sentry activity to be completely distinct. The authors, however, give no explanation for why these heterogeneous items would load on one factor. Furthermore, they continue to call the new amalgam of Ambassador and Sentry items “Ambassador” activity, downplaying the sudden inclusion of the Sentry behaviours. Other than Ambassador activity, their EFA supported the use of the Guard and Scout roles as defined in the earlier typology and suggested that an additional group of behaviours be added. They label the new role the “Task Coordinator” because behaviours loading on this factor describe interactions aimed at coordinating technical or design issues. In sum, later work by Ancona and Caldwell departed from their theoretical delineation of communication roles and suggested the use of a new four-role scheme including Ambassador, Task Coordinator, Guard, and Scout communication roles.

There are no empirical data available regarding the relations of the four initial communication roles to team performance. Thus, we are unable to examine the relations of

the original Sentry and Ambassador roles with performance. Instead, we are able to examine the relations of the new roles (including task Coordinator and the Sentry-Ambassador composite) with performance ratings.

In their study of external communication and performance, Ancona and Caldwell (1992a) asked managers to rate their teams, at two different stages in the development process, on five dimensions; efficiency; quality of technical innovations; adherence to schedules; adherence to budgets; and ability to resolve conflicts. Instead of relating communication to a consistent set of outcomes at the two times, based on EFA, different performance composites were created at Time 1 and Time 2. At Time 1, the performance criteria were divided into two composites including a composite of the items regarding adherence to budgets and adherence to schedules (called "Budgets and Schedules") and a composite of the remaining three items (called "Efficiency of Innovation"). At Time 2, the five items were split into a single item measure of quality of technical innovation (called "Innovation") and a composite of the other four items (called "Team Operations"). Results of multiple regression analyses in which frequency of communication, Ambassadorial activities, Task Coordinator activities, and Scout activities were regressed on the four dependent variables revealed differing patterns of relations at Time 1 and Time 2. At Time 1, Ambassador activity was positively related to performance on Budgets and Schedules, but not related to the Efficiency dependent variable. In contrast, Scouting activity was negatively related to both dependent variables. Task Coordinator activity was not related significantly to either measure of Time 1 performance. At Time 2, Ambassador activity was no longer related to performance. Instead, Task Coordinator activity was related positively to the single-item Innovation measure. Again, Scouting activity

was negatively related to performance. In sum, Scouting activity was the only communication role that was consistently related to performance, and its relation was negative. Early in the new product development process, teams were rated more positively when they engaged in more Ambassador activity whereas later in the process, teams engaging in Task Coordinator activity were rated more positively. Thus, external communication roles were related significantly to innovation performance but the direction and magnitude of these relations varied between roles .

(ii) A New Communication Role: The Management Coordinator.

Technical experts are not the only source of valuable information outside the team. Many authors have discussed the importance of keeping an open channel of communication with management (e.g., Thamhain, 1990; Ancona & Caldwell, 1990b; Kanter, 1988). Management can provide the team with years of experience in new product development and also with information about the broad organizational and market context into which the new product must fit.

There are two different reasons for which team members might seek out information from managers. First, it is possible that team members might ask for product-related information from managers, perhaps because managers have had experience with a wide variety of products and have worked through many product development dilemmas in their careers. This type of communication can be called product-related Management Coordinator communication. Alternatively, team members might seek out information regarding the organizational context in which they are working, a role that could be called strategy-related Management Coordinator communication.

The latter notion, that managers can provide valuable contextual information is discussed in the writings of several innovation theorists. These theorists suggest that communication with managers is not only about keeping the channels open; rather, they argue that the crucial purpose of communication with management is to ensure that members of the team are aware of and have internalized the goals of the organization. Among Angle's (1989) propositions for innovation success is one that states that success is positively related to management's ability to balance team members' commitment to the innovation and to the larger organization. Van de Ven (1986) makes a similar point arguing that there should be an institutional context that links new product development teams to an overarching organizational mission and strategy.

Although the importance of communicating management's perspective to the team is stressed by several theorists, it is not fleshed out in the external communication typologies developed by Ancona and Caldwell (1987; 1992a). The kind of communication with management stressed by theorists is the infusion of management's perspective into the team, which is an inward flow of information to the team. In Ancona and Caldwell's schema, there is a dimension of communication with management, but it refers to the degree to which the team members tell managers about their ideas (the Ambassador role: an outward flow of information). Furthermore, the dimensions that relate to bringing task-related information into the team refer specifically to communication with technical experts rather than with managers. Thus, Ancona and Caldwell's framework includes communication with managers and information flow both into and out of the team, but it neglects the inward flow of information from management (the Management Coordinator). Although the preceding work collectively

suggests that product development will be more effective if the managerial perspective is salient to team members, the empirical support for this notion is scant. Thus, the following hypothesis will be investigated in the present study.

Hypothesis 1: *Team performance will be higher under conditions of greater Management Coordinator activity, both in relation to strategic and technical product development matters.*

Group Cohesiveness: An Antecedent to External Communication

(i) Positive Effects of Cohesiveness on Performance

It is easy to imagine that members of groups who will be working together for long periods of time strive to create a positive and cohesive group environment. In fact, there are data to support the notion that members of product development teams believe they are doing well when they establish a highly cohesive group. More specifically, in Ancona & Caldwell's study (1992a), group cohesiveness was strongly associated with team members' ratings of the team's performance, $r = .89$, $p < .01$.

This desire to have a cohesive group certainly makes sense. Groups with a very low degree of cohesion are not usually pleasant settings in which to work (Michel & Hambrick, 1988). Some groups in this situation will choose not to convene, others will face increased conflict and hostility. Not only does member satisfaction suffer, but performance detriments are also obvious in groups with very low cohesiveness (Tamhain & Wilemon, 1988; Shaw, 1981). In a case study of educational-consulting groups, Ancona and Caldwell (1990b) described one group in which there was so little cohesiveness that meetings were often canceled and members ended up challenging the leader of the group for control. Members of this team reported that they could not get anything done because of the level of conflict. It is

clear that at least some degree of cohesiveness is important for success.

(ii) Negative Effects of Cohesiveness on Performance

Understanding the potential benefits of group cohesiveness, one might want to encourage teams to form very close working relationships. This seems logical with such advice as that provided by Thamhain & Wilemon (1987) who list barriers to innovativeness of which several are related to low cohesiveness (e.g., different interests and priorities, lack of team definition, etc.). Kidder (1981) notes that some organizations intentionally make teams feel like outsiders to heighten their commitment to the group. But there are dangers to this approach. As cohesiveness increases, self-directed teams can fall victim to deleterious group process effects such as groupthink (Janis, 1972; 1982).

Groupthink is a “mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members’ strivings for unanimity override their motivation to realistically appraise alternative courses of action...groupthink refers to a deterioration of mental efficiency, reality testing, and moral judgement that results from in-group pressures” (Janis, 1972, p. 9).

Although Janis’ groupthink notion was developed to help explain the political decision-making crises he called “policy fiascos” (e.g., the Bay of Pigs Invasion), many of its tenets apply equally well to new product teams. The relevance of groupthink to this setting has been described by several authors including Van de Ven (1986) who suggested that as the complexity of the decision increases, the means (i.e., group processes) become more important than the ends and irrationality sets in. In one of the few field studies examining the impact of groupthink on self-managed teams, Manz & Sims (1982) detailed several cases in which

transcriptions of team meetings revealed the low amount of disagreement and high consensus that are associated with groupthink. Further evidence comes from the case studies of educational consulting teams mentioned earlier. Teams with too much cohesion seemed to create a 'we' versus 'them' mentality and the negative stereotypes that are associated with groupthink (Ancona & Caldwell, 1990b). Thus, some evidence does suggest that new product development teams are susceptible to becoming in-groups that focus effort on maintaining pleasant group relations to the detriment of task demands and decision quality.

Hypothesis 2: *Low levels of group cohesiveness will be associated with poor performance.*

Hypothesis 3: *High levels of group cohesiveness will be associated with poor performance.*

Group Cohesiveness as an Antecedent to Communication

What effect does this group cohesion have on communication? In a study of 45 product development teams in the high technology sector, it was clear that group cohesiveness was quite strongly negatively related to frequency of external communication, $r = -.54$, $p < .01$, (Ancona & Caldwell, 1992b). Although this result is correlational, Ancona (1990) has cited other evidence suggesting that the causal relation is such that opening a team's boundary can have negative effects on internal process, and therefore, teams begin to reduce external communication in order to maintain effective group dynamics. It is also consistent with the groupthink theory to suggest that, because external communication can disrupt harmonious group relations, cohesive groups engage in relatively little external communication.

One of the educational consulting teams described in Ancona and Caldwell's (1990b) paper clearly illustrates this point. The team using what they call the "isolationist" approach had very high cohesiveness, high ratings of internal process, but showed the least external

activity of all the groups. Moreover, the people supervising the project rated this groups' performance as low. One quote helps to illustrate this point. The X team's members "were seen as happy and committed, and they satisfied many superintendents. But the commissioner reported that they had not done 'a damn thing'; they were just happy to be with each other and go to superintendent meetings" (Ancona & Caldwell, 1990b, p. 355).

Cohesiveness is associated with decreased external communication, but the research is even more specific. Past research has suggested that one form of external communication that is reduced in cohesive groups is communication with technical experts. Talking with technical experts is important because it helps bring in new ideas and helps provide novel perspectives on problems the team might encounter. This reduction in technical communication in cohesive groups was demonstrated in Ancona and Caldwell's (1992b) study of the 45 teams in which cohesiveness was negatively related to behaviors such as collecting technical information/ideas from individuals outside of the team (Ancona & Caldwell, 1992b). A similar reduction in technical communication was demonstrated in a study of 61 product development teams in which length of time the team had been together was positively related to cohesiveness and negatively related to communication with outside professionals (Katz, 1982).

As discussed above, Ancona and Caldwell's (1990a) measure of external communication does not include items pertaining to the Management Coordinator role, and therefore no evidence exists that cohesiveness decreases this type of communication. It is logical, however, to assume that communication with managers is as, or even more, likely to cause problems for group harmony as is communication with technical experts.

Hypothesis 4: *Group cohesiveness will be negatively related to external communication with management; the Management Coordinator role.*

The Sentry Role.

To this point, the argument has been made that cohesiveness decreases external communication because cohesive groups do not want information from outside sources. This argument is oversimplified because it ignores external communication roles that are intended to stop the flow of information. One such role is Ancona and Caldwell's (1987) Sentry. As described earlier, Sentry communication has the goal of stopping information from coming into the team. It is often used to prohibit managers from overwhelming the team when they are busy with design issues. If the logic holds that cohesive groups minimize external communication, then because the Sentry prohibits information from coming into the team, it should be positively related to cohesiveness². (See Figure 1a.)

Hypothesis 5: *Sentry Communication will be positively related to team performance.*

Testing a Model

Rather than testing the relation of each type of communication to the performance of new product development teams, the present model tests the predictive power of only two types of communication; the Management Coordinator and the Sentry roles. These two roles were chosen because of the emphasis in the innovation literature on the importance of contextual information to team success. The provision of contextual information is facilitated through communication with managers and is diminished through use of the Sentry role.

² The guard role, in which team members prohibit the outward flow of information from the team would follow the same logic. Increased group cohesiveness should be associated with increased guard activity.

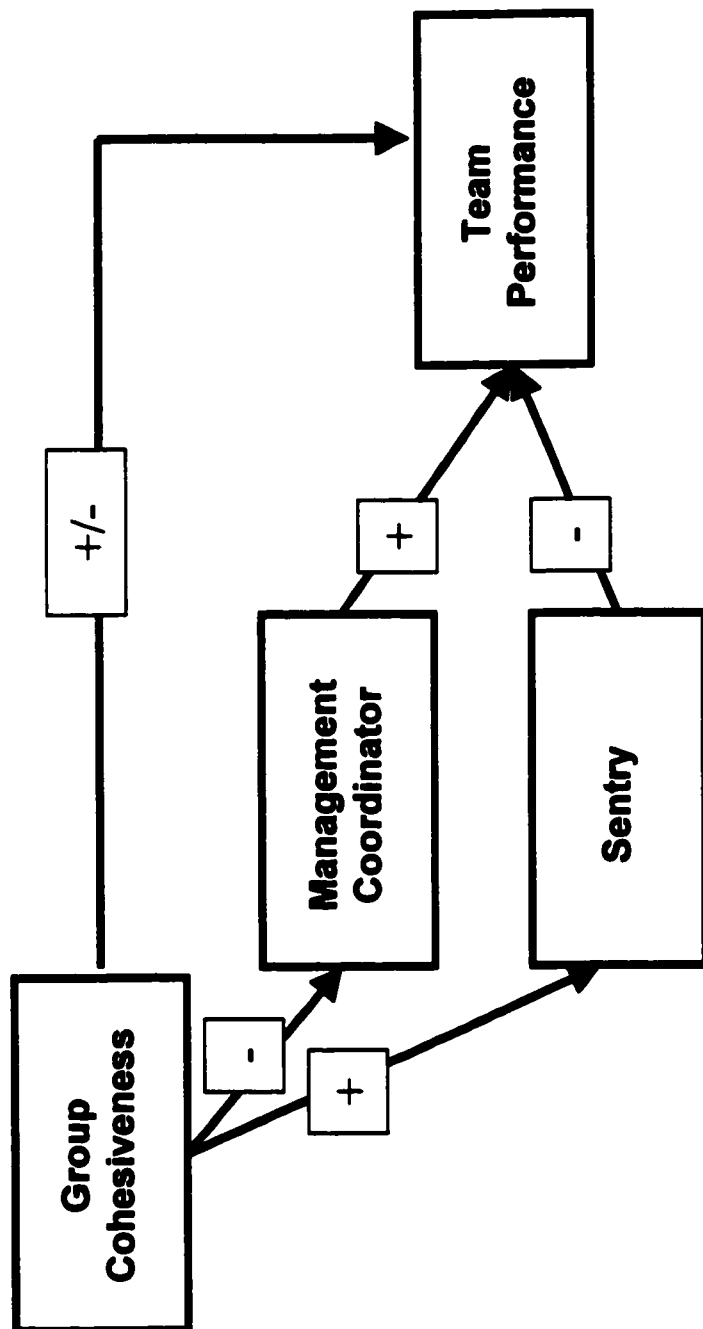


Figure 1a: Model Predicting Relations of Communication, Group Cohesiveness and Team Performance

The other four communication roles (Ambassador, Task Coordinator, Guard, and Technical Scout) will be included in the present study to allow a complete description of the communication in which teams engage.

Antecedents to Communication

(i) Team Members' Goals

The present research is focused on exploring a type of external communication that has not been tested previously: the Management Coordinator role. This study does not, however, stop at the hypothesis that increased communication with management will enhance performance ratings. Instead, the roles of several team and organization-level variables as antecedents to communication are examined. One of these variables is team-member goals.

It is hypothesized that there are two different sets of priorities that team members can embrace. First, there is the goal of forming a highly cohesive group in which members work harmoniously (called "Spirit Goal"). As described earlier, this goal of smooth group process can lead to excessive levels of group cohesiveness and perhaps even a situation of groupthink in which group process goals begin to supercede work goals. As cohesiveness increases and the team becomes an in-group, team members seek out less communication with managers and they begin to lose touch with the managerial perspective on strategy and organizational context.

Hypothesis 6: *Team members' goals of maintaining positive group relations will be positively related to their group cohesiveness, which in turn will relate to their use of external communication.*

The alternate scenario is one in which team members' goals are to do things that are good for the organization and that take the management perspective into account (called "Profit Goal"). Within this kind of team, increased communication with managers will help the team stay attuned to management's perspective by sensitizing them to the broader organizational context into which their product idea must fit. As team members communicate more with management and have a better idea of the broader organizational context in which they are working, managerial evaluations of the team will likely increase. In reality, these relations, like so many of those in the management of innovation, are certainly a delicate balance: too much emphasis on either group process or management priorities are likely to be detrimental to performance. (See Figure 1b.)

Hypothesis 7: *Team members' goals of making decisions that are beneficial for the organization will be positively related to their use of Management Coordinator communication and negatively related to their use of Sentry communication.*

(ii) Organizational Climate and Culture

The last category of variables in the proposed model is somewhat more distal to performance. As explained above, individuals' goals of maintaining a happy team or doing things that are good for the organization are expected to relate to the team's external communication and, indirectly, to their performance. But can we explain what factors influence individual goals? It seems reasonable that, at least to a certain extent, individual goals will be affected by the direct and indirect messages sent to team members from management and from the organization more generally. For example, some organizations might have a culture in which employees are encouraged to foster harmonious group relations

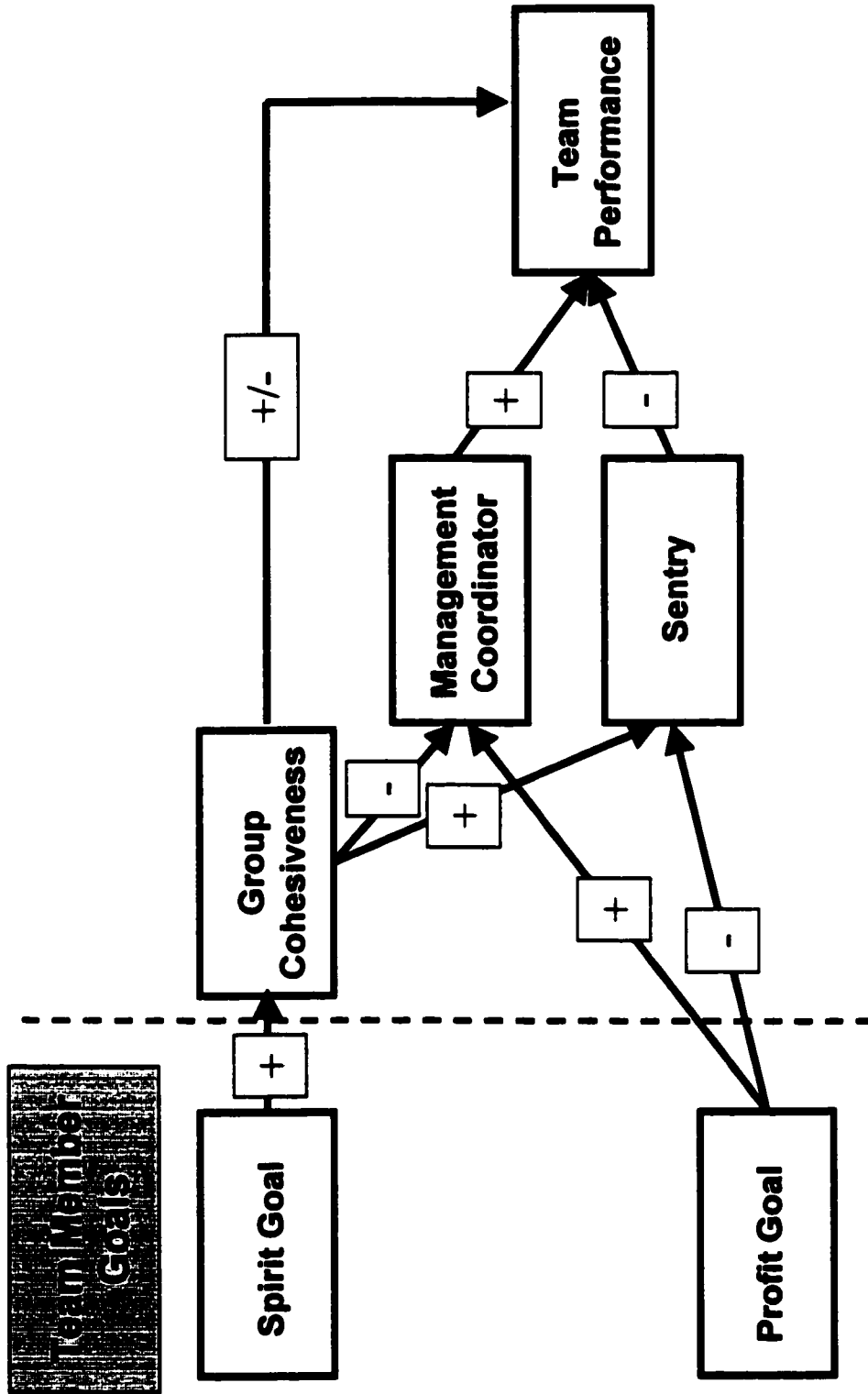


Figure 1b: Model Predicting Communication, its Team Member Goal Antecedents and Team Performance

(called “Spirit Culture”). It is also possible that managers make public directives that profit should be the primary goal of team members (called “Profit Culture”). Thus, direct and indirect messages from managers and the organization might be one factor that influences team members’ goals

Hypothesis 8: *Spirit Culture will be associated with team member goals of maintaining positive group relations.*

Hypothesis 9: *Profit Culture will be associated with team member goals of doing what is best for the organization.*

To summarize, the goal of the present study is to test a model of new product development team performance in which various factors are hypothesized to influence the use of external communication which will subsequently impact the performance of the team. A diagrammatic representation of the full model is presented in Figure 1c.

Past research has provided reasonably solid evidence of the negative relationship between cohesiveness and external communication and the positive association between external communication and managerial ratings of performance. The proposed study, however, extends the literature in three ways, (1) by expanding the conceptualization of external communication to include the Management Coordinator role, (2) by exploring the role of group process variables as antecedents to communication with management, and (3), by testing a model of how Management Coordinator communication and its antecedents affect performance.

MEASUREMENT OF PERFORMANCE

Past studies of new product development teams, and of innovation more generally,

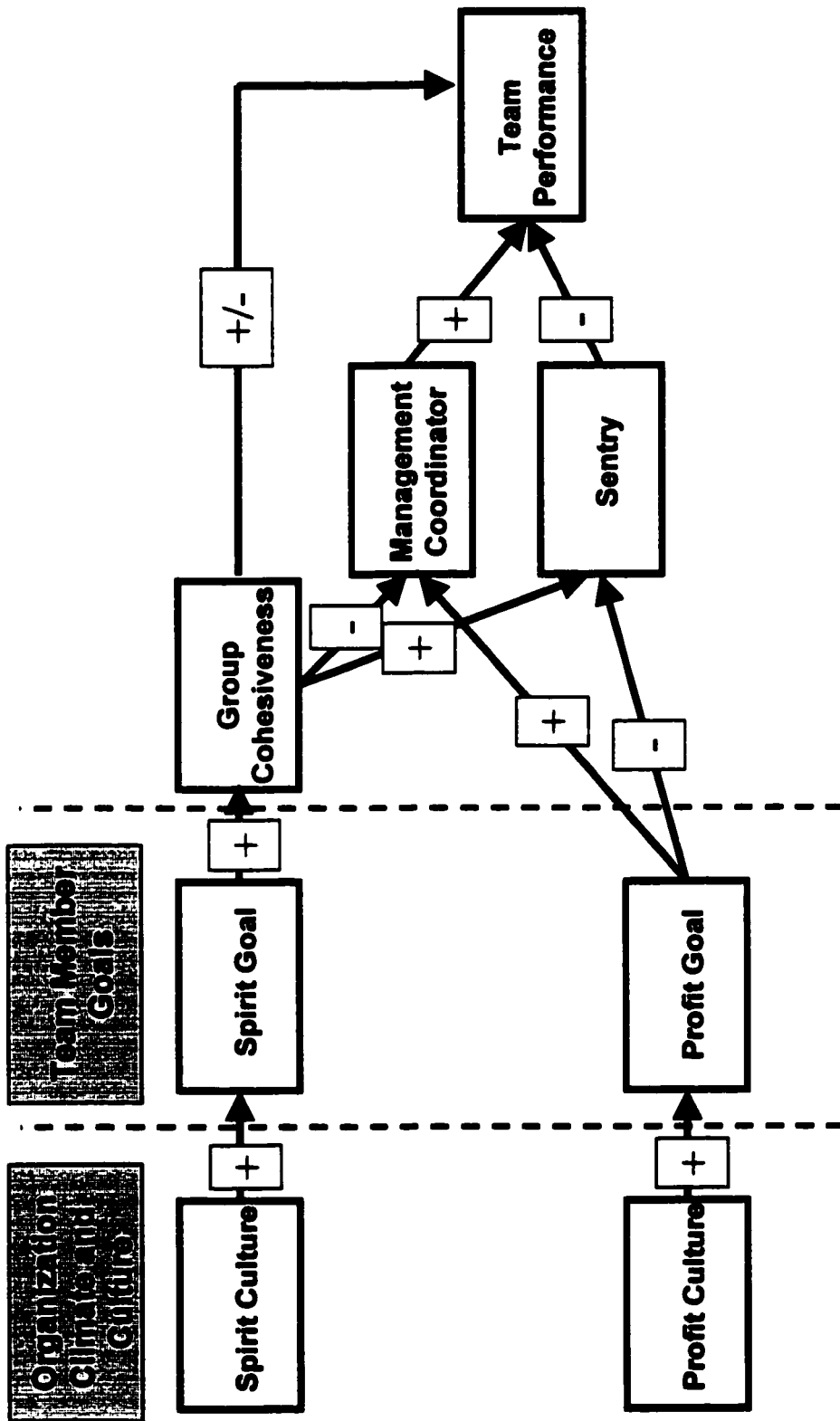


Figure 1c: Model Predicting Communication, its Antecedents and Team Performance

have been plagued by problems of poor measurement of dependent variables. Researchers have expended great effort collecting a multitude of measures from large samples of product developers, but by using brief, three or four item, measures as the dependent variables in their studies, they have missed an opportunity. For example, in a study by Birmingham and West (1995), the dependent variable was a four-item composite formed by averaging scores on items asking about (1) the newness of ideas, (2) number of new ideas, (3) significance of ideas, and (4) effectiveness of ideas.

In a study designed to assess the characteristics of the development that would lead to future product success, Robert Cooper and Elko Kleinschmidt (1991) collected subjective ratings of team performance during product development and then collected objective measures of product performance two years after the products were introduced to the marketplace. This research suggested that the presence of several characteristics during development was associated with later success on indices such as market share and product sales. It is hoped that including some of these factors that have been associated with a new product's long term success will enhance the external validity and generalizability of the present study's findings.

Thus, although a cross-sectional design limits the performance data one can gather, an effort was made in the present study to identify various different outcomes that could be considered aspects of innovation success. This list of innovation outcomes can be divided into two broad categories. The first area of new product development team performance relates to the new product development *process*, with measures such as the team's ability to stay on target with respect to schedules and budgets. The second group of outcomes relates to the

product itself, with indicators such as the creativity of the ideas and the team's attention to quality. The quality of both the innovation process and the product itself will be used as dependent variables in the present study.

LEVELS OF ANALYSIS

A key issue in team-based research is that of levels of analysis (Rousseau, 1985; Klein, Dansereau, and Hall, 1994). Although samples nesting individuals within teams within organizations are appealing because of the rich information they provide, they present several challenges for statistical analysis and subsequent interpretation of results. Klein et al. (1994) recommend that authors provide details about the level of theory, level of measurement, and level of analysis used in their studies.

The theoretical focus of the present study is at the team level. More specifically, the current model predicts that teams engaging in more communication with managers will have their process and their product rated more highly by their manager than teams engaging in little communication. Unfortunately, when trying to understand the group process or work climate of a team, it is impossible to hand a questionnaire to "the team" to fill out. Instead, the level of measurement for most of the variables in the present study is the individual level. Because the desired level of theory is the team level, to avoid committing a fallacy of the wrong level (Rousseau, 1985), it is necessary for the level of statistical analysis to be the team level.

Variables not Requiring Aggregation

In some cases, the level of theory, measurement, and statistical analysis are all in accord. This is true of the managerial performance ratings in the present study. The theory is

based at the team-level, the data are collected from a single manager (thus leading to only one description of each team), and the data analysis requires no aggregation. In other cases, the levels of data collection is inconsistent with the level of theory, requiring aggregation to the team level.

Variables Requiring Within-team Homogeneity

Aggregation to the team level brings up the issue of within-group homogeneity. As James (1982) suggests, the use of aggregates is predicated on showing agreement among individuals within the group because their perceptual agreement suggests a shared meaning of the construct being measured. This logic certainly holds for three of the variables in the present study: Group Cohesiveness, Sprit Culture, and Profit Culture. That is, to assign a score describing a team's Profit Culture, it is important to demonstrate first that team members are in agreement with respect to that Culture. If there was little agreement about managerial directives, with some reporting profit as a strong priority and others reporting that profit is only a minor consideration, who is the researcher to believe? It is only when members of a team share a common perception of the Culture that it makes sense to describe a team with a single rating. Thus, for Cohesiveness and the two Culture variables, it will be important to demonstrate a within-team agreement before aggregating to the team-level.

Variables Not Requiring Within-team Homogeneity

Although demonstrating within-team homogeneity is very important for some variables, it makes less sense for others. For example, the present study poses several questions about the relations between communication and performance. In contrast to variables such as Cohesiveness, when discussing communication, it is logical to assume that

team members will differ in their reports about the amount and types of communication in which they engage. Some are likely to be talking with managers on a regular basis, whereas others might speak with people outside the team infrequently. Thus, there is unlikely to be consistency across members of a team in their reports. However, even without this consistency, there is still value in describing a team based on the average level of communication. The primary reason for this is that the mean level of communication is more interpretable when there is heterogeneity than is the mean level of a variable such as Cohesiveness.

METHOD

SAMPLE

Because this study was conducted using a survey method, the specifics of participant recruitment are very important. The nature of the research questions being posed dictated that only organizations conducting team-based new product development would be included in the potential sample. Even with that specification, the problem of how to identify appropriate organizations and how to obtain a mailing list of how to contact those organizations remained. The solution was to use an online database of firms in the computer and high-tech sector called "Computer Select." For each of approximately 36,000 companies, this database provides contact information, a list of senior executives, and a brief description of the products and services provided by that company.

By far, the majority of these are small private computer companies with less than 10 employees. Therefore, to increase the chance of finding companies with multi-team research and development efforts, records were manually sorted and a filter was applied such that only companies with greater than 1000 employees were retained in the database. There were approximately 500 companies with 1000 or more employees listed in the database. An attempt was made to contact each of the 500.

Two different recruitment strategies were used. For companies whose Computer Select profile included the name of a person in charge of new product development (e.g., Director of Development, Senior VP of Research and Development, etc.), I attempted to reach a contact person by telephone. Approximately one quarter of the sample was contacted initially by telephone. In all but three cases, these calls were answered by voice-mail. A

standard message was used for both voice mail and email contact (see Appendix B).

Alternatively, for companies whose Computer Select profile did not suggest an appropriate contact, the researcher used the company's World Wide Web homepage to send an electronic mail message to the best available contact. (In the majority of cases, this was a general information address such as info@bigcompany.com.) Because of the vast number of organizations, the initial contact was not followed-up unless someone at the organization replied to the initial contact.

In total, approximately two dozen organizations entered into serious discussions regarding participation in the study. Of these, contacts at 12 companies committed one or more teams to the project. Of the 12 that declined participation, some were excluded from the sample because they did not use a true team-based approach, whereas others were not able to get agreement from team-members to commit the time necessary to participate. Of the 12 companies in the sample, seven had been contacted initially by phone and five had been contacted initially by electronic mail.

PARTICIPANTS AND PROCEDURE

As mentioned, 12 organizations were included in the sample. After agreeing to participate, the contact person was asked to provide a list of teams and a head-count for each team. In total, surveys were sent to 458 members of 58 teams. The average team size was approximately eight members, but several teams were quite small (3 members). Each survey booklet was coded with a number for the organization and a number for the team, but because of extreme concerns about confidentiality, no individual identification was used. Team members completed the Team Member Survey, sealed it in the envelope provided, and

returned it to the contact person. For each organization, one senior person who was familiar with the performance of all the teams involved in the study completed the Manager Survey. The contact then mailed completed surveys to the researcher in one package from each organization.

At a very late stage in the research, two organizations were removed from the sample. One of these organizations was part of a very large-scale corporate merger and subsequent downsizing. In this case, the contact person could no longer be reached and communication was severed. In the case of the second company, the contact person telephoned to apologize and to regretfully inform the researcher that major corporate restructuring had made it impossible for the company to continue to participate. Between the two, 13 teams consisting of 78 members were lost from the sample.

Of the 45 remaining teams, the data from one team was said to have been mailed, but was never received. Eight other teams continually delayed completing the survey, and therefore, were not included in the sample. In the end, 315 surveys were delivered to members of 37 participating teams. Of these, 207 completed surveys were returned to the researcher.

Organizational Level

The ten organizations in the final sample represented a variety of firm characteristics. Six of the organizations were located in Canada and four were located in the United States. Five of the firms could be classified as software developers, whereas five were developing computer or telecommunications hardware. The oldest company in the sample was 114 years old and the youngest company was 19 years old (the mean age was 46 years). The largest firm in the study employs 38,300 people, whereas the smallest employs only 1000 (the median size

was 5,300).

Team Level

Although it would be beneficial to have collected demographic data about the participants, concerns about confidentiality were so extreme that we decided not to ask questions that might identify the respondents. Respondents were, however, asked to provide a description of their team (see Appendix C). Team members were asked to state the total number of people on the team, provide a breakdown of the functional specialties of team members (e.g., engineer, marketing, production) and to report the length of time the team had been working together.

Responses to these questions were puzzling. There was very little consistency among members of a team as to the number and function of team members or the tenure of the team itself. In one team, for example, the organization chart attributes nine members to the team. Completed surveys were received from seven members of the team. The mean response to the question of how many people belong to the team was 8.42. That seems reasonably close, but surprisingly, no one said there were nine members. Instead, estimates ranged from a low of four to a high of 18 members. Furthermore, there was little agreement about the composition of the team. Although everyone agreed that there were engineers on the team, estimates of the number of sales and marketing specialists ranged from zero to seven. When asked how many months the team had been working together, answers ranged from four months to a year. These responses are typical of the low agreement about general team characteristics found in the data.

The most probable cause of some of the variance in responses is the distinction

between a “core” team and the more general team. Often, people from functions such as marketing and manufacturing are included in a general description of the people who are working on a team, but not classified as core members. It is likely that some respondents focused only on the stable core team, whereas others included people who work with the team on various parts of the project. This is not a complete explanation because of the small number of people whose estimates were less than the managers’ description of the number of core team members. These inconsistencies in reporting team characteristics would be an interesting avenue of future research.

Team Characteristics

The team description data from any given team is quite variable, but the average characteristics of the sample are still of interest. The average team size described by respondents was 16.47, sd = 11.46. Of these team members, the average functional breakdown was 8.6 engineers, 1.9 sales people, 1.8 managers, 1.9 manufacturers, and 1.8 “other” functional specialties. The average respondent reported that their team had been together for 18 months, and expected to be together for another 7.2 months. Finally, when asked how far their team had progressed in the initial idea generation stage of new product development, the average respondent said their team was 81% finished idea generation.

EMPLOYEE SURVEY QUESTIONNAIRE

Surveys were printed in booklet form with the University of Waterloo and Institute for Innovation Research logos on the front cover. The survey consisted of one measure of each variable in the proposed model. The survey started with one page of general information (such as the team description discussed above) followed by eight pages of scales. A total of 115

items were included in the survey. All items on the scales were rated on five-point Likert-type response scales. (Because response anchors varied, they will be discussed separately in relation to each particular scale.)

Organizational Climate and Culture:

This scale consisted of 11 items rated on 5-point Likert scales. (A complete list of items is provided in Appendix D.) Respondents were given these instructions... “The following list contains statements about the direct and indirect messages you and your team get from management. Please indicate the extent to which each of these statements is true by circling a number in the box beside it.” Because the question asked about the extent to which various messages were passed, anchors ranged from “little or no extent” to “very great extent.”

As discussed in the introduction, there were two types of organizational climate and culture messages that were of primary interest in the present study and each was reflected in the content of some of the items. First, the Spirit Culture scale posed several questions regarding the extent to which the organization promotes positive group relations. An example of a positive relations climate item is “Managers make it clear that teams should be tightly knit groups.” An example of a Spirit Culture items referring to indirect messages is “The culture in this company is that there should be solidarity among members of team.” Second, the Profit Culture items asked about the extent to which the organization encourages basing decisions on what is best for company profits. A sample climate item of this type is “Management makes it clear that teams are responsible for making the best use of organizational resources.” An example of a culture item is “In this organization, the emphasis is on profit.”

Individual Goals

This scale consisted of 12 items rated on 5-point Likert scales (see Appendix E). Care was taken in writing the instructions for this scale because of a concern that respondents would not differentiate between organizational goals (referred to in the Organizational Climate and Culture items) and their own goals. To help make the distinction clear, the following directions were used. “The first page of questions asked you to tell us about the directives coming to you from management. For the next set of statements, we don’t want you to just tow the company line. Instead, we want to hear what YOU want and what YOUR goals are.” Because the question asked about the importance of various goals, anchors ranged from “no importance” to “extreme importance.”

Although the items were different from those of the Organizational Climate and Culture scale, the same two concepts were tapped. First, Spirit Goal items inquired about the extent to which members of the team strive toward positive team relations (e.g., “I want to create a group atmosphere that is supportive of team members”). Second, Profit Goal items asked to what degree team members’ goals are focused on doing what is good for the company (e.g., “I want to help develop a product that fits well with existing product lines”).

An additional concern with the Individual Goals scales was caused by the high social desirability of a team member claiming that all of the goals are of extreme importance. In an attempt to reduce consistently high responding, the following statement was placed below the instructions (in boldface type). “You might consider each of these statements to reflect things that you want, but we would like you to be more specific. We are interested in which things are somewhat more important to you and which are somewhat less important.”

Isolationism

This measure consisted of 10 items rated on 5-point Likert scales. (A complete list of items is provided in Appendix F.) Respondents were given these instructions... “The following statements describe different opinions about what leads to success in new product formulation. Please indicate your agreement or disagreement with the following statements by circling a number beside each.” Because the question asked about team members’ agreement with several statements, anchors ranged from “strongly disagree” to “strongly agree.”

Isolationism items probed respondents’ opinions regarding the effectiveness of cutting off communication with people outside the team (positively-keyed items) versus encouraging communication with outsiders (negatively-keyed items). An example of a positively-keyed item is “Communicating with people outside of your team distracts you from getting your job done.” A sample negatively-worded item is “People outside the team can be helpful because they have different perspectives on teams’ products.” To reduce a social desirability bias toward one view or the other, equal numbers of positively and negatively worded items were used.

Group Cohesiveness

This scale consisted of 13 items rated on 5-point Likert scales. (A complete list of items is provided in Appendix G.) Respondents were given these instructions... “The following statements reflect different feelings you might have about the state of your team. Please indicate your agreement or disagreement with the following statements by circling a number beside each.” Because the question asked about team members’ agreement with several statements, anchors ranged from “strongly disagree” to “strongly agree.”

In their study, Ancona and Caldwell (1992a) used four items developed by Seashore (1954) to assess cohesiveness. These items asked team members (1) how willing they are to defend one another from criticism; (2) how well they help each other; (3) how well they get along; and (4) the extent to which they stick together. Although I was concerned with the issue of comparability, to help improve the reliability and validity of the index, additional cohesiveness items were added. The revised 13-item scale consisted of items concerning respondents' pride in belonging to the team, their enjoyment of working with other team members, and their desire to minimize conflict with their teammates. An example of a positively-worded item is "Maintaining good relationships with my teammates is important to me." An example of a negatively-worded item is "I don't have much in common with my teammates."

Communication Items

The communication items were grouped into two broad categories: Communication Outside the Team (but within the organization) and Communication Outside the Organization. Within the first broad category were five separate types of communication including Management Coordinator, Ambassador, Task Coordinator, Sentry, and Guard. The items referring to communication outside the organization were the Technical Scout items. (A complete list of communication items is presented in Appendix H.)

The instructions for the communication items were carefully thought-out because of the difficulty of choosing a wording that asked exactly what I was trying to assess. For example, one potential format was to ask how frequently team members engage in various types of communication behaviours. The problem with that approach is that past research

(Ancona and Caldwell, 1992a) has shown differences in the potency of the communication roles (e.g., communicating with a senior vice-president once per month might be relatively more than communicating with a technical expert once per week). An alternative wording that I considered was that used by Ancona and Caldwell (1992a) which asked team members to “indicate the extent to which you feel each of the items is part of your responsibility in dealing with people outside the team.” My concern with this question was that team members could agree that a certain type of communication was “part of their responsibility” without actually engaging in that behaviour. It was the relation between actual communication and performance that was of interest rather than the relation between one’s perceived role and performance. In the end, the item deemed most accurate was as follows...“Please indicate to what extent you do the following in dealing with people who are outside the team but within the organization.”

The Management Coordinator scale consisted of 10 items. Each of the items asked about the extent to which team members engaged in some form of communication with managers. Items included questions about product-related communication such as “encourage managers to have input in the product design process” and strategy-related communication such as “seek out information about your company’s strategy that might affect the project.”

The Sentry scale consisted of 10 items, each of which asked about communication intended to cut off the flow of information into the team. These items each tapped different types of filtering behaviours (e.g., “Make decisions about what information will distract the team” and “Cut off the flow of information into the team when it is time to focus on a solution”). To a large extent, items on the Sentry, Ambassador, Task Coordinator, and Guard

Scales were taken from Ancona and Caldwell's measure. Doing so increased my ability to compare the results of the present study with those of past research. However, in some cases, their items were not included because they were considered inappropriate. In other cases, items were added to enhance the scales. To allow the reader to compare directly, Appendix A contains the full list of Ancona and Caldwell's communication items.

The Ambassador Scale consisted of eight items. Each item related to a different type of promotional activity aimed at securing support from people in the organization. Items included "Persuade others to support the team's decisions" and "Tell others how the project fits with the goals of the organization."

The Task Coordinator Scale consisted of seven items related directly to accomplishing the new product development task. Behaviours addressed in this scale include looking for technical expertise, seeking resources, and coordinating stakeholders within the organization who are involved in the product development process (e.g., procuring resources, agreeing on schedules). Items included "Resolve design problems with external groups" and "Ensure other groups' schedules match with yours so that there are no delays in product development").

The Guard Scale consisted of six items regarding the withholding of information from people outside the team. The Guard Scale items are essentially the opposite of the Sentry items because they ask about the filtering of information going out of the team, rather than filtering of information coming into the team. Items included "Avoid the release of information to others in the company to protect the team's image or the product it is working on" and "Ensure that information about the product isn't leaked before the team is in agreement about the design."

The second category of communication items was communication outside the organization. These 11 items were grouped into a single scale that focused primarily on searching for technical product-related information from sources outside the organization. Items included “Scan the environment outside the organization for technical ideas/expertise” and “Attend conferences or meetings to get a broad perspective on the problems your team faces.”

Team Performance

The primary dependent variable in the present study was team performance. Several different aspects of successful performance were included in the measure. The scale included business related issues (such as on-time and on-budget performance), product related issues (for example, significance of ideas and incorporating emerging technology), group process issues (including commitment to the project and sticking to the task at hand) and factors believed to be associated with future commercial success (such as unique benefits to user and attractiveness to market). These instructions preceded the items “The following items ask you to rate your team’s performance on several dimensions. Depending on how far into the formulation of the product your team is, some of these questions might be more or less relevant. If the items refer to things you have yet to complete, just respond by giving an idea of whether your team is “on-track” to accomplish these things. If an item is not at all applicable, please indicate this fact in the rightmost box. The 5-point anchors were poor, satisfactory, good, very good, and excellent. (A complete list of performance measure items is included in Appendix I.)

MANAGER SURVEY

The Manager Survey was much shorter than the Team Member Survey, including only two of the scales from the Team Survey. To provide the managers an opportunity to describe the direct and indirect messages they send to team members, the Manager Survey included the identical Organizational Climate and Culture Scale as in the Team Member Survey. The Manager Survey also included the primary dependent variable in the study: the Team Performance Scale (which was also identical to that in the Team Member Survey).

The only items that appeared on the Manager Survey but not on the Team Member Survey were eight questions regarding the context of the new product development process. These items asked about how revolutionary is the product being developed, how much experience the organization has with similar products, and the availability of resources such as personnel and equipment. (A complete list is provided in Appendix J.)

DATA ANALYSIS STRATEGY

Analysis Technique.

The multi-level structure of the data being collected would normally suggest the use of Hierarchical Linear Modeling (HLM) as a data analysis technique. Although HLM would facilitate tests of the individual-, team-, and organization- level variance, the design of the present study is not suitable to HLM. In this study, potential individual-level variables would include the six communication variables and perhaps the team member goals variables. Team-level variables would include cohesiveness, climate and culture, and performance ratings. Unfortunately, HLM is only designed to test models in which the dependent variable is at the lowest level of analysis. All other variables must be aggregated at least to the level of the

criteria measure. In the present study, that would mean aggregating communication and team member goals to the group level. Even after aggregating all variables to at least the level of the criterion, there can still be a benefit to using HLM if one is interested in variables at a higher level of aggregation (e.g., the organization level). In the present study, there are no variables of interest at a level superior to the team level and therefore the data are analyzed using aggregation to the team level and path analysis.

A second possible data analysis technique is Structural Equation Modeling (SEM). SEM would be appropriate for the data in the present study because of its ability to integrate both the structural model and the measurement model, which is beneficial in large survey studies. Unfortunately, the sample size at the team level (37 teams) is insufficient to support such a large model. Instead, every attempt will be made to hone the measures before including them in a path analysis.

Power Analysis

Although the sample size will be relatively large at the individual-level, the corresponding sample size at the team-level will be much smaller. The power to detect significant effects using correlational techniques is quite poor when small sample sizes are used. With a sample size of 30, the power to detect an effect of magnitude .40 with a significance-level of .05 is .56. In an effort to increase the statistical power, a $p < .10$ significance criterion will be used so that the power to detect an effect of magnitude .40 will be .68. It is worth noting that, when viewed in a traditional power analysis framework, power is a straightforward function of N , but reliable measurement enhances power, and aggregation promotes reliability under some circumstances (as will be verified in the analysis of the data).

Thus, the apparent power problem resulting from the $N=37$ is reduced substantially by aggregation.

RESULTS

SCALE CHARACTERISTICS

Organizational Climate and Culture.

Two subscales were created from the 11 items of the Climate and Culture scale. First, based on item content, five items were grouped into the Spirit Culture subscale. This subscale describes the extent to which managers give direct and indirect messages that teams should be cohesive groups with a cooperative spirit among members. During item analysis, one item was removed from this subscale due to a poor item-total correlation. The resulting four-item scale had a Cronbach's alpha coefficient of internal reliability of .72. (A list of all scale means, standard deviations, Cronbach's alphas, and mean inter-item correlations is presented in Table 2.)

The second Climate and Culture subscale, Profit Culture, was a grouping of six items referring to managers' direct and indirect messages that teams should be focused on profits and other organizational outcomes. As with the preceding subscale, one item was removed from this subscale because of the item analysis. The final five-item scale had a Cronbach's alpha of .73.

Team Member Goals.

Similarly to the Climate and Culture items, the Team Member Goals items were divided into two subscales. These subscales parallel those of the Climate and Culture measures. The first subscale, Spirit Goal, was a collection of three items each asking about the extent to which respondents had the goal of creating positive group relations and a supportive atmosphere in the team. This scale had a Cronbach's alpha of .70.

The second subscale of the Goals measure, Profit Goal, asked respondents the extent to which their goals are to make decisions that will be beneficial for the organization. This five-item scale had a Cronbach's alpha of .80.

Group Cohesiveness.

Thirteen items were used to assess the teams' cohesiveness. One of these items was dropped because of a low item-total correlation. The remaining twelve items showed reasonably good psychometric properties with a Cronbach's alpha of .81 and a mean inter-item correlation of .28.

The Communication Items

In total, 52 items were used to assess the six different communication types address by the study. Two approaches were used to determine the psychometric properties of the communication items. First, traditional item analyses using measures of internal consistency were conducted separately on each of the six scales. Second, all 52 items were submitted to a DECIFER analysis (a combination of exploratory factor analysis and cluster analysis) to see if items on each scale would hang together when given the opportunity to correlate with items on the other communication scales.

(i) Item Analyses.

The mean inter-item correlations and Cronbach's alpha for each of the six communication scales are presented in Table 3. Each scale had an alpha of at least .83, with the most reliable scale having an alpha of .92. Mean inter-item correlations ranged from .44 to .56.

Table 2: Scale Characteristics

Scale Characteristics				
Scale	Mean	St. Dev.	α	Mean r_{ii}
Spirit Culture	3.34	.69	.69	.22
Profit Culture	3.36	.72	.68	.27
Spirit Goal	3.89	.68	.70	.44
Profit Goal	4.07	.63	.80	.46
Group Cohesiveness	3.78	.45	.79	.24

Table 3: Communication Scale Characteristics

Scale Characteristics				
Scale	Mean	St. Dev.	α	Mean r_{11}
Management Coordinator	2.46	.83	.90	.47
Sentry	1.99	.81	.92	.56
Ambassador	2.52	.85	.88	.49
Guard	1.78	.70	.83	.45
Technical Scout	2.56	.82	.85	.44
Task Coordinator	2.17	.80	.90	.46

(ii) DECIFER Analysis.

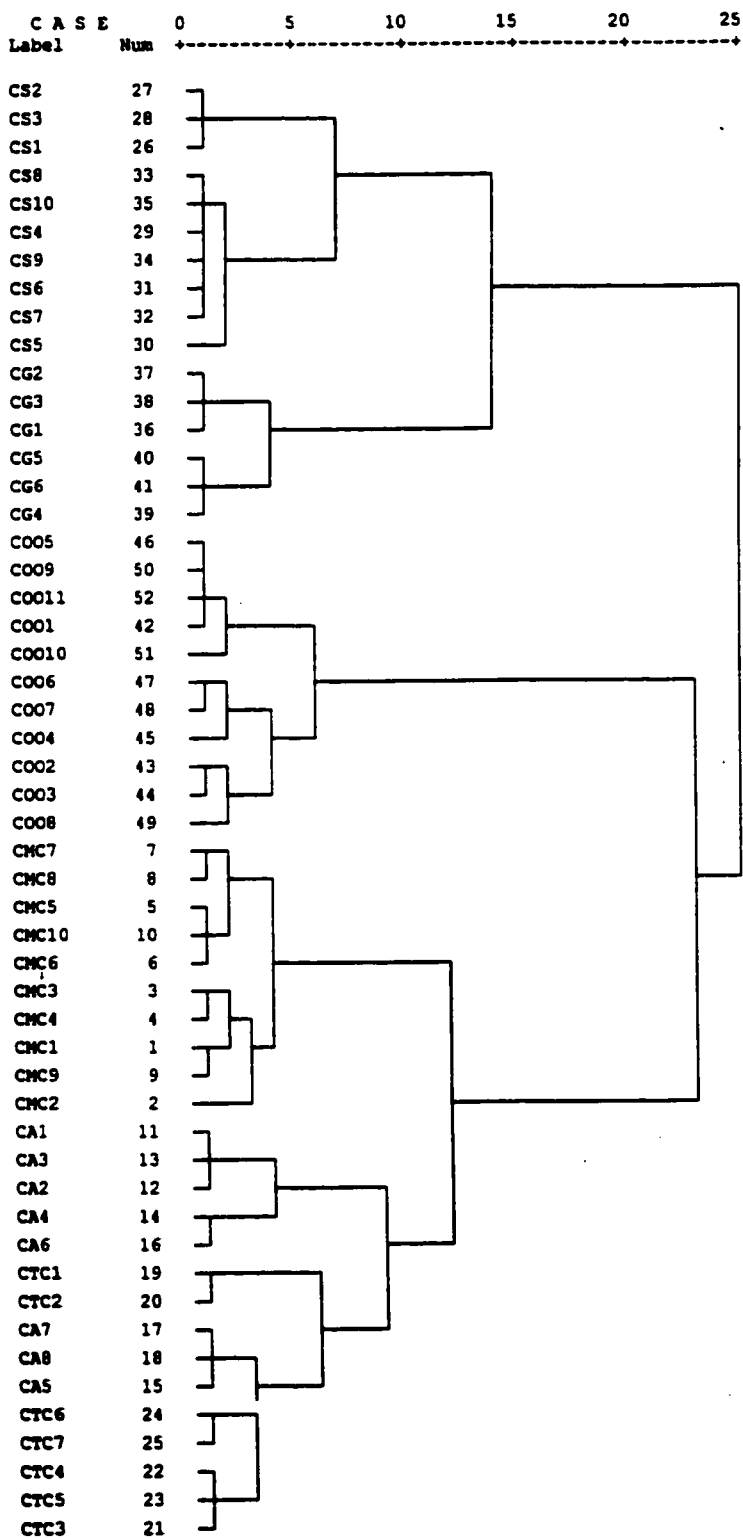
DECIFER works by examining the patterns of factor loadings in a traditional exploratory factor analysis. Items that share similar loading patterns (e.g., high on factor 1, low on factors 2 and 3, high on factor 4) will cluster together. The results of a DECIFER analysis are displayed in a dendrogram, which is so named because of its branching, tree-like structure. Pairs or groups of items that link, or cluster, together on the left side of the diagram are more similar to one another than those that link further to the right.

Examining the dendrogram of communication items in Figure 2, we see that items on each communication scale linked much more closely with each other than with items on the other scales. One exception was the items on the Ambassador and Task Coordinator scales. Two of the Task Coordinator items clustered together with the Ambassador items rather than with the other Task Coordinator items. There is no clear reason based on item content why this would be the case. For the purposes of this study, the scales will be used in their original form, as shown in Appendices E through K. Further research should examine the psychometric properties of the Task Coordinator and Ambassador scales and constructs in another sample.

Performance Scales

As discussed in the introduction, an effort was made to improve the measurement of team performance. In contrast to past studies that have used as few as one or two items to measure performance, the performance measure in the present study consisted of 17 items. As a complete scale, the 17-item measure had a Cronbach's alpha of .93, with a mean inter-item correlation of .43. Clearly, there is justification for using the scale as a whole.

Figure 2: Dendrogram Showing Relations of Communication Items



It is also interesting to divide the performance scale into two subscales: one that relates to the new product development *process* and one that relates to the *product* itself. A priori, there were eight items that relate to team process (including such items as “on-time performance” “efficiency”, and “sticking to the task at hand”). The Cronbach’s alpha for this subscale is .91, with a mean inter-item correlation of .56. A priori, there were five items that related to the new product being developed (including items such as “creativity of ideas”, “concern for quality” , and “incorporating emerging technology”). The Cronbach’s alpha for this subscale is .73, with a mean inter-item correlation of .36. One of the items on the product subscale had a poor item-total correlation. This item, which refers to the concern for quality displayed by the team, was deleted from the subscale. The remaining four items have an alpha of .78, with a mean inter-item correlation of .48. Unfortunately, the ratio of cases to variables (slightly greater than 2) was insufficient to warrant the use of an exploratory factor analysis on the performance items.

For the analysis of the primary hypotheses, the full scale will be used. Additional analyses will then be conducted to examine differences in relations between predictors and team performance depending on whether the dependent variable is Team Process or Product Quality.

THE USE OF VARIOUS TYPES OF COMMUNICATION

One of the purposes of this study was to examine the extent to which teams engage in Management Coordinator and Sentry communication and to compare the use of those roles to the use of the other types of external communication. In general, Management Coordinator communication was used to a large extent, with mean levels similar to that of Ambassador and

Task Coordinator activities. Of the items ranked among the ten highest means, three were Management Coordinator, whereas five were Ambassador and two were Task Coordinator activities. In contrast, Sentry activity was reported to a lesser extent, with a mean level similar to that of the Guard and Technical Scout roles. Of the ten least common items, five were Sentry activities, whereas one was a Technical Scout and three were Guard items. Means and standard deviations for each of the communication roles are presented in Table 3.

Although the use of Management Coordinator communication did not vary with demographic or environmental context variables, the use of other types of communication were related to these team characteristics. More specifically, teams engaged in more Task Coordinator communication to the extent that they were facing more competition, $r(33) = .39$, $p = .03$, and to the extent that they had more experience in dealing with this type of project before, $r(33) = .30$, $p = .09$. On the contrary, teams engaged in less Task Coordinator communication the more funds they had available to them, $r(33) = .39$, $p = .02$. Technical Scouting was negatively related to how evolutionary (versus revolutionary) the product being developed was, $r(33) = .32$, $p = .07$. Communication variables were also related to team tenure, but because of the poor psychometric properties of the aggregated team characteristics variables, these results will be discussed in the section on exploratory analyses.

TEAM LEVEL ANALYSES

Justification for Aggregating to the Team Level.

As discussed in the introduction, the multi-level nature of these data require some caution in justifying aggregation from one level to a higher level. HLM is very helpful in providing a test of the appropriateness of aggregating individual data to the team level. To

justify the aggregation of certain variables to the team level, it is important to show that members of a team share a common perception of the target variable. HLM was used to test assumptions about the within-team homogeneity of these variables. To do this, the variable of interest was entered at the individual level and a fully-unconditional model was used to examine the intra-class correlation (ICC, a reliability coefficient in this context) of the variable at the team level and to test for the presence of significant team-level variance in the dependent variable. The HLM program simultaneously generated an ICC reliability and chi-square test for the organization level of analysis.

First, the two Organization Climate and Culture subscales (Spirit Culture and Profit Culture) were entered as dependent variables in two separate fully unconditional hierarchical linear models. In the Spirit Culture analysis, the reliability estimates at the team and organizational levels of analysis were .08 and .32, respectively. The Chi-square test revealed significant variance at the team level, $\chi^2(27) = 43.23, p = .03$ and at the organization level, $\chi^2(9) = 47.38, p < .001$. In the Profit Culture analysis, the reliability estimate was (level 1 .37, level 2 .09). The Chi-square test again revealed significant variance at the team level $\chi^2(27) = 61.85, p < .001$. Next, the Group Cohesiveness scale was entered as a dependent variable in a fully unconditional model. The reliability estimate at the team level and the organization level were .21 and .18, respectively. The Chi-square test revealed significant variance at the team level $\chi^2(27) = 55.59, p = .001$, and the organization level $\chi^2(9) = 38.24, p < .001$. In sum, the three scales for which we assumed there would be within-team homogeneity do seem to have significant team-level variance.

Ancona and Caldwell (1992a) use a less state of the art test to justify aggregation to the

team level: Oneway ANOVAs with team membership as the independent variable. They use the logic that a significant F value suggests that the between-team variance exceeds what one would expect given the within-team variance. Results of this analyses using this method also support aggregation to the team-level. For Group Cohesiveness, $F(36,170) = 2.92, p < .001$. For Spirit Culture, $F(36,170) = 2.42, p < .001$. For Profit Culture, $F(36,170) = 2.09, p = .001$.

TESTING THE MODEL OF COMMUNICATION AND PERFORMANCE

AMOS 3.6 (Arbuckle, 1994) was used to perform a maximum likelihood method path analysis testing the proposed model of communication and performance. Data from the 37 teams were entered into the analysis, but due to missing manager ratings, path coefficients leading to Manager Ratings of Team Performance are based on a sample size of 34 teams. Results of the path analysis are presented graphically in Figure 3.

Hypothesis 1, positing that Management Coordinator communication would be positively related to Manager Ratings of team performance was supported, $\beta = .31, p < .05$. The hypothesis that Sentry activity would be negatively related to Manager Ratings of Performance, was also supported, $\beta = -.36, p < .05$.

Results of the path analysis also supported the Hypothesis 2, which suggested that Group Cohesiveness would be positively related to performance, $\beta = .39, p < .01$. (This assumes a linear relation between Cohesiveness and Performance. A test of the potential curvilinear relation between these variables, as suggested by Hypothesis 3 will be discussed later.) Surprisingly, the hypotheses suggesting that Group Cohesiveness would be negatively related to Management Coordinator and positively related to Sentry activity were not supported. Group Cohesiveness did not significantly predict either type of communication.

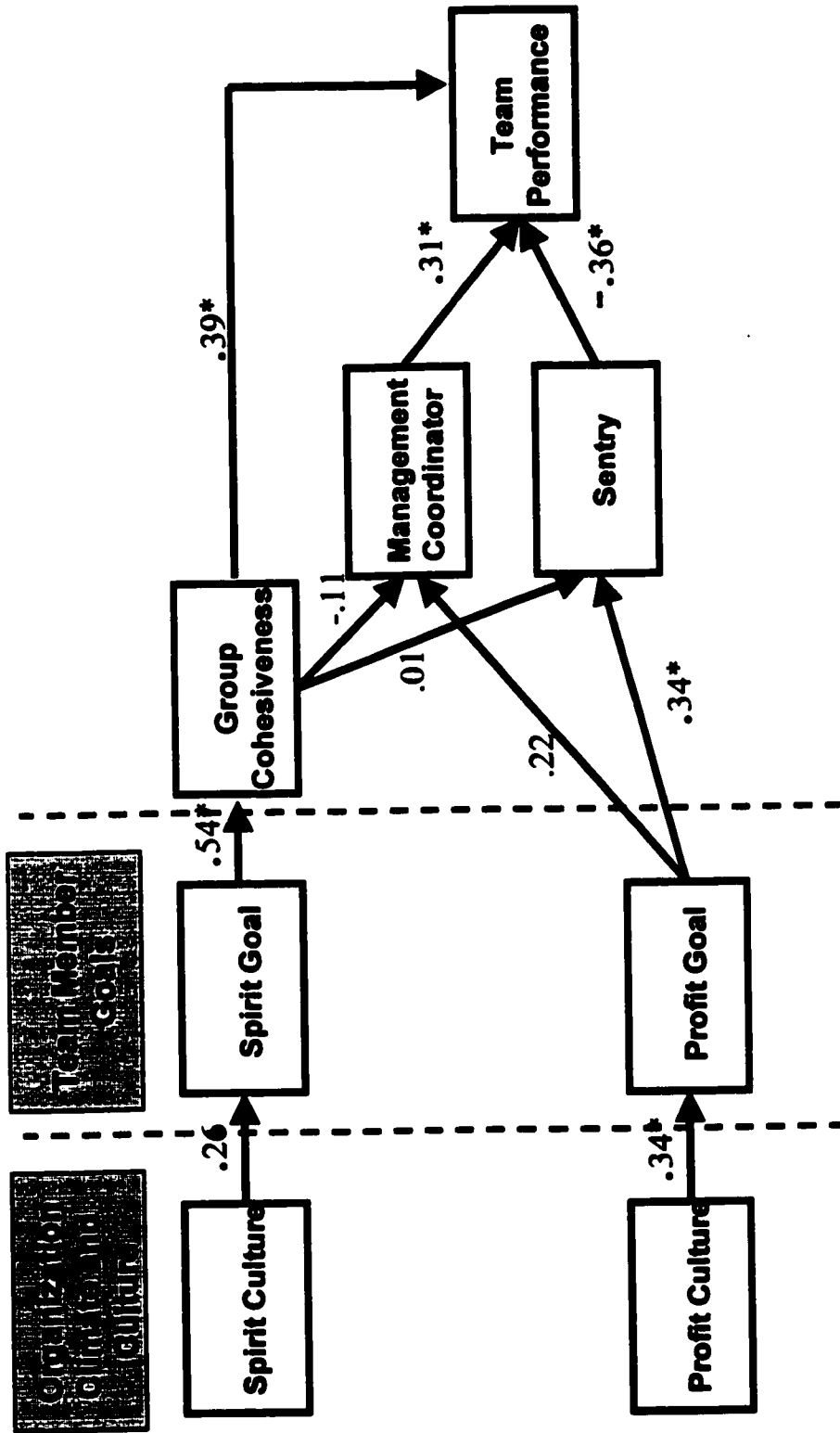


Figure 3: Results of the Path Analysis of the Model Predicting Communication and Performance

There were several hypotheses associated with the Team Member Goal variables. First, in Hypothesis 6, it was posited that the goal of maintaining a happy group (Spirit Goal) would be positively associated with Group Cohesiveness. This hypothesis was supported in the data, $\beta = .54$, $p < .001$. In Hypothesis 7, it was proposed that the team member goal of doing things that are good for the organization (Profit Goal) would be positively related to Management Coordinator activity and negatively related to Sentry activity. Results with regard to Profit Goal were unexpected. Although Profit Goal was not related to Management Coordinator communication, it was significantly positively related to Sentry activity, $\beta = .34$, $p < .05$. Thus, teams whose members have higher Profit Goals actually engage in more activities designed to filter out information that is coming into the team.

The hypotheses relating to Organizational Climate and Culture were straightforward. It was predicted that managerial messages encouraging cooperative group relations (Spirit Culture) would be related to team members' goals of fostering a happy group (Spirit Goal) and that managerial messages focusing the team on organizational outcomes (Profit Culture) would be related to team members' goals of doing what is best for the organization (Profit Goal). The former hypothesis regarding the Spirit variables did not receive statistical support at the significance level established for this study, $\beta = .26$, $p > .10$. The latter hypothesis, that Profit Culture would be associated with Profit Goals was supported, $\beta = .34$, $p < .05$.

In sum, the proposed model of communication and performance was supported in several ways. First, communication activities were related, in the predicted directions, to managerial ratings of team performance. Second, the data suggested that Organizational Climate and Culture variables were predictive of Team Member Goals. Third, Group

Cohesiveness was related to performance ratings.

The data did not support the model in one key area: There was no evidence that Group Cohesiveness led to reduced amounts of Management Coordinator activity or to increased amounts of Sentry activity. The hypotheses that Group Cohesiveness would be positively related to Sentry activity and negatively related to Management Coordinator activity were based on the logic of groupthink proposed in the introduction. Several additional analyses were conducted to shed light on why the groupthink logic did not hold true in these data. The results of these analyses will be presented in the section on exploratory analyses.

A Deeper Look at the Model

(i) The Two Purposes of Management Coordinator Communication.

According to the definition given earlier, Management Coordinator activity consists of any communication initiated by a team member with the purpose of gathering information from a manager. That definition encompasses communication behaviours with a variety of purposes. As discussed in the introduction, the Management Coordinator scale includes items pertaining to two distinct reasons for communicating with managers. First, some items referred specifically to soliciting information from managers regarding product design (e.g., “Encourage managers to have input in the product design process”). Second, several items referred to seeking information about higher-level organizational context issues (e.g., “Keep up with management’s strategy of what markets need to be tapped”). To explore potential differences in predictive power between these two types of communication, subscales of “Management Coordinator Product” and “Management Coordinator Strategy” were computed and then entered in place of Management Coordinator in the path model. Results suggested

that the Strategy subscale was more highly related to Performance ratings than was the complete scale, whereas the Product subscale was related less strongly to Performance (the relation of Management Coordinator Product with Performance was not statistically significant). The results of the path analyses are presented in Figures 4 and 5.

(ii) The Two Dimensions of Performance.

As discussed in the method section, the Performance scale incorporated questions pertaining to the quality of the product being developed and questions pertaining to the development process. Two different models were tested using either Product Quality or Team Process as the index of team performance. Results of the path analyses are presented in Figures 6 and 7.

Results indicated that Product Quality subscale was more significantly positively related to Management Coordinator communication, $r = .39$, $p < .05$, and significantly negatively related to the team members use of Sentry communication, $r = -.29$, $p < .10$. Relative to their relations with the overall performance measure, Management Coordinator was more strongly related to Product Quality, whereas Sentry communication was less strongly related to Product Quality. It is also interesting to note that Group Cohesiveness was not significantly predictive of Product Quality, $r = .22$, n.s..

Results of the path analysis with Team Process as the criterion showed the opposite results. In this case, Management Coordinator communication was not significantly related to Team Process, $r = .24$, n.s., whereas Sentry communication did predict ratings of Team Process, $r = -.33$, $p < .05$. Group Cohesiveness was also significantly related to Team Process, $r = .38$, $p < .05$.

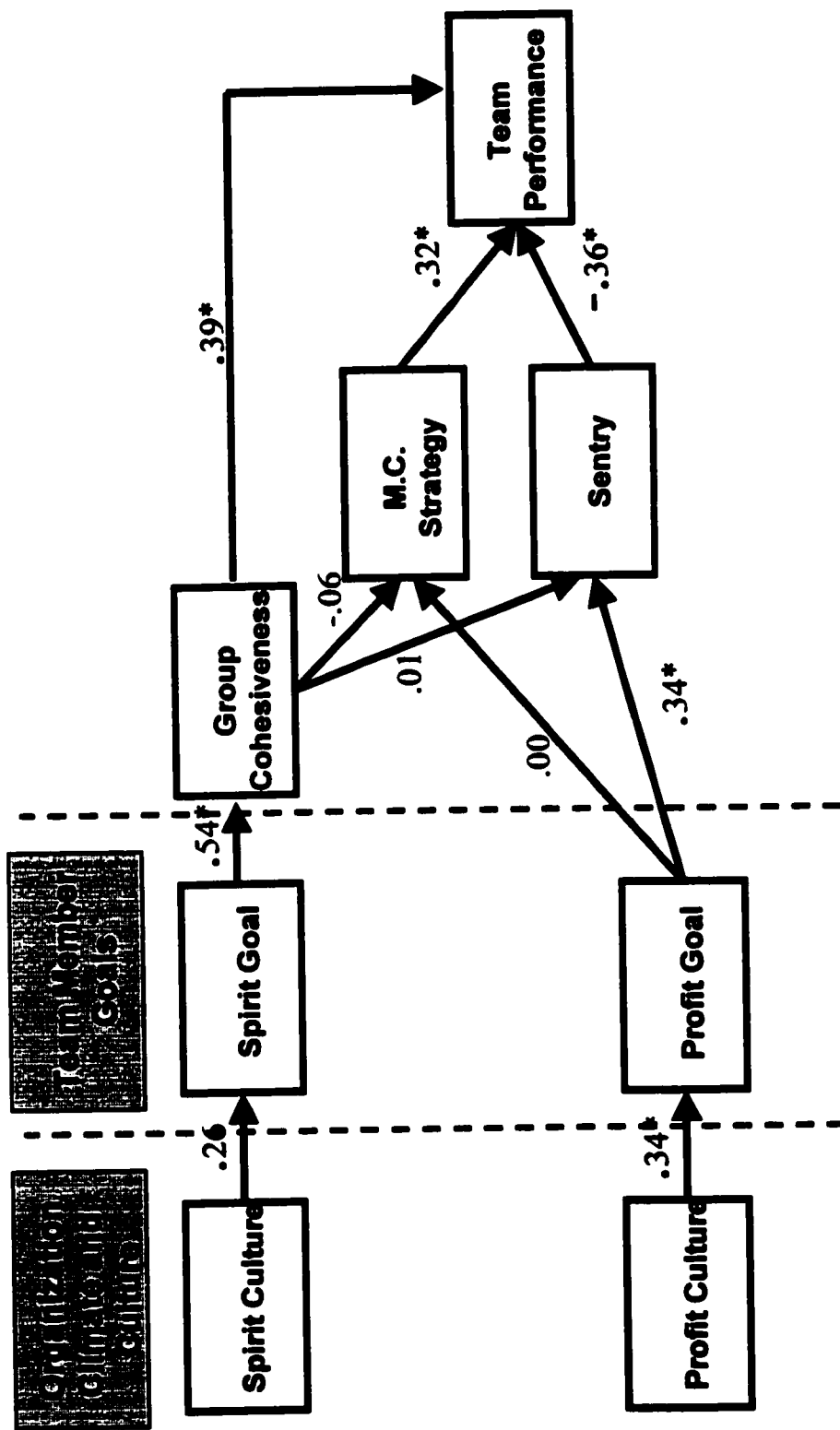


Figure 4: Results of the Path Analysis of the Model Predicting Management Coordinator: Strategy and Performance

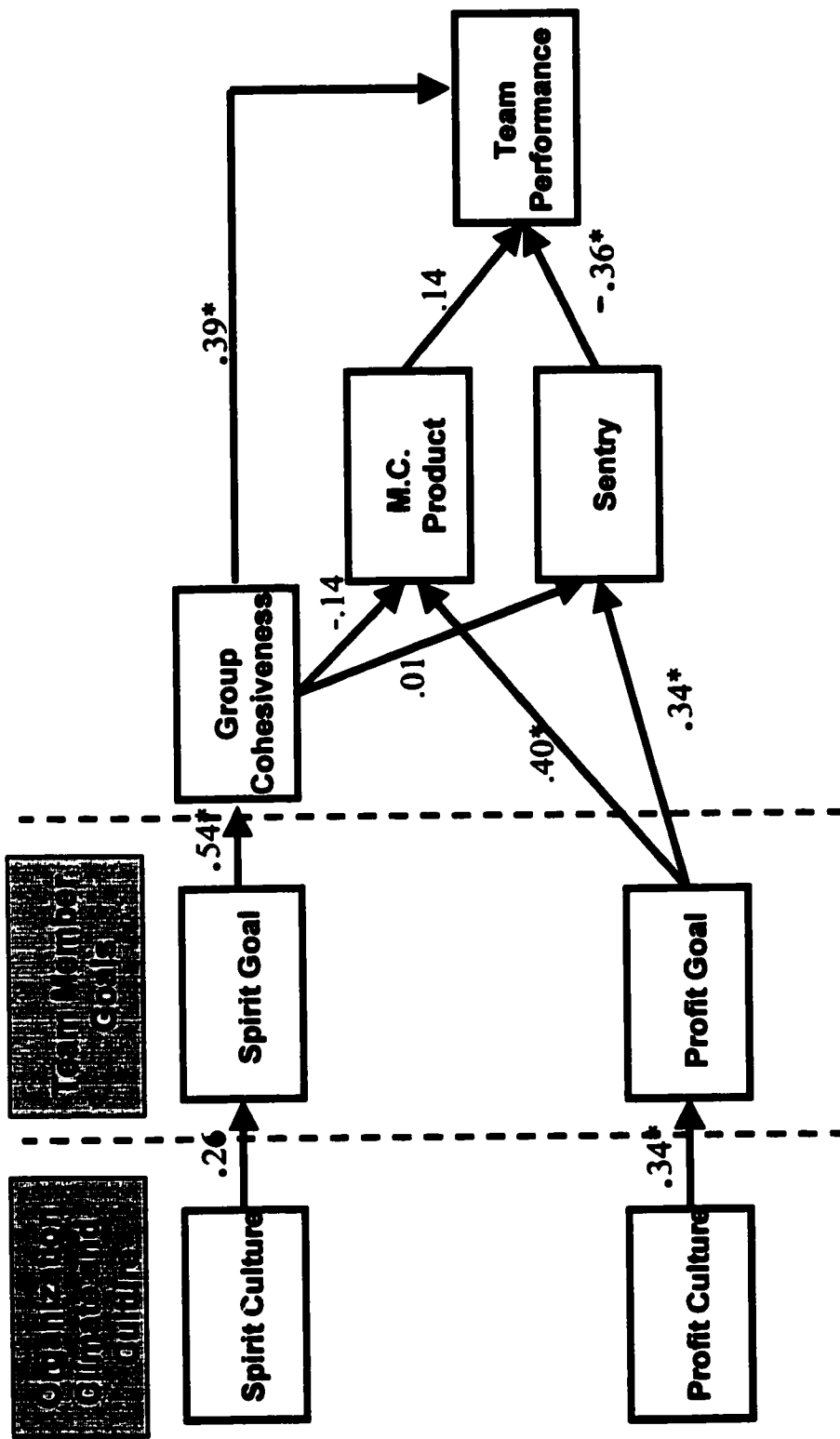


Figure 5: Results of the Path Analysis of the Model Predicting Management Coordinator: Product and Performance

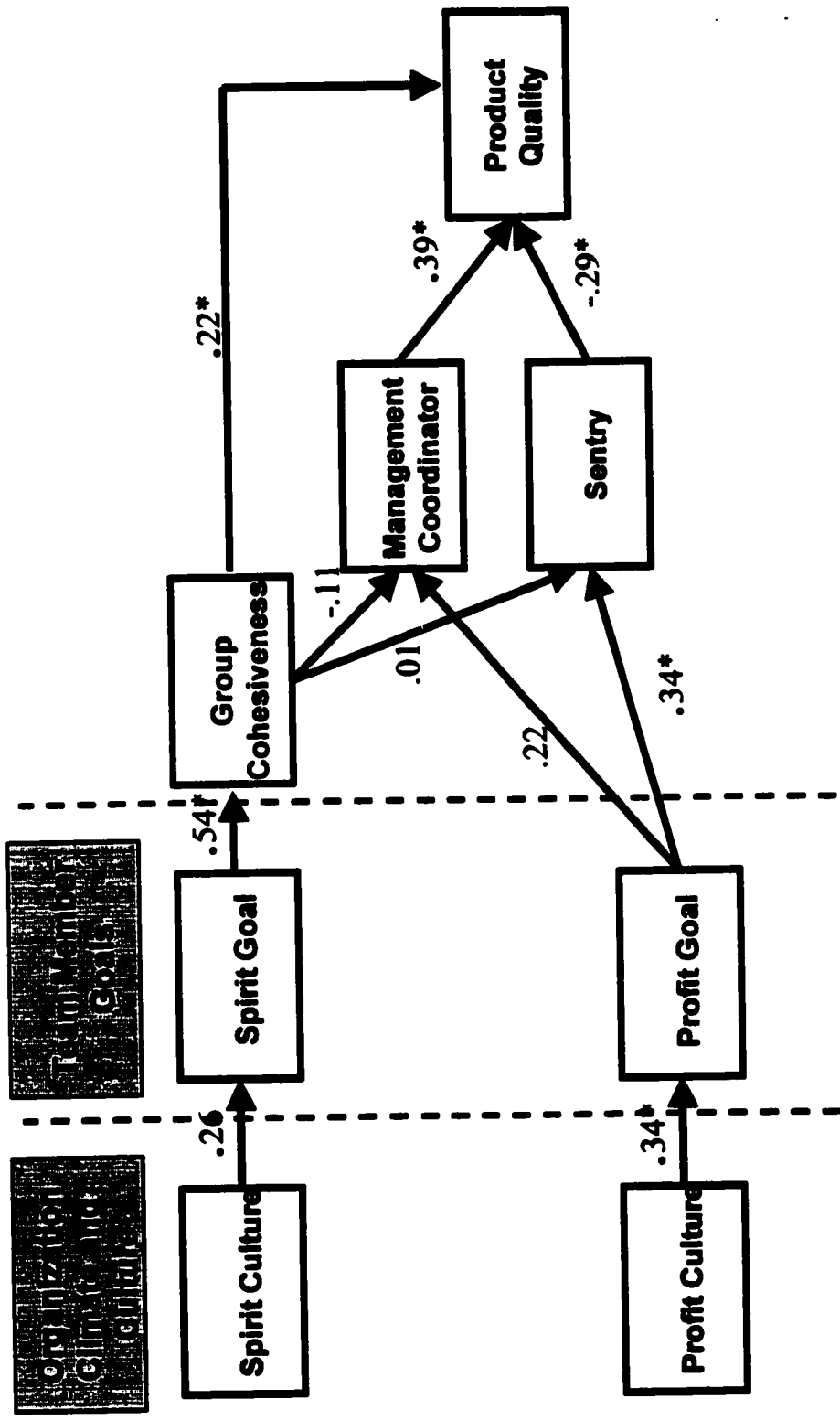


Figure 6: Results of the Path Analysis of the Model Predicting Communication and Product Quality

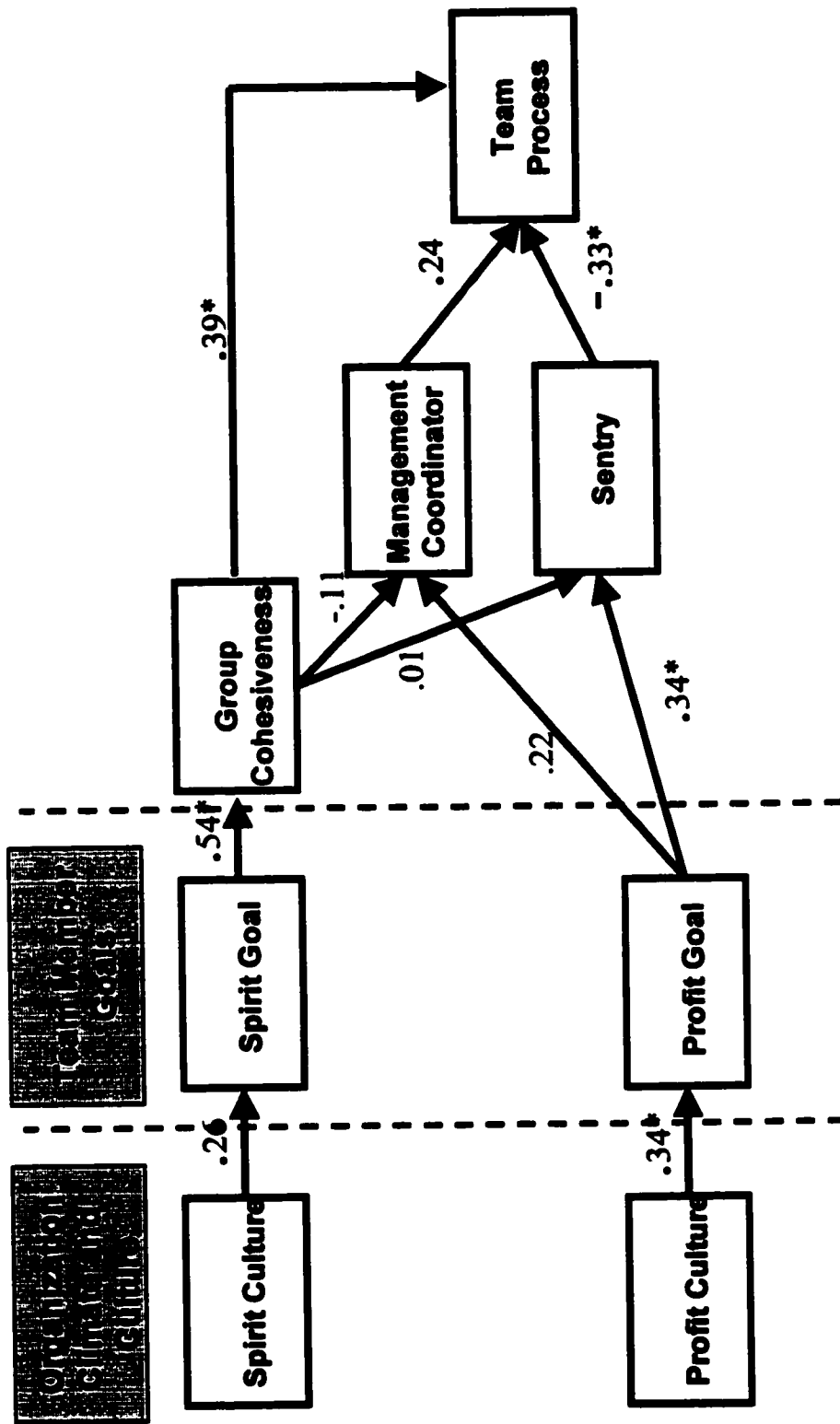


Figure 7: Results of the Path Analysis of the Model Predicting Communication and Team Process

(iii) The Differences Between Strategy and Product Related Communication in Predicting Performance.

Using both types of Management Coordinator communication (Strategy- and Product-related) and both performance subscales (Product Quality and Team Process) it is possible to test four different models linking Management Coordinator communication and Performance.

Comparing the results of these four analyses provides a clearer picture of the item content that is driving the correlations. Figures 8 through 11 show the path coefficients for the different models. These results suggest that both types of Management Coordinator communication are more strongly related to Product Quality than to Team Process. In addition, results show that Management Coordinator (Strategy) is more highly related to performance than is Management Coordinator (Product). The strongest of the four relations is between Strategy communication and Product Quality, whereas as the weakest of the relations is between Product communication and Team Process (which is not statistically significant).

EXPLORATORY ANALYSES

Exploring Groupthink: Cohesiveness, Isolationism, and Communication

As mentioned, the prediction that Group Cohesiveness would be positively related to Sentry activity and negatively related to Management Coordinator activity was based on the theory of groupthink. This theory suggests that when groups become very cohesive, they alter their normal activities to reduce conflict and dissension. One way of reducing this conflict is to minimize communication with outsiders who might interject opposing viewpoints. Clearly, groupthink is quite an extreme phenomenon. Perhaps the present sample did not include teams with such extreme cohesiveness as would be needed to cause groupthink.

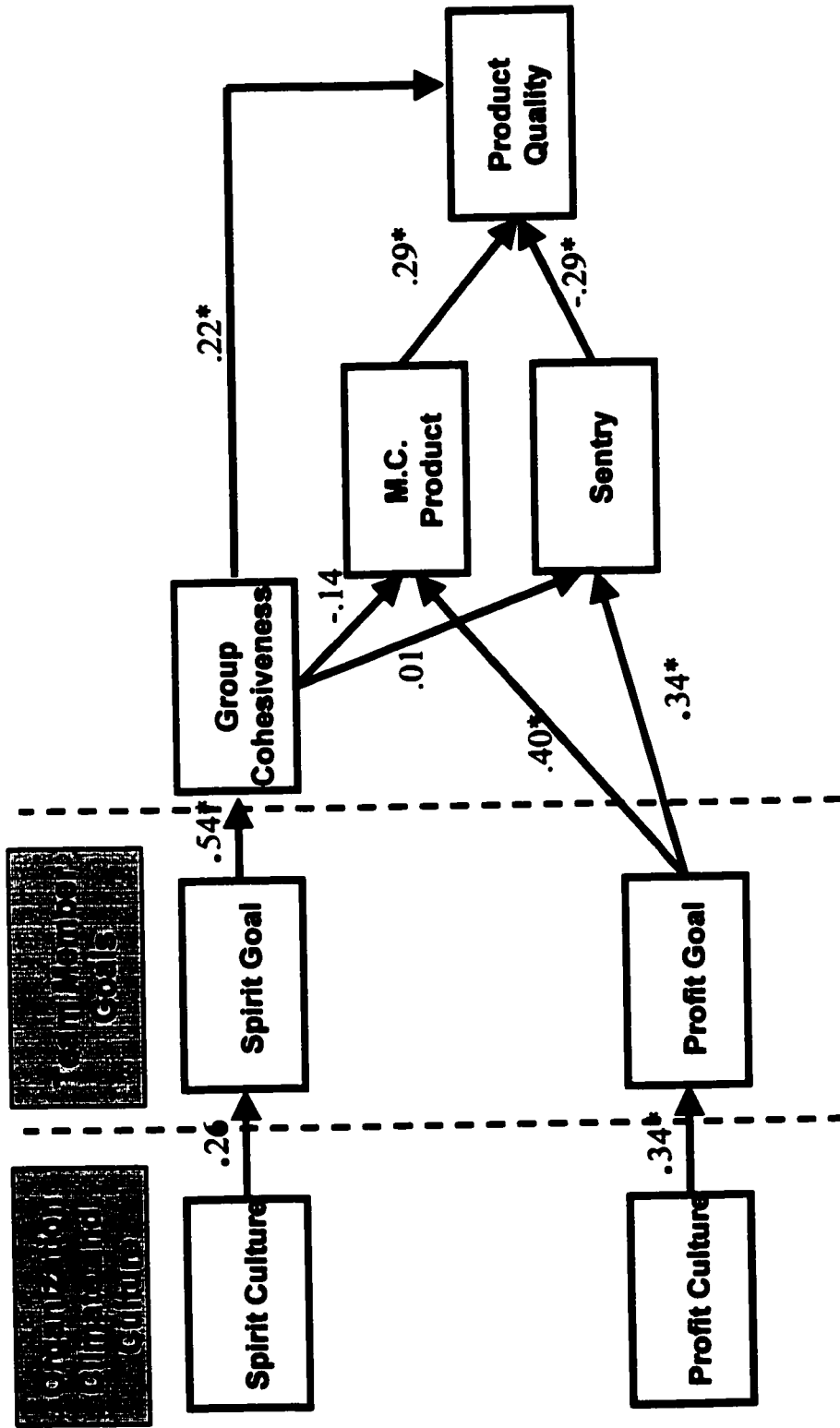


Figure 8: Results of the Path Analysis of the Model Predicting Management Coordinator: Product and Product Quality

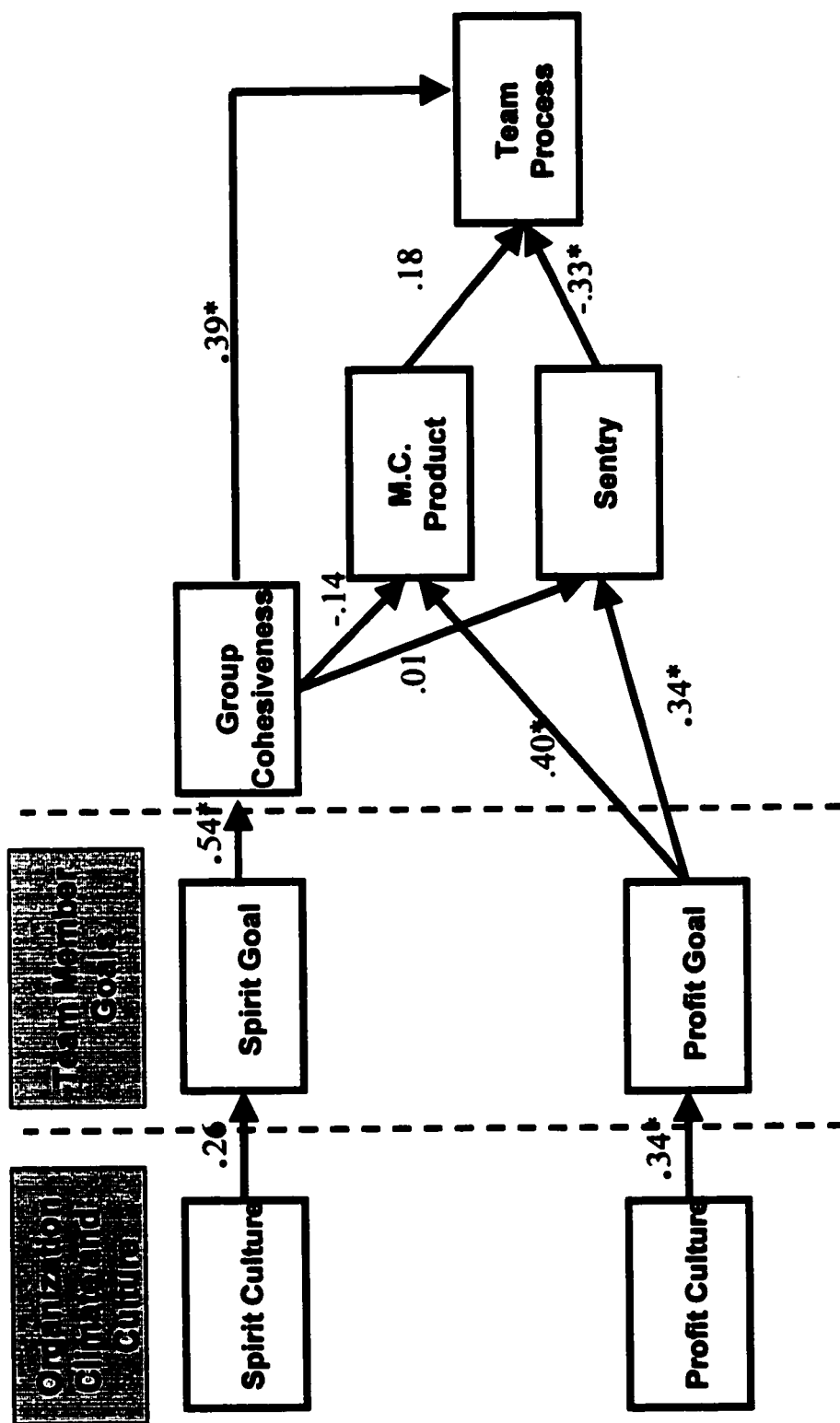


Figure 9: Results of the Path Analysis of the Model Predicting Management Coordinator: Product and Team Process

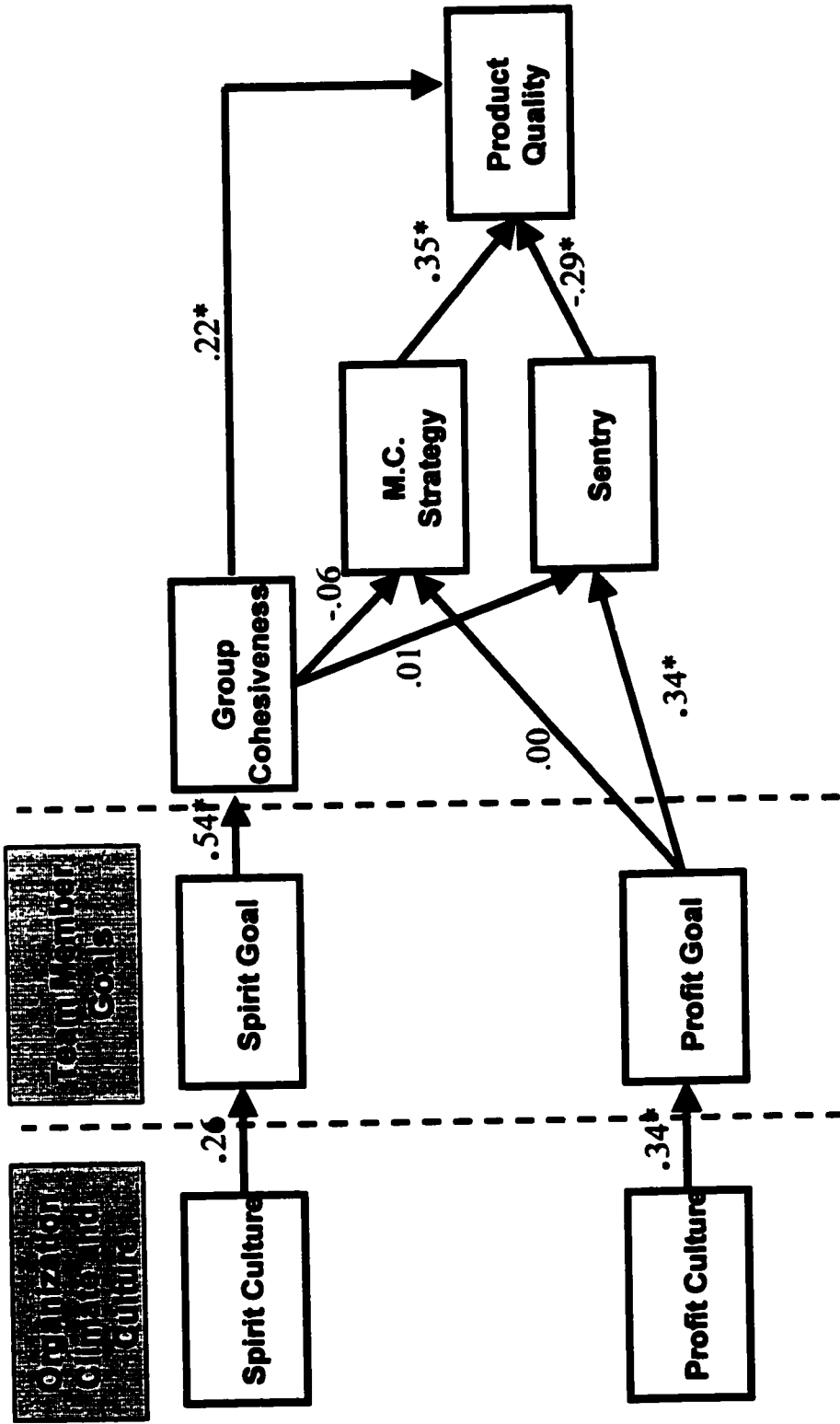


Figure 10: Results of the Path Analysis of the Model Predicting Management Coordinator: Strategy and Product Quality

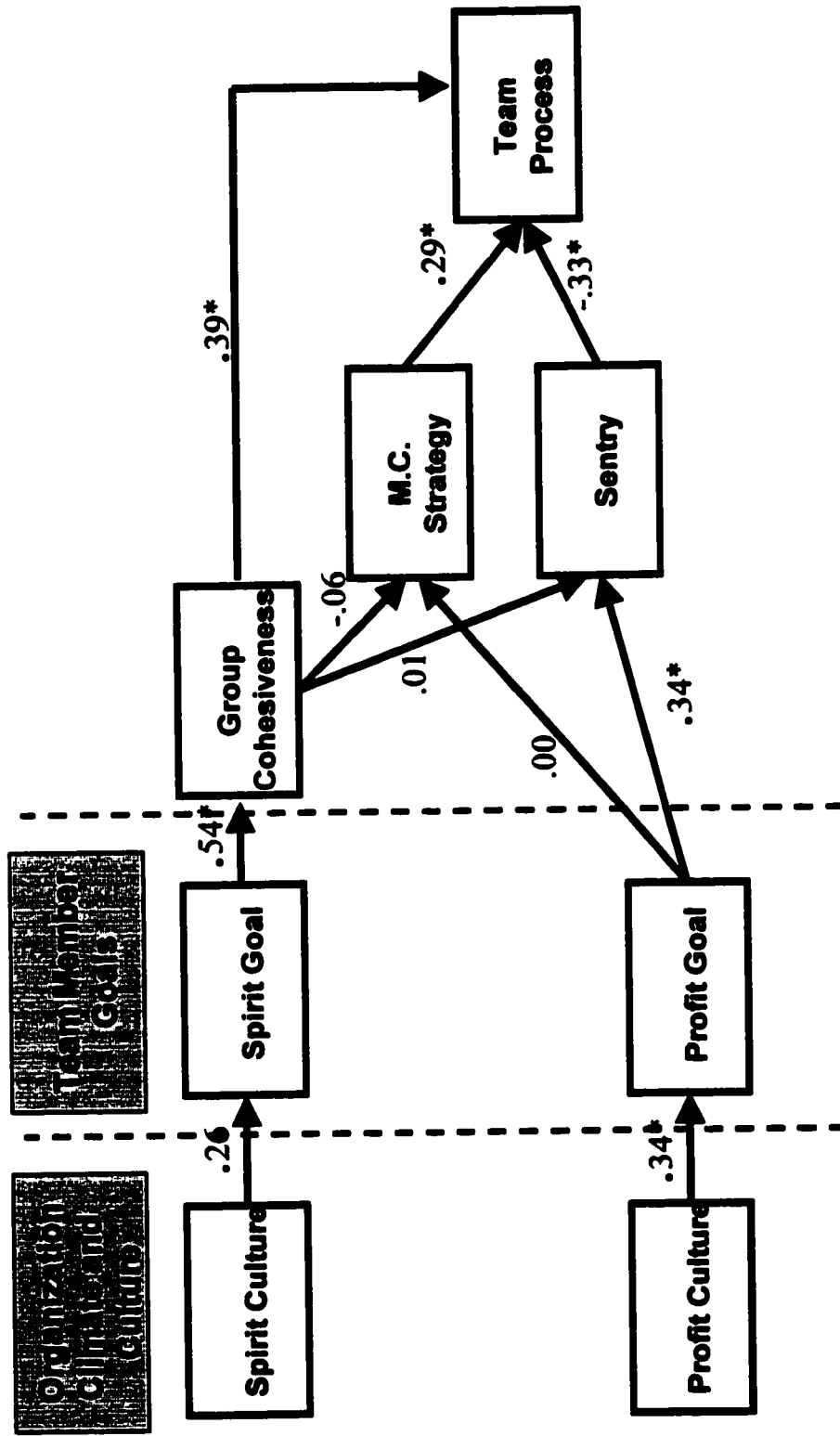


Figure 11: Results of the Path Analysis of the Model Predicting Management Coordinator: Strategy and Team Process

(i) Levels of Group Cohesiveness.

The mean level of Group Cohesiveness was 3.80 out of a possible 5, with a standard deviation of .31. This distribution was slightly positively skewed with somewhat more teams scoring below the mean than above it. There was certainly no grouping of teams with very high levels of Cohesiveness and perhaps no team was so Cohesive that they were motivated to sever communication with people outside their team. That possibility can be tested directly using the measure of isolationism included in the survey. When groupthink occurs, teams isolate themselves from outside influence. This was definitely not the case in this sample. The mean score on the Isolationism measure was only 2.04 out of a possible five. Moreover, the most isolationist team scored only 3.20 on the scale. These low levels on the measure of Isolationism suggest that groupthink was not occurring.

The relation between Group Cohesiveness and Isolationism was tested in two ways. First, the linear relation was assessed using a simple bivariate correlation. Contrary to Groupthink hypotheses, Group Cohesiveness was negatively linearly related to Isolationism, $r(37) = -.50$, $p = .002$, suggesting that highly cohesive teams were less likely to report closing the team boundary to outsiders. Second, it is possible that Cohesiveness is curvilinearly related to Isolationism such that extreme levels of Cohesiveness (both high and low) are associated with Isolationism because either extreme is indicative of problems with group process. The Curvfit program of SPSS was used to test the hypothesis that Cohesiveness and Isolationism have a quadratic relation. Results did not support this notion as the Beta-weight for the quadratic term was not significant, $\beta = .29$, $p > .10$.

Team Tenure

There are several interesting issues related to changes in team process with increasing team tenure. Respondents in the present survey were asked for how many months their team had been working together. Unfortunately, as described in the method section, there was a great deal of variability within teams in members' reports of team tenure. For that reason, analyses based on aggregations of team tenure to the group level can be considered only "exploratory." The effect of heterogeneity within a team is a reduction in the reliability of a scale, making it more difficult to detect significant effects. The presence of significant relations of tenure with other variables suggest that the reliability is high enough to justify aggregation.

Interestingly, tenure was significantly related to several variables under consideration. For example, communication patterns were related to the length of time team had been working together. Teams with greater tenure engaged in less Task Coordinator communication, $r(37) = -.30$, $p = .07$, and in less communication with outside technical experts, $r(37) = -.29$, $p = .08$. In contrast, although tenure was not significantly related to the other communication scales in their entirety, there was a significant positive relation between tenure and the guard activity of "avoiding the release of information to others in the company to protect the team's image or the product it is working on," $r(37) = .37$, $p = .03$. In general, the pattern was for tenure to be positively related to the activities that inhibit communication (Sentry and Guard) and to be negatively related to activities that promote communication. The other set of variables that is related to tenure is the perceptions of the organizational climate and culture. Teams that have been together longer report receiving more direct and

indirect messages about both Spirit Culture, $r(37) = .47, p = .004$ and Profit Culture, $r(37) = .28, p = .09$. Teams with longer tenure do not differ from newer teams on any of the other group process variables (including Group Cohesiveness).

Team Members' Ratings of Performance

Although managerial ratings of team performance were the primary criterion of interest, the data collected also included team members ratings of their own performance. There was a small, but significant correlation between the team ratings and managerial ratings, $r = .28, p < .10$. Somewhat surprisingly, the mean performance ratings of managers and team members were very similar ($M = 3.47$ versus $M = 3.43, SD = .61$ and $.43$). Substituting team performance ratings for managerial ratings in the path analysis yielded very different results from the managerial rating analyses. More specifically, Management Coordinator and Sentry communication were not significantly predictive of Team Performance ratings. The only significant predictor from the managerial analysis was Group Cohesiveness, which was even more strongly related to team ratings of performance, $\beta = .69, p < .001$.

QUALITATIVE FOLLOW-UP

As described in the general introduction, the purpose of the present research was to examine the role of external communication in the performance of new product development teams. In the quantitative section of this study, empirical relations among several variables, including different types of communication, group process variables, organization-level variables and team performance were examined. Results of the survey suggested that the performance of teams reporting more Management Coordinator communication was rated more positively by senior managers than was the performance of teams communicating with managers to a lesser extent.

The survey provided very valuable information about the relations of group process variables in the performance of new product development teams. It is, however, imprudent to draw conclusions about the directions of causality based on the results of a cross-sectional survey. To begin to address directionality and to help generate hypotheses that will drive future experimental work, focus-groups were conducted with new product development team members. The goal of the qualitative follow-up study was to discuss the findings of the survey with members of several different teams and, in so doing, to gain insight into how group process variables might be related to team performance.

The quantitative research examined relations among a large set of variables and it was infeasible to have discussions about all of the variables included in the survey. Instead, the intended topics of the focus-groups were the three variables most central to the model tested in the quantitative research; (1) Management Coordinator communication, (2) Sentry communication, and (3) Group Cohesiveness. More distal variables, such as organization

climate and culture, were not specifically raised as issues in focus-group discussion, although it was hoped that the influences of these variables would be apparent in the comments of focus-group members.

METHOD

Participants

(i) Organizations.

Focus-groups were conducted with two teams from each of two participating organizations. The four teams varied with respect to several factors. With respect to the novelty of their products, two teams were evolving an existing technology for use with a new customer base, whereas the other two were pioneering more revolutionary designs. With respect to their products, one organization represented in the focus-groups designs products that integrate both hardware and software, whereas the other is primarily a hardware developer. The two organizations represented the extremes with respect to size. One organization participating in the focus-groups was the largest one included in the survey sample (greater than 30,000 employees worldwide), whereas the other was the smallest (with only 1,000 employees). Both were old, established companies.

With respect to size, two of the focus-groups included three participants, one group included four, and one included five participants. In all cases, the focus-group consisted of only a subgroup of actual team members. With respect to the heterogeneity of organizational functions, one of the three-person focus-groups was comprised solely of engineers whereas the other three focus-groups included a variety of mechanical engineers, electrical engineers,

manufacturing representatives, and project leaders. Of the 15 participants, three were women and 12 were men.

Procedure

The sample of organizations from which to choose the focus-groups was limited by geography. Three companies participating in the original quantitative sample were within a six-hour drive and those companies were asked to participate in the qualitative follow-up. At each of the three companies, the contact person from the quantitative survey was contacted by telephone. The contact was asked whether or not his/her employees would be interested in participating in focus-groups that were being conducted as a follow-up to the communication survey. Meetings were arranged with four teams within the two companies who were willing to participate.

To encourage the participation of people who were very busy, we conducted all focus-group sessions over lunch, with the facilitator providing pizza and drinks for the participants. Sessions lasted for between one and two hours. The relaxed, informal environment created by hosting the sessions over lunch was in some ways beneficial and in some ways detrimental because of the kind of conversations it promoted (These conversations will be discussed in the results.) For the most part, participants were very interested in the topic and very interested in the results of the research project.

Discussion Framework

Although I afforded a great deal of flexibility to follow the conversation where it led, I entered the focus-groups with a set of prepared questions and some related probes. At the outset, participants were told that they could describe situations or opinions related to their

current team or to teams they have worked on in the past. They were, however, discouraged from talking too much about teams about which they did not have first-hand experience.

(i) Introduction.

Participants were welcomed and thanked for their participation. Each member was provided with a copy of the original survey to which they could refer throughout the discussions. Participants were then given a brief overview of the results of the quantitative study. Specifically, they were told that, of the communication behaviours they had been asked about, the Management Coordinator and Sentry roles were most predictive of managers' ratings of performance. In addition, they were told that Group Cohesiveness was related positively to managers' ratings of teams' performance. Finally, I mentioned the lack of support for the groupthink hypotheses, which had proposed that extreme cohesiveness would lead to reductions in Management Coordinator communication and to parallel increases in Sentry communication.

(ii) Key Issues.

Management Coordinator Communication

Do you do it? Does it help? What information do you get from managers?

Are you aware of the overall strategy of the organization? Do you try to create products that will support this strategy? Are there aspects of Management Coordinator communication that you believe are unhelpful?

Sentry Communication

Do you do it? Does it help? How much information do you typically have flowing into the team? Who performs the Sentry role? Can there be too much Sentry activity?

Do you prefer to have a Sentry in a team or not to have one?

Group Cohesiveness

Is it a good thing? What are the threats to group cohesiveness? What factors enhance group cohesiveness? Is group cohesiveness ever a hindrance? Have you ever experienced a group where there is so much cohesiveness that they sever most communication with people outside the team?

FINDINGS

The discussions in the focus-groups provided information that was very helpful for understanding the results of the quantitative research. A complete listing of the issues raised in the focus groups is presented in Table 4.

Management Coordinator Communication.

The value placed on communicating with managers varied greatly depending on which team was being interviewed. The worst appraisal of the value of Management Coordinator communication was given by Team 1. The focus-group session started with the comment “We never talk to a manager to get a new perspective.” With further probing, it was obvious that this team was frustrated by what they considered to be short-sightedness among the senior leaders in the organization. The frustration was especially apparent when they were asked about the value of asking managers to provide insight into the organizational strategy or business goals. Members of the team expressed frustration that the organization doesn’t make strategy clear and as a result, team members can’t make decisions based on what would best suit the strategy. For example, the team is required to get a product to an important trade show each year. This usually causes extreme time pressures for team members. They suggested that

Table 4: Focus Group Comments

TOPIC		Sentry	Group Cohesiveness	Other
Team	<p>Management Coordinator</p> <p>We never talk to a manager to get a new perspective.</p> <p>The manager needs to understand the scope of the problem and its implications.</p> <p>It's the manager's orientation that is so important. He or she needs to have an engineering background or they just don't understand our problems and issues.</p> <p>Formal channels of communication: It is really easy to get to speak with the first level manager and even easy to get to speak with the second level manager, but beyond that, you just don't have access.</p> <p>Management needs to be careful not to push ideas on people who are too passive. Sometimes a poor team leader will just accept everything that the manager has to say and not question it. That</p>	<p>The important thing about the Sentry role is to have someone who is really good at it. If you could have someone who knew what information to pass along and what to stop, it would be really helpful for saving time while still keeping you informed.</p>	<p>Getting along with the team is really important.</p> <p>There are lots of times when unpleasant things need to be said and in those times it is really important to be sensitive and word things carefully.</p> <p>Doing things with the goal of making decisions that are good for the organization is important, but not as important as having a happy group.</p> <p>Sometimes things are "fun" and nothing gets done.</p> <p>Some conflict is stimulating as long as it is not personal.</p> <p>I was in a team where cohesiveness led to us isolating ourselves (in a different company). Battles between groups made it really unpleasant. In that team, when one guy left, everyone left.</p>	<p>Location within the plant is strongly related to communication, electrical and software talk frequently because they have informal discussions because they are collocated.</p> <p>Production people are far away and information does not get transferred as easily</p> <p>Big meetings with all stakeholders in the group gave a really good idea of where the project was at. The problem is that at some point other people's work just</p>

	<p>leads to problems when what they have promised is not feasible. There is a lot of dysfunctional communication that goes on.</p>		<p>That's the risk you take when the team is a really close group (in fact, the people all moved to the same place together)</p> <p>In my experience, cohesiveness is only a problem at a real extreme. It is really rare to see it become detrimental.</p>	<p>becomes irrelevant. Team members are really taken for granted much of the time.</p> <p>Voice of the customer: The voice of the customer is important, but it can be overrated sometimes. I guess what is helpful is to know how you plan to use the product.</p>
2	<p>Leaders come to you "in your face." They are always there telling you what they want. But when you need them, they are never there.</p> <p>The problem is that a lot of managers are people who are really hard to communicate with, and it's just not worth it. They have already made up their mind when they come to you, and they are not going to change it.</p> <p>For managers, scheduling is the only thing that really matters. Is</p>	<p>Look, it happens, you get saturated. Ideally, the team leader should perform that role. If you have a good team leader, they will.</p> <p>Unfortunately, the Sentry is often too high up. They make decisions about what information should and should not come to us, but they don't understand our perspective and they don't know what information would be</p>	<p>There is some degree of "forced bonding" around here.</p> <p>We have company sessions where you have to "get to know each other" etc.</p> <p>One of the most successful times for cohesiveness is the picnic. When you are at the picnic, you are in this huge wide open space and you can just wander around and talk to whomever you want about whatever you want. It's that freedom to "bond" on your own</p>	<p>Decision making is a big issue around here. Often you will go to managers with a decision that you think should be made and then they won't make a decision. Everyone is scared to do something that is "final."</p> <p>There is a real problem with strategic thinking.</p>

	<p>it going to be done on time? They are only worried about covering themselves because they have promised the finished product to someone else and they have to cover their rear ends. In my experience, managers make commitments before they come and talk to you and then they just tell you that there is no choice, it has to be finished by then. It is not frequency of communication that's important, it is the type. Managers here have made a real effort, they have weekly meetings etc. But if it is only one-way communication at the meetings then it is a waste of time. Having managers who appreciate you and understand the problems you face is the issue. (facilitator asked about the degree to which strategy and goals are communicated) response: We just don't get access to long term strategy. No one tells us what is going on beyond our project. This is a really reactive</p>	<p>helpful to us. The team leader is the right level for the Sentry role. One of the biggest problems these days is e-mail pollution. It is just so easy to send an e-mail out to the entire company and to people for whom the message is irrelevant. A huge problem on our team is that people cannot stay focused because they are still responsible for old projects. If there was a way to filter out that information it would be really helpful.</p>	<p>terms that makes it work. It is genuine.</p>	<p>By the time things have reached us, we often get a speech about how there is "no time to think strategically this time" Just this one time, do it this way. But when you keep postponing any discussion of where you are going strategically, you keep having crises. The most frequent types of communication are for the purposes of product, scheduling, and communicating with marketing. Sometimes talking with marketing makes things worse. They want more and better and they don't understand the trade-offs that you</p>
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	<p>environment. They let the crisis build and then they deal with it. Sometimes managers have good ideas, but it is rare that we get any input.</p> <p>What we do a lot of is what you are calling the Ambassador role, we have to get other people to support our product.</p> <p>I think that the communicating with managers is really helpful in a team when the manager has credibility. If he has proven to you that he will listen and respect where you are coming from, you can build a really valuable relationship. Then you get more information too.</p>			<p>need to get things done on their timeline.</p> <p>Voice of customer: In my experience, focus groups with customers have made our products better.</p> <p>We really need a higher-up who is a risk taker, that would make all the difference.</p>
3	<p>Strategy is a really important issue here because we have a new policy of tying R&D money to projects that are aligned with strategy. If you don't fit with the strategy these days you don't get funding.</p> <p>In a way, strategy isn't communicated from managers here. A lot of strategy is driven by the engineers and percolated</p>	<p>We never cut off communication with the customer or the market. We encourage communication with customers, field people, sales reps.</p> <p>Our managers are really helpful and there isn't really a need to filter out the communication. I</p>	<p>Our team is spread all over the world. This makes sense because it ties us more closely to the customer and gives us market coverage.</p> <p>There is definitely a certain level of conflict in the team because people have different agendas. Who is going to run the business? People are used to having a certain amount of</p>	<p>When teams don't work it is mostly the fault of senior people. The biggest problem is often egos. The other problem is when there are no clear synergies or when activities are disjointed.</p>

	<p>upward.</p> <p>We have no problem communicating upward. The senior people really help in this group and it's good because people give them credit for what they do.</p> <p>The other thing we did was to bring in someone from the customer industry to give us guidance. This really keeps us in tune with what our strategy and business goals need to be.</p> <p>There is very little research that is not attached to the market.</p> <p>Engineering groups have to show that what they do is tied to business in the future.</p>	<p>guess a good manager filters himself, knowing the what is worth telling the team and what isn't.</p>	<p>power.</p> <p>The matrix nature of the company makes a lot of the issues more difficult. No one ever just reports to one person. There is functional reporting, business unit, and geographic accountabilities.</p>	<p>One of the issues with communication is that the messenger is often the one who gets "shot."</p> <p>Sometimes people don't want to communicate negative information because people will take it out on them.</p> <p>These days, the company is run by "bean counters" who believe that it is better to buy than to make. It changes the atmosphere for the engineers when this is the new way of doing things in the organization.</p> <p>Innovation these days is all about understanding what the problems and needs are... it doesn't matter if</p>
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				<p>you have to go out and buy something from somewhere else, you just have to solve the problems that the market has.</p>
4	<p>A lot of the communication that goes on relates to the matrix organization. You are often treated as a representative of your functional group. You have to be a "conduit" between your team and your functional department.</p> <p>The process upwards is very formal. Everything is related to timing and setting commitments.</p> <p>Things are good if the area's plan matches the global plan, but often the plan that comes from above is a stretch.</p> <p>The problem with the strategy of the firm is that it keeps changing. There is a new CEO and there is a new "flavour of the month." The climate becomes "I'm not going to spend much time on this because it's just going to change."</p>	<p>Communication takes a lot of time and effort. Sometimes it is just not worth it... it gets you off course.</p>	<p>The team structure just doesn't work when people are told that they have to be on a certain team. People are frustrated because they have no authority and they are just lame ducks.</p> <p>The worst team I've been on was just because of a bad mix of people. There were two directive people and the rest were compliant. There was no balance. The directive people would get frustrated. In that case, people formally requested to be taken off the team. The reaction was to make the team very directive with more lashing. They didn't even bother with team building. They just weren't proactive about team dynamics. In this case, the supplier relations weren't bad, the customers</p>	<p>The president of the business unit is extremely aware of what's going on. There is nowhere to hide 14 years worth of skunkworks.</p> <p>Now everything is a defined process for a concept. The days of playing in the sand are over.</p> <p>The company now delineates between R&D for a product line versus the advanced development that is still cutting edge.</p> <p>I had a problem when the functional groups wouldn't</p>

			<p>weren't bad. The manager could manage fine, he just couldn't build a cross-functional team.</p> <p>To have a really successful team the leader needs to blend personalities. It's also important to have some "wins" to keep the team revitalized.</p> <p>There are no more lone wolves in this organization.</p>	<p>support my team.</p> <p>There was no engineering rep on the team, but problems kept coming up after the fact. With no engineering rep, you still have to get the work done. The chain is only as strong as the weakest link.</p>
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knowing how the organization would like to balance speed with quality would help them decide how to proceed.

In stark contrast to Team 1, Team 3 had very positive things to say about the management of their business unit. Members of this team believe that they had a very good idea of strategy because it is built into the project planning process. In their case, the strategy was clearly to solve the problems expressed by the customers using whatever resources (internal or external) were required to get the job done. In this case, knowing the strategy did not mean that the team members agreed with the strategy, but they were able to make decisions knowing what would be rewarded by the organization.

In general, team members suggested that managers do not make a great effort to inform team members of the organizational strategy, business goals, or context. Several participants suggested that this information would be beneficial in the new product development process.

Sentry Communication.

Opinions about the Sentry role were mixed. Almost all participants suggested that Sentry activity is necessary to some degree, but who the appropriate person is to filter the information and what needs to be filtered was debated. With respect to the appropriate person to perform Sentry duties, many of the participants mentioned the team leader. These team members felt that the leader was the one who got access to the most information and was thus in the best position to determine what information should be shared with the team. Another participant said that the filtering should be happening at the source, with senior people being more aware of limitations on the amount of information people can process. One team mentioned a problem with allowing senior people to filter information. They suggested that

the senior people who decide on what information to share don't understand team members' perspective and, therefore, don't know what information would be helpful or not.

With respect to the type of information participants believed needs to be filtered, there were two different issues. First, several participants mentioned the increasing amount of information to which they are exposed because of e-mail. It was not uncommon for team members to receive 100 e-mails within a week. This barrage of information was considered a distraction by several focus-group participants. Second, one team particularly mentioned the problem of legacy issues. Because the cross-functional new product development teams are continually changing, members often have responsibilities to past teams. These responsibilities often distract team members from their new work. One participant suggested that it would be highly beneficial to limit this type of communication.

Group Cohesiveness.

This was the most controversial topic discussed in the focus-groups. Although all participants agreed that some degree of cohesiveness is important, several people were very negative about the "artificial" ways that managers try to promote cohesiveness. For example, one team discussed what they called team "bonding sessions" that were forced upon them by their manager. These team members argued that the best way to increase cohesiveness is to give opportunities for people to interact casually. They provided the example of the company picnic... "When you are at the picnic, you are in this huge wide open space and you can just wander around and talk to whomever you want about whatever you want. It's that freedom to "bond" on your own terms that makes it work. It is genuine." A participant in another team said that in his experience the cross-functional team just does not work when people are told

that they have to be on a certain team. The focus-group results suggested that it is not possible to force group cohesiveness, but rather it has to develop naturally over time.

Participants were also asked whether too much group cohesiveness could be a bad thing. One participant described a team in which the level of group cohesiveness became so high that the group could no longer function properly. In this case, the participants described extreme isolationism and a strong in-group bias. Members of that team were reluctant to allow new perspectives into the team or to discuss issues with outsiders. It was interesting to learn that one member of this team eventually decided to leave the organization, and he was subsequently joined at his new firm by several other members of the old team.

DISCUSSION

The purpose of the present research was to examine the role of Management Coordinator communication in the new product development process. The results of the quantitative and qualitative studies contributed to our understanding of the importance of external communication in three ways. First, the results supported the expansion of existing communication schemes to include the Management Coordinator role, a communication role aimed at bringing information from management into the new product development team. Second, the results explicated several group process variables that are related to Management Coordinator and Sentry communication. Finally, the data described herein were used to test a model of how communication and its antecedents relate to managerial ratings of Team Process and Product Quality in new product development teams.

At the most descriptive level, the data indicated that communication behaviours that are intended to transmit information (i.e., the Management Coordinator, Ambassador, and Task Coordinator roles) were used more frequently by team members than were roles inhibiting communication (i.e., Sentry and Guard roles). Technical Scout activity was also reported to a relatively lesser extent. This pattern is somewhat similar to that uncovered by Ancona and Caldwell (1992a) in which Ambassador activity was the most common, whereas Guard activity was the least common communication activity reported by team members. The extent to which teams reported engaging in these different types of communication was also related to various team characteristics. Team tenure was one of the demographic characteristics related to communication. Older teams were less likely to use Task Coordinator communication or to use technical expert communication. Conversely, older

teams were more likely to use guard activities. These results revealed a tendency for older teams to engage in less communication with people outside the team than teams that are earlier in their life cycle. This finding is similar to one uncovered by Katz (1982) in his study of product development teams. In that study, he found that length of team tenure was related negatively to the amount of communication with outside professionals.

It is possible that older teams have completed many of the tasks that would benefit from extensive Task Coordinator or technical expert communication and instead, older teams might focus on getting their product diffused through the organization. If this were true, one would expect decreasing Task Coordinator communication to be met with a corresponding increase in Ambassador or Management Coordinator communication. Interestingly, there is no such increase in communication among older teams.

The extent to which teams reported engaging in Task Coordinator communication was also related to the environmental context in which teams were working. Teams working in more established fields (working against greater competition but with more past experience) engaged in more Task Coordinator communication than teams working on more revolutionary projects. As discussed earlier, the Task Coordinator role involves procuring necessary resources, aligning schedules to avoid delays, and resolving design issues with other groups in the organization. The relative propensity to engage in Task Coordinator activity among teams in more established fields might be explained by the teams' increased awareness of what coordination is required, knowledge that older teams have gained through past experience.

RELATION OF COMMUNICATION AND PERFORMANCE

In addition to describing the levels of various types of communication, the present study examined relations between two specific types of communication and team performance. Results demonstrated that teams who, on average, report communicating with managers to a greater extent are rated more positively by senior managers than are teams who communicate with their managers less. More specifically, analysis of two separate performance dimensions showed that Management Coordinator predicted managerial ratings of product quality and team process. The finding that Management Coordinator communication related to both Product Quality and Team process is consistent with Kanter's argument that communication fuels both the "creative" and the "political" sides of innovation when there is a free flow of ideas (Kanter, 1988).

Although the relation between Management Coordinator communication and performance had not been tested empirically until now, past theorizing suggested that the two variables should be related. For example, in discussing the results of his previous studies, Thamhain (1990) included management involvement and good communication in the list of factors that managers perceive as important to product team performance. His empirical results supported the existence of relations between performance and both good communication and management involvement. In Thamhain's study, however, managers provided the data on the drivers and their relations to performance. The present study provided stronger evidence of the importance of communicating with management because rater-bias was reduced by collecting the ratings of management involvement from team members and collecting the ratings of performance from senior managers.

Results of supplementary analyses suggested that some aspects of the Management Coordinator role might be more pertinent than others in predicting high performance. More specifically, the items of the Management Coordinator scale referred to two different purposes for communicating with managers. The first type of item asked about communication seeking information on product design (e.g., “Encourage managers to have input into the product design process”). The second type of item asked about communication seeking information on organization strategy and the current context of the organization (e.g., “Keep up with management’s strategy of what markets need to be tapped”). Reflecting on the arguments of innovation theorists, it was clear that they emphasized the latter purpose when urging teams to communicate with management.

Results suggested that the relation between Management Coordinator communication and performance was being driven by the strategy-related items. The importance of having team members aligned with the broader organizational context has been discussed by several innovation theorists. For instance, Van de Ven (1986) argued that successful management of innovation requires an institutional context that fosters innovation and aligns teams with a larger, more encompassing organization mission and strategy. Thamhain and Wilemon (1987) recommend that senior management help to communicate the project objectives and their importance to the organization. Similarly, Kanter cites the work of Bailyn (1985) in suggesting that teams are given too much “strategic autonomy,” being left on their own to make decisions about the goals of their research. Kanter argues that the formula for success in new product development is giving strong directives regarding strategy and freeing up operational controls for the team (Kanter, 1988).

The qualitative data provided by the focus-groups also speaks to the importance of the strategy component of the Management Coordinator role. Comments made by two of the teams revealed frustration at the lack of strategy information provided to them. Participants in both groups suggested that knowing “the big picture” would help them make decisions about their project such as when to make a trade-off between quality and speed (the classic dilemma when it is vitally important to be first-to-market). Focus-group members argued that their organization doesn’t make them aware of broader organizational goals and that they, therefore, cannot work with those goals in mind.

The second type of communication included in the model of team performance was Sentry activity. Unlike Management Coordinator communication, because Sentry activity aims to reduce the amount of information coming into the team, it was expected to relate negatively to performance. The results of the present study supported that hypothesis as teams who reported engaging in Sentry activity to a greater extent were rated less favourably by their managers.

Sentry activity was negatively related to both product and process related performance. The magnitude of those relations, however, suggested that engaging in a greater amount of Sentry activity is more deleterious to the innovation process than to the quality of the product being developed.

The direction of the relation between Sentry activity and product development team performance is somewhat contentious. Although the importance of good communication is stressed by innovation theorists (e.g., Ancona and Caldwell, 1992; Angle, 1987; Van de Ven, 1988), some argue that, at critical points in the development process, teams need to reduce the

amount of information coming into the team. Kanter argues that the “group must both buffer itself against too much input from its environment as well as manage the demand for what it is producing so it has an appropriate level of exchange with the world around it—not too much, not too little” (Kanter, 1988, p. 192). The results of the present study did not support the idea that Sentry activity is beneficial to team performance.

GROUP COHESIVENESS AND GROUPTHINK

Results of the path analysis suggest that group cohesiveness has a strong, positive, linear relation with managerial ratings of performance. Teams whose members report feeling closer to one another and more supportive as a group were rated more favourably by their managers. More specifically, managers rated the innovation process more favourably in highly cohesive groups, whereas cohesiveness was not significantly related to the quality and innovativeness of the product being developed.

It was hypothesized that moderate levels of group cohesiveness would be necessary for teams to perform well, but that exceedingly high levels of group cohesiveness would be associated with reduced levels of communication and corresponding reductions in performance ratings as groupthink set in. The idea that group cohesiveness can be a positive or a negative phenomenon is a delicate issue facing managers. Angle argues that

“group cohesiveness can either foster or thwart organizational effectiveness, depending on how well integrated the goals of the group are with those of the larger organization. Indeed, resolving the potential clashes between commitments to the subunit and commitments to the organization constitutes one of the classic dilemmas facing management. Because of the intensity of people’s

engagement and the inherent discontinuity between the innovation and the established order, resolution of this dilemma assumes particular importance in the case of innovation" (Angle, 1987, p. 159).

Somewhat unexpectedly, in the present study, cohesiveness was not significantly related to either Management Coordinator or Sentry communication. Furthermore, the results of a curvilinear regression did not support the hypothesis that performance would drop-off in highly cohesive teams. These results run counter to the findings that extremely cohesive groups begin to focus exclusively on group process to the detriment task demands and decision quality (e.g., Ancona, 1990; Mans & Sims, 1982). It is worth noting that the issue of statistical power might be salient here because of the reduced power to detect an interaction or a curvilinear effect.

One possible explanation for the absence of negative effects of group cohesiveness is that no teams in the present sample were sufficiently cohesive to cause groupthink to occur. This idea is supported by the finding that teams did not endorse an isolationist approach. In fact, only one team had a mean level of isolationism above the midpoint of the 5-point scale. The idea that extremely high group cohesiveness is rare among new product development teams was supported by the qualitative results in which only one participant could provide an example of the deleterious effects of cohesiveness.

A study by Pelz and Andrews (1966) suggested that heterogeneous groups become very homogeneous in perspective and approach, but in that study, the timeframe for that assimilation to occur was three years. It might be that the teams in the present sample had not been working together for long enough to become extremely cohesive.

TEAM MEMBER GOALS, CLIMATE, AND CULTURE

Results of the path analysis indicated that team members' goals were related to their group cohesiveness and to their communication behaviours. With respect to the measure of Spirit Goals, teams who, on average, reported wanting to maintain harmonious group relations also rated themselves as more cohesive. With respect to the measure of Profit Goals, teams who strongly endorsed Profit Goals engaged in Sentry activities to a greater extent than did teams rating Profit Goals as less important. There was also some evidence that team members' goals were related to the direct and indirect messages of organizational climate and culture. Specifically, team members' Profit Goals were strongly related to the extent to which the organization and its managers emphasize the importance of making decisions based on what is best for the organization. The relation between the Spirit Culture of the organization and team members Spirit Goals did not reach statistical significance in this sample.

CONTRIBUTIONS

The results of this quantitative and qualitative research made at least three important contributions to new product development research. First, this study expanded on existing communication schemes by defining and creating a measure of the Management Coordinator role, a communication role aimed at bringing information from management into the new product development team. This is an important addition to past research because previous communication typologies did not include communication from management into new product development teams. The most important deficiency of these past typologies (Ancona & Caldwell, 1987; Ancona & Caldwell, 1992) and questionnaires was that they did not allow researchers to test the hypotheses of pre-eminent innovation theorists such as Van de Ven and

Kanter, who argued that the communication of strategy into new product development teams is essential for maximizing their performance. The creation of this measure made possible an empirical examination of this hypothesis.

Second, the results explicated the relations of Group Cohesiveness to Management Coordinator and Sentry communication and to team performance. This was an important contribution to new product development research because it shed light on the proposition that group cohesiveness is a delicate balance, with too little or too much cohesiveness threatening efficient team performance. The present study supported the notion that low levels of cohesiveness are associated with poor performance. It did not, however, support the idea that excessive levels of cohesiveness are deleterious (as might be expected based on the logic of groupthink). Although the concept of groupthink has been applied to new product development team once previously (Mans & Sims, 1982), this study is the first empirical test of the relations of cohesiveness, isolationism, communication, and performance.

Third, the data described herein were used to test a model of how communication and its antecedents relate to managerial ratings of team performance. Although previous work by Ancona and Caldwell (1992) has shown that communication behaviors predict team performance, enhanced measurement and the use of structural equation techniques in the present research allowed the researcher to discriminate what aspects of Management Coordinator communication (Strategy- or Product-related communications) were related to which type of performance enhancements (enhanced product or process). No previous study has provided this kind of insight into the process by which communication enhances new product development.

LIMITATIONS

Reverse Causality

The direction of causality is always debatable when using a cross-sectional design. In the case of the present study, the possibility of reverse causality is particularly relevant. For example, teams describing their organizational climate and culture as one that reinforces the importance of team spirit also report that their personal goals are to have happy teams. Although the present model suggests that organizational climate and culture influence employees' personal goals, the data cannot rule out the possibility that people who wish to promote positive group relations have a biased perception of their organizational culture.

Even more central to the current theory of team functioning is the relation of Management Coordinator communication and performance ratings. The present model posits that greater communication leads to enhanced performance. Again, the data cannot prove definitively that that is the true direction of causality. It is possible, for instance, that teams who perceive more favourable attitudes on the part of their manager are more comfortable initiating communication with that person. Thus, the standard admonition applies, results of the present study can only be taken as evidence of the existence of relations between variables, and not as evidence that causality occurs in the direction implied by the theory.

Cross-sectional Design

The present study made use of a cross-sectional research design. A cross-sectional design is not optimal for the study of new product development. Unfortunately, it is extremely difficult to gain access to teams of these very busy and pressured people. As noted in the method section, attempts were made to contact 500 organizations developing new products.

Even when interested people with the authority to make such a decision were engaged by telephone, the number of teams who were unable to spare the time to participate was high. It takes several years for innovation researchers to build the kind of relationships with new product development teams that allows them the access needed to conduct longitudinal studies of ongoing product development efforts. A longitudinal design would certainly have allowed me to test the changes in the relations of Sentry communication and performance over the new product development lifecycle.

Homogeneous Sample

Kanter specifies that the isolation of the new product development team is more appropriate later in the innovation process, after the product idea has been generated, when the group must focus on developing and elaborating on an idea without distraction. Although the present results demonstrate that (1) teams engaging in more Sentry activity are rated less favourably by managers, and (2) Sentry activity is unrelated to team tenure, they do not speak directly to the possibility that older teams that engage in more Sentry activity might outperform older teams that do not engage in Sentry activity. Ideally, a sample including a distribution of teams with varying tenure could be used to test this possibility.

Small Sample:

The number of teams for which complete data were available was quite low. As a result, the ratio of cases to variables for the path analyses fell below the conventionally acceptable ratio of 5:1 (Klein, 1998). To ensure that the regression coefficients were reasonably stable, the two exogenous variables pertaining to Organizational Climate and Culture were removed from the analyses (raising the ratio of cases to variables to a

conventionally acceptable level). The pattern of results in this analyses was identical to the original analyses, with the regression coefficients shifting only slightly. Thus, the regression weights seem to be stable, even given the relatively small sample size.

Team member disparities on demographic characteristics:

As discussed in the method section, there was a great deal of variability in how members of the same team responded to the questions about their team's characteristics. Some of the discrepancies are likely due to differences in whether respondents were referring to a "core" versus a more complete group of people working on the project. This explanation does not, however, explain the cases where respondents reported a smaller number of individuals than on the "core" team. These discrepancies raise concerns that respondents were not rating the same attitude object (i.e., the same team) and thus that there would not be homogeneity within teams for the variables in the model. Fortunately, the observed level of homogeneity on variables such as group cohesiveness suggests that team members were rating their teams similarly regardless of the exact members to whom they were referring. One caveat is important. Differences in team member's perceptions of who is included in the team might have lead one respondent to classify a given communication as Sentry communication (because they filtered information coming from a person who is not on the team), whereas another member might have considered the same communication to have been internal to the team (and thus not described it on the survey). Results pertaining to Sentry communication should be interpreted with the appropriate level of caution.

Future research could alleviate these concerns by having managers provide respondents with a list of the team members to whom they should be referring. This would be especially

important in cases where there is a core and an extended team.

Reliance on Single Method:

As is often the case with survey methods, the quantitative portion of this study suffered from method bias. That is, the ratings of team member goals, cohesiveness, and communication were all collected from the same source on the same questionnaire. Correlations of variables collected through a single survey tend to be somewhat inflated compared with the correlations of variables collected through a variety of survey, archival, and observational methods. Thus, the reader should consider the magnitude of the relations between the variables provided in these results as estimates that must be triangulated with data from other sources such as the comments provided in the qualitative study.

Performance Ratings

There are several issues related to the type of performance measures used in the present study. First, performance ratings were strictly subjective and did not include objective measures such as cost of development or product marketshare. The reason for that is obvious given the cross-sectional design. A similar study conducted longitudinally could measure the effects of process variables (such as communication) both during the development stage and on the subsequent performance of the product after it is released to the market. Being limited by a cross-sectional design, it was only possible to collect measures of team performance at the same time as collecting measures of communication behaviours and group process variables. Although the present study relied on subjective ratings, to enhance the generalizability of the performance measures, items that have been shown previously to relate to future product performance were included in the performance index. These items included whether or not the

product had unique benefits to the user and whether the product incorporated emerging technologies. It was hoped that including these items would improve the measurement of the criterion relative to studies asking only about the overall innovativeness of the product.

A second issue related to the performance measure is the reliance on a single rater for each organization. The use of one rater can be thought of as a help or a hindrance to the validity of the study. On the one side, using a single rater makes the researcher dependent on the quality of that rater's judgements. Each rater's personal biases are likely to impact the ratings of the teams. On the other side, the use of a single rater eliminates one level of variability in the performance ratings. If a different rater had judged each group within an organization, it would be impossible to discern whether differences in ratings were due to differences in team performance or to differences in the raters themselves. In sum, the choice of the single rater strategy enhanced interpretability of responses but left the data open to the raters' personal biases. Future studies using a combination of objective and subjective criteria would be less susceptible to these personal biases.

Demographic Variables

The present data were greatly limited with respect to demographic variables. At the individual level, extreme discomfort among managers at the prospect of being able to single out respondents meant that all questions about individual-level characteristics were excluded from the questionnaire. At the team-level, every attempt was made to collect information about the size of the team, the functional breakdown of team members, and the team's stage in the development process. Curiously, there were wildly different responses to these questions from members of the same team. As a result, analyses including demographic variables had to

be treated as exploratory, with the caution that heterogeneity within groups threatened the interpretation of team-level aggregates of these variables. Future research can benefit from this experience in two ways. First, researchers should be sure to collect “objective” information regarding team characteristics (including organizational charts, and lists of members). Second, it is a fascinating question in and of itself why members of the same team have such discrepant perceptions of team membership and tenure. This suggests a breakdown in communication with managers that is far more elemental than the communication discussed in the present research. It is hard to imagine that team members can make maximal use of communication networks when they are not in agreement about team membership. Future research could explore the causes of these discrepancies and the managerial actions that might ameliorate this peculiar problem.

DIRECTIONS FOR FUTURE RESEARCH

Results of the present study suggest several areas for future research. As mentioned above, team members show little agreement with each other in their perceptions of the demographic characteristics of their team. Future research should explore the causes (e.g., poor communication from project leaders, personal definitions of what constitutes the team) and the results of such disparities.

Another issue exposed by the present research is the discrepancy between the predictors of teams’ and managers’ ratings of performance. For example, whereas Sentry activity was negatively related to managerial ratings of performance, it was positively related to ratings provided by the teams themselves. Furthermore, Management Coordinator communication was related to managers’ ratings of team performance but not to teams’

ratings.

These discrepancies in what predicts managers' versus teams' ratings are similar to those found by Ancona and Caldwell (1992) in their study of new product development teams. In contrast, Thamhain and Wilemon (1987) showed high levels of agreement between managers and product team members on what they rated as the most important task- and people-related qualities for innovation success. One difference in method is that both the present study and that of Ancona and Caldwell collected team members' ratings on several dimensions and then correlated those ratings with performance ratings. In contrast, Thamain and Wilemon (1987) just asked team members and managers what they believed to be the most important factors to team success.

Future research should explore the disconnect between managers and teams to determine the conditions under which ratings will be similar and those under which they will be different. This issue is of great import for the management of innovation because team members are likely to engage in the behaviours that they believe will lead to success. If their perceptions of those success factors are somehow distorted, team members with the best intentions might be expending their energies in the wrong direction.

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APPENDIX A

Ancona and Caldwell's Team Communication Questionnaire Items

- 1. Absorb outside pressures for the team so it can work free of interference.**
- 2. Protect the team from outside interference.**
- 3. Prevent outsiders from "overloading" the team with too much information or too many requests.**
- 4. Persuade other individuals that the team's activities are important.**
- 5. Scan the environment inside your organization for threats to the product team.**
- 6. "Talk up" the team to outsiders.**
- 7. Persuade others to support the team's decisions.**
- 8. Acquire resources (e.g., money, new members, equipment) for the team.**
- 9. Report the progress of the team to a higher organizational level.**
- 10. Find out whether others in the company support or oppose your team's activities.**
- 11. Find out information on your company's strategy or political situation that may affect the project.**
- 12. Keep other groups in the company informed of your team's activities.**
- 13. Resolve design problems with external groups.**
- 14. Coordinate activities with external groups.**
- 15. Procure things which the team needs from other groups or individuals in the company.**
- 16. Negotiate with others for delivery deadlines.**
- 17. Review product design with outsiders.**

- 18. Find out what competing firms or groups are doing on similar projects.**
- 19. Scan the environment inside or outside the organization for marketing ideas/expertise.**
- 20. Collect technical information/ideas from individuals outside of the team.**
- 21. Scan the environment inside or outside the organization for technical ideas/expertise.**
- 22. Keep news about the team secret from others in the company until the appropriate time.**
- 23. Avoid releasing information to others in the company to protect the team's image or product it is working on.**
- 24. Control the release of information from the team in an effort to present the profile we want to show.**

APPENDIX B

Initial Contact Script

My name is Liane Davey and I am a researcher at the University of Waterloo Institute for Innovation Research. We are currently looking for organizations that would be interested in participating in research on new product development.

To be more specific, we are looking for organizations with several new product development teams that would be willing to participate in a study on communication patterns in innovative teams. Currently, several companies including Digital, and NCR are participating in the research..

Although there has been increasing interest in the early stages of product development (labeled by some as the "fuzzy front end") much of this interest has been focussed on specific technical or engineering aspects of the task. Our project is focussed on the way people experience the ambiguity and the lack of clarity when trying to develop a new product.

The project has two components. First, we would like to survey a large number of new product development teams to get a better understanding of the way they experience new product formulation. This survey asks questions about patterns of communication, team goals, and the team's view of its own performance. In addition to having team members fill out the questionnaires, we need one manager to fill out a very brief questionnaire about the teams' performance to date.

The second component of the project will only be completed with a subgroup of companies (as dictated by interest and geographic location). The purpose of the second

component is to conduct focus groups with a few teams. We hope that having an interactive session with team members will help us to probe some of the interesting questions that arise from the survey. This focus group would take an hour or two of team members' time. We could arrange to do this over lunch, if that would be convenient for people.

WHAT ARE THE BENEFITS TO YOUR ORGANIZATION

In return for participating in this project, we will provide a full report on the results of the study. As we will be surveying a wide variety of organizations, we believe that this report will provide valuable benchmarking data. In addition, participating companies will be given a copy of a final report detailing the findings and implications of the research.

If you would like more information about the project, please let me know. I appreciate your help.

APPENDIX C

First Page of Employee Survey Questionnaire

INNOVATION IN NEW PRODUCT TEAMS: TEAM COMMUNICATION SURVEY

The purpose of this survey is to assess the impact of different communication patterns on new product formulation teams. The survey has been designed and administered by researchers at the University of Waterloo, with support from the Social Sciences and Humanities Research Council (SSHRC).

The survey asks about your communication with your team, your communication with people outside of the team, and the messages that people outside the team communicate to you. For the purposes of this survey, a "team" is defined as a group of individuals who are working together to formulate a product.

Responses to this survey will be presented as averages or other non-individualized descriptions, so that responses will remain completely confidential. Surveys are coded only with a number to indicate your team membership. How many people belong to the team?

<p>How many members are from each of the following functional areas?</p> <p>_____ engineers/technical specialists _____ marketing/sales _____ project management _____ manufacturing/production _____ other (please specify): _____ _____</p> <p>How long has the team been together? _____ years and _____ months</p> <p>How long do you expect will be required to finish the formulation stage of this project? _____ years and _____ months</p>	<p>Assuming that researching initial specs is the beginning, and getting a decision about going forward with the product is the end, show on this timeline approximately how far into formulation your team is presently.</p> <p>Please describe briefly the main tasks your team is working on at this point.</p> <p>_____ _____ _____ _____</p>
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APPENDIX D

Organizational Climate and Culture Items

- 1. Managers foster a cooperative spirit among members of a team**
- 2. Managers state explicitly that teams should be concerned that their product will complement intellectual assets (core competencies) of the firm**
- 3. Teams are expected to focus their decision making on what will yield the best results for the company**
- 4. In this organization, you just don't get really close to the people on your team**
- 5. Managers make it clear that teams should be tightly knit groups**
- 6. In this organization, the emphasis is on profit**
- 7. Managers become concerned if the members of a team become a very close group**
- 8. Team members in this company feel a responsibility to cut the company's losses if a product formulation isn't going well**
- 9. The culture in this company is that there should be solidarity among members of teams**
- 10. Management wants teams to link their product designs to organizational strategy**
- 11. Management makes it clear that teams are responsible for making the best use of organizational resources**

APPENDIX E

Team Member Goals Items

- 1. I want to create a group atmosphere that is supportive of team members**
- 2. I want to have an efficient team that can get things done without conflict**
- 3. I want everyone to enjoy working in our team**
- 4. I want to get things done without wasting time arguing**
- 5. I want to help design a product that is very innovative**
- 6. I want to help design a product that is very important to the company's bottom line**
- 7. I want to make decisions that help the company be profitable**
- 8. I want my decisions to reflect management's perspective**
- 9. I want to help develop a product that fits well with existing product lines**
- 10. I want our product to have an impact on the organization**
- 11. I want to be friends with the people on my team**
- 12. I want to see something we created being put into production**

APPENDIX F

Isolationism Items

- 1. Teams usually have all the expertise they need without looking for information outside of their team**
- 2. The team's success depends on finding sources of information outside of the team**
- 3. Communicating with people outside of your team distracts you from getting your job done**
- 4. Having open lines of communication with people outside the team is crucial to success**
- 5. Managers' expertise is not really suited to helping in product formulation**
- 6. If a team works on its own for long, it loses touch with the rest of the organization**
- 7. A lot of communication with managers runs the risk of getting the team off track**
- 8. People outside the team can be helpful because they have different perspectives on teams' products**
- 9. The more advice you can get from people outside the team, the better**
- 10. Teams should have an opportunity to "work the bugs out" of their idea without having to answer to people outside the team**

APPENDIX G

Cohesiveness Items

- 1. I am interested in how my teammates feel about me**
- 2. I am willing to defend members of my team from criticism**
- 3. Members of my team do not impress me**
- 4. Members of my team get along well**
- 5. I feel somewhat detached from members of my team**
- 6. I am careful not to say things that will upset my teammates**
- 7. Maintaining good relationships with my teammates is important to me**
- 8. I am proud to tell people that I belong to my team**
- 9. I frequently compromise so that meetings will run smoothly**
- 10. My team is not a very supportive group**
- 11. I don't have much in common with my teammates**
- 12. Working with my teammates is very satisfying**
- 13. Our team meetings are often hindered by conflict**

APPENDIX H

Communication Items

- CMC1** **Communicate with managers about product ideas**
- CMC2** **Look for suggestions from managers two or more levels about the team's direct supervisor**
- CMC3** **Encourage managers to have input in the product design process**
- CMC4** **Seek out constructive criticism from managers**
- CMC5** **Seek out information about your company's strategy that might affect the project**
- CMC6** **Try to determine from management how the product could be a good fit with existing product lines**
- CMC7** **Discuss strategic organizational goals with management**
- CMC8** **Look for a new perspective on a problem by talking to managers**
- CMC9** **Discuss product ideas with senior managers**
- CMC10** **Keep up with management's strategy of what markets need to be tapped**
- CA1** **Persuade other that the team's activities are important**
- CA2** **"Talk up" the team to outsiders**
- CA3** **Persuade others to support the team's decisions**
- CA4** **Scan the environment inside the organization for threats to the product team**
- CA5** **Report progress of the team to a higher organizational level**

- CA6 Find out whether others in the company support or oppose your team's activities**
- CA7 Keep other groups in the company informed of your team's activities**
- CA8 Tell others how the project fits in with the goals of the organization**
- CTC1 Look for a new perspective on a problem by talking to technical experts outside the team**
- CTC2 Resolve design problems with external groups**
- CTC3 Seek more resources (e.g., money, personnel, equipment) for the team**
- CTC4 Coordinate activities with external groups**
- CTC5 Procure things that the team needs from other groups of individuals in the company**
- CTC6 Negotiate with other for delivery deadlines**
- CTC7 Ensure other groups' schedules match with yours so that there are no delays in product development**
- CS1 Absorb outside pressures for the team so it can work free of interference**
- CS2 Protect the team from outside interference**
- CS3 Prevent outsiders from "overloading" the team with too much information or too many requests**
- CS4 Filter the information that is coming into the team**
- CS5 Prevent negative information from coming into the team**

- CS6** Cut off the flow of information into the team when it when it is time to focus on a solution
- CS7** Ensure that information from outside doesn't get the team off-track
- CS8** Stop controversial information from coming into the team
- CS9** Try to isolate the team so it can concentrate on developing the product
- CS10** Make decisions about what information will distract the team
- CG1** Keep news about the team secret until the appropriate time
- CG2** Avoid the release of information to others in the company to protect the team's image or the product it is working on
- CG3** Control the release of information from the team in an effort to present the profile the team wants to show
- CG4** Make decisions about when to discuss ideas with people outside the team
- CG5** Protect ideas that don't have the "bugs worked out" from being criticized by others
- CG6** Ensure that information about the product isn't leaked before the team is in agreement about the design
- COO1** Scan the environment outside the organization for marketing ideas/expertise
- COO2** Scan the environment outside the organization for technical idea/expertise
- COO3** Collect technical information/ideas from technical experts outside the organization
- COO4** Review product design with outsiders

- CO05 Find out what competing firms or groups are doing on similar projects**
- CO06 Discuss recent advances in your area of expertise with people outside of the organization**
- CO07 Talk to people outside of the organization who have a different area of expertise**
- CO08 Try to generate novel solutions to problems by bouncing ideas off technical experts outside the organization**
- CO09 Attend conferences or meetings to get a broad perspective on the problems your team faces**
- CO010 Talk with people outside the organization about emerging technologies**
- CO011 Communicate with technical experts about new market opportunities**

APPENDIX I

Performance Measure

1. On-time performance
2. On-budget performance
3. Creativity of ideas
4. Newness of ideas
5. Prioritizing work
6. Efficiency
7. Significance of ideas
8. Concern for quality
9. Incorporating emerging technology
10. Unique benefits to user
11. Attractiveness to market
12. Willingness to change the project plan if necessary
13. Commitment to the project
14. Defining goals
15. Meeting goals
16. Sticking to the task at hand
17. Overall innovation performance

APPENDIX J

Environment Items

1. How revolutionary (radical change) is the technology used in the product?
2. How evolutionary (incremental change) is the technology used in the product?
3. How much experience does the company have in developing similar products?
4. How much external competition does the product face?
5. At what rate is the target market changing?
6. How available is the necessary personnel?
7. How available is the necessary equipment?
8. How available are the necessary funds?