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# FROM CHIMNEYS TO CROSS-FUNCTIONAL TEAMS: DEVELOPING AND VALIDATING A DIAGNOSTIC MODEL

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**This article develops a framework for studying cross-functional teams in organizations that focuses on three domains: organizational context, internal process, and outcome measures. The framework was developed from qualitative data from over 200 individual and group interviews, written descriptions, and team observations. We then operationally defined this model through a set of questionnaire items and validated it through quantitative analysis of data from 565 members of cross-functional teams. The resulting framework provides a base for the future study of cross-functional teams.**

Cross-functional teams (CFTs) are spreading rapidly in organizations as they attempt to improve coordination and integration (Ford & Randolph, 1992; Knight, 1976), span organizational boundaries (Ancona, 1990; Ohmae, 1990), and cut cycle time in new product development (Ancona & Caldwell, 1992a; Hitt, Hoskisson, & Nixon, 1993; Takeuchi & Nonaka, 1986). Cross-functional teams take many forms, but they are most often structured as working groups, created to make decisions lower in an organization's hierarchy, that have links to multiple subunits—or "chimneys"—and are designed as an overlay to an existing functional organization (Galbraith, 1994). CFTs share many characteristics with conventional teams, but they also differ in important ways: First, they are usually representative groups in which each member has a competing social identity and obligation to another subunit of the organization (Alderfer, 1987; Alderfer & Smith, 1982; Brown, 1983). Second, they are often temporary task teams experiencing abundant pressure and conflict, so the early development of stable and effective group processes

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is critical to their success (Ford & Randolph, 1992; Gersick & Hackman, 1990). Third, cross-functional teams typically confront a different set of performance expectations than conventional work teams and are often expected to reduce cycle time, create knowledge, and disseminate organizational learning (Nonaka, 1991; Pinto & Slevin, 1988a, 1988b).

Empirical research on cross-functional teams, however, has lagged well behind their rate of adoption (Knight, 1976). Existing research on teams and their organizational contexts provides a useful point of departure but has left many important questions unanswered (Ancona, 1990; Ancona & Caldwell, 1992a; Gladstein, 1984; Hackman, 1987, 1990). In this article, we sought to develop a framework and a set of measures for examining cross-functional teams by first collecting and analyzing qualitative data from 200 members of CFTs to develop a conceptual framework and an item pool. We then refined those measures through the analysis of survey data from three separate samples totaling 565 team members. Thus, the primary contribution of this research is to examine a new and emerging organizational form and to develop a framework and a set of measures that can be used in studying that form. In addition, this article makes a contribution by contrasting CFTs with other types of teams and linking this research with the existing literature on teams and their contexts.

## CROSS-FUNCTIONAL TEAMS: BUILDING ON THE LITERATURE

Although there is little existing literature directly on cross-functional teams, two related streams of research have served as a starting point: The first of these is the literature on teams and their organizational contexts (Ancona, 1990; Ancona & Caldwell, 1992b; Gladstein, 1984; Hackman, 1987, 1990), and the second is the work on product development teams, which has frequently addressed the process of combining varied sources of expertise to create innovative outcomes (Cohen & Ledford, 1991; Donnellon, 1995; Katz, 1982; Katz & Allen, 1985; Pelz & Andrews, 1976; Takeuchi & Nonaka, 1986).

### The Organizational Context of Teamwork

Many authors have addressed the topic of team-based organizational design (Galbraith, 1973; Hackman & Walton, 1986; Leavitt, 1975; Manz, 1992; Pasmore, 1988), but relatively few have discussed the organizational context of teams—the overarching structures and systems external to a team that facilitate or inhibit its work. We begin by reviewing two distinct approaches to organizational context that appear in the literature, the first focusing on an organization's impact on teams (Hackman, 1987, 1990) and the second examining the teams' attempts to influence the larger organization (Ancona, 1990; Ancona & Caldwell, 1992a, 1992b).

These two approaches share several characteristics. For example, both perspectives examine context by looking at the interactions that occur in the interface between individual teams and their organizational environment. As such, they share a definition of context as something external to the team

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yet internal to the organization. In both approaches, team effectiveness is also a concern and is addressed through three-stage *context-process-outcome* models. These models are linked to more traditional social psychological input-process-outcome models (Hackman & Morris, 1975; Sundstrom, De-Meuse, & Futrell, 1990) and incorporate many of the suggestions offered by Guzzo and Shea (1993), Mowday and Sutton (1993), and O'Reilly (1991) in their discussions of the importance of developing a contextual perspective in group and organizational research.

Hackman's (1987, 1990) model of team effectiveness conceptualizes the impact of organizational context on teams in terms of three main influences: (1) the design of a team and its task, (2) the transfer of information, resources, and rewards to the team, and (3) the existence of process assistance that can be provided to facilitate a team's work. These three factors define the context domain and incorporate it within a general model of the effectiveness of work teams that also includes team processes and task outcomes. Our research was also influenced by Hackman's discussion of the relationship between context, team processes, and outcomes as well as by Gladstein's (1984) study showing that contextual factors were more potent determinants of team effectiveness than internal team processes.

The second approach to studying teams and their organizational contexts focuses on how teams manage their interface with the larger organization (Tushman, 1977; Tushman & Katz, 1980). Ancona and Caldwell (1988), for example, examined how project teams managed their organizational contexts in high-technology companies. Ancona (1990) extended this research by describing the role orientations of effective and ineffective consulting teams in an educational organization. Teams that were isolated, passive, or overly technical were far less successful than teams that proactively managed the political dynamics of their client organization. Ancona and Caldwell (1992b) reported similar findings from a study of product development teams.

Both of these perspectives have been applied to a wide range of teams, and they help to explain many aspects of the functioning of cross-functional teams. But several aspects of the multifaceted context of such representative teams are not addressed, since the primary purpose of these models is to conceptualize a team's interaction with a primary context. Hackman's model, for example, conceptualizes context in terms of the transfer of information, resources, and rewards from organization to team and pays only limited attention to possible conflicts and inconsistencies among the sources of these inputs. In addition, little empirical research has been done on the factors outlined in Hackman's (1987, 1990) model of team effectiveness.

Ancona (1990) and Ancona and Caldwell (1988, 1992a, 1992b) also presented a model that tends to conceptualize the influence of a team on a relatively unitary (albeit complex) organizational context. They argued that team members manage context through their strategic role orientations—teams with "task coordinators" or "ambassadors," for example, will be better able to control their context than teams whose members play the more passive role of "scout." These authors paid less attention, however, to the targets of

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a team's scouting or diplomacy, or to the need to scout one context, coordinate with a second context, and be diplomatic toward a third. CFTs must, however, coordinate action among a diverse set of functions, interests, and areas of expertise in order to be successful (Donnellon, 1995; Manz & Sims, 1987).

The existing literature on teams provides a rich base for conceptualizing the internal process of cross-functional teams, but neither Hackman nor Ancona included a particularly rich set of process dimensions in their studies of context, process, and outcomes. Since the fragmented context in which these teams operate may in fact place significant strains on team processes, it seems important for new research to reexamine the role of such processes in conjunction with a study of a multifaceted context. Finally, the relevant range of outcomes for CFTs has received little attention in existing research on context. Although such teams' tasks are integrative and often creative, existing studies of context have typically examined conventional outcomes, such as task performance, cohesiveness, and member satisfaction. Concern with these outcome issues, in particular, led us to examine additional research literature on product development teams.

**Product Development Teams: Internal Processes and Outcomes**

As noted in the introduction to this article, there are many different varieties of CFTs, including planning teams, ad hoc project teams, quality teams, process improvement teams, and product development teams. Although there are important differences among these types of teams, they all are typically task teams, with members representing multiple organizational functions, that are formed to integrate expertise from those functions and operate at a lower level in the hierarchy.

One research literature that helps contribute to a general understanding of CFTs is that on product development teams, a specific type of cross-functional team. Product development teams focus on combining diverse sources of expertise in order to develop innovative new products. Although some product development is still done by functional (for instance, engineering) teams, this approach is increasingly rare. Research on product development teams in many cases helps to highlight the general problems facing CFTs of all types.

Research on project management, new product development, and organizing for innovation and creativity (Imai, Nonaka, & Takeuchi, 1985; Larson & Gobeli, 1988; Pelz & Andrews, 1976; Tushman, 1978; Tushman & Nadler, 1986) has shown that effective new product development occurs when two conditions are present: First, the requisite diversity of viewpoints, disciplines, and functional specialties is represented in a team, and second, the team is able to span organizational boundaries and integrate the functional expertise represented by team members (Fruin, 1996).

This literature addresses the issue of the relationship between CFTs and their contexts but does so primarily in terms of the conflict created by matrix structures (Davis & Lawrence, 1977; Galbraith, 1973, 1994; Larson & Gobeli, 1987). Most product development teams are influenced by one line of author-

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ity for the functions—the source of the specific forms of expertise required to develop a new product—and a second line of authority for the project organization developing the product (Gobeli & Larson, 1987).

Implicit in this literature is the notion that cross-functional teams can perform systemic tasks such as product development better than functions working in isolation (Ancona & Caldwell, 1992a; Clark & Fujimoto, 1991; Nonaka, 1990; Takeuchi & Nonaka, 1986). This idea, however, often neglects the fact that team membership, identity, and loyalty in CFTs may be in question (Donnellon, 1995). Donnellon argued that CFTs are less often teams with a high degree of interdependence, a group task, and a strong group identity than they are "co-acting" work groups composed of independent, highly competitive individuals who pursue their own goals over those of the teams (Hackman, 1987; Katzenbach & Smith, 1993). These issues seem to suggest that internal team processes are an important mechanism to create organizational coordination (Ancona & Caldwell, 1987, 1990; Barker, Tjosvold, & Andrew, 1988).

The literature on product development teams also suggests a more relevant and complete set of outcome measures than traditional research on groups and their contexts (Gobeli & Larson, 1987; Pinto & Slevin, 1988a, 1988b). This research adds to the traditional measures of task accomplishment, cohesion, and member satisfaction, concerns such as time compression, innovation, the integration of diverse viewpoints, learning, and capability development (Clark & Fujimoto, 1991; Takeuchi & Nonaka, 1986).

Although the team context and product development literatures have generated important insights concerning the contexts, processes, and outcomes of effective teams, they have produced less in the way of theory development, comparative research, and development of measures. Thus, our central concern, the development of a framework for understanding the effectiveness of cross-functional teams and a complementary set of valid measures, has received only limited attention in either literature.

## METHODS

This study was conducted in two separate stages: First, we gathered qualitative data from stories, interviews, written descriptions, and observations. A content analysis of these data suggested a set of issues that cross-functional team members thought were important to the effectiveness of their teams. Next, we used these issues and the qualitative data from which they were drawn as a basis for generating a pool of questionnaire items that began to operationally define influences on team effectiveness (Pinto & Prescott, 1988). Drawing on previous research that has defined context, process, and outcomes as important domains in team research (Ancona, 1990; Ancona & Caldwell, 1992b; Gladstein, 1984; Hackman, 1987, 1990), we grouped the issues and items into three domains and began to identify the most salient items and dimensions for each domain. Analysis of data from two samples of members from a diverse collection of CFTs was used to refine a set of measures for the dimensions within each domain. All data were collected

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from multiple divisions and locations of one multinational organization, a large American automobile manufacturer, and included data from team members in 15 different countries. This article reports the results in detail for the final sample of 364 members of 43 product development teams.

We began collecting data by conducting 50 informal interviews with members of CFTs, including planning teams, quality teams, process improvement teams, and product development teams. Each interview focused on the effectiveness of a team that the interviewee had been a member of, and the data were captured as a set of stories about the important characteristics of CFTs. Next, we collected written descriptions of teams from 174 middle managers who had been members of CFTs and were participants in a management development program. They were asked to describe, in writing, an effective cross-functional team and an ineffective cross-functional team and to list the characteristics that they thought distinguished effective and ineffective teams.

Data from both of these sources were content-analyzed and then summarized in terms of a set of concepts and themes that captured the range of issues represented in the qualitative data. We grouped these concepts and themes into the three domains of context, process, and outcomes as suggested by the literature. From this set of concepts and the coded qualitative data from which they were drawn, we then developed an initial pool of questionnaire items to be used as the basis for a set of measures.

The second stage of the research focused on refining a valid and reliable set of measures for the context, process, and outcome domains suggested by the literature. In several cases in which the context was similar to existing scales in the literature, we borrowed items to help measure dimensions (Hackman, 1987; Hart, 1985). Next, we administered a questionnaire with this set of 123 items to 200 middle managers in a company executive development program. Respondents were asked to identify a team that they had been a member of and to respond to the items with respect to that team. On the basis of results, we added, discarded, or reworded items. This refinement process also involved frequent reference back to our qualitative data (Glaser & Strauss, 1967). This process was then repeated a second time on a second sample of 200 middle managers.

The resulting set of items was then administered to the members of 43 intact CFTs who were involved in three large product development programs, each of which was dedicated to one vehicle. Each of these programs was led by a program manager and was made up of 15–30 cross-functional teams that held responsibility for separate modules or subunits of the vehicle. Each of these teams had a core of 5–20 members who came from functional organizations such as design, body or powertrain engineering, manufacturing, marketing, purchasing, and so on. Since the official list of team members often included nominal members who did not attend meetings or contribute much, we asked the leaders of each team to identify core members of the team, those who attended meetings regularly, spent at least 20 percent of their time working for the team, and were central to the team's activities.

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Using this procedure, we targeted 565 individuals who were members of 43 CFTs as questionnaire respondents. Surveys were distributed to core team members by their team leader at one of their regular meetings, and respondents were given two weeks to complete the survey and return it to us using an enclosed envelope. After three weeks, a second set of surveys was distributed to those who had not yet responded. Overall, 364 respondents representing 43 CFTs responded for an overall response rate of 65 percent. The respondents were primarily managers and engineers between the ages of 25 and 55, 85 percent of whom were men.

## RESULTS

We begin by presenting a brief story for each domain, illustrating some of the dimensions identified by our qualitative research; we then present a factor analysis of the item pool for the domain. Finally, we present a second-order confirmatory factor analysis conducted to determine if the derived factors fit into the three domains suggested by the literature and by our qualitative analysis.

### Organizational Context

The context of cross-functional teams is complex and differs from that of more conventional teams in that it includes hierarchical, lateral, and interteam dependencies that require continuous negotiation. For teams to exist within an organizational environment, they must define their role in relation to upper management and resolve the inherent conflicts between the functions that they represent. An example drawn from an interview in one product development team shows how difficult this can be:

> The total amount of electrical power in a vehicle is determined by the capacity of the alternator. This power must serve over 20 subsystems, such as the stereo, the engine, the instrument panel, and so on. These subsystems are developed and controlled by separate "chimney" organizations, and power allocations must be made for each system. The problem was, in this vehicle program, when the requirements of all the chimneys and teams were added up, they equaled 125 percent of the capacity of the alternator. Keith, who had recently taken over as head of this vehicle program, which had made many changes in direction and was behind schedule to begin with, called a meeting of the Program Steering Team designed to resolve this conflict and reach a compromise. However, many of the chimney representatives who were the members of the team came to this meeting with instructions from their bosses (who, incidentally, did their performance appraisals . . . ) *not* to make any compromises, but to make certain that their chimney "got what it needed" and "didn't lose out." After Keith presented the group with the problem and the need to reach a compromise solution, their response surprised him: "It's not *our* problem," they replied, "it's *your* problem." Keith soon changed jobs again.

This story illustrates several of the critical dimensions of organizational context and their relation to team effectiveness. Power dynamics between

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teams and functional organizations can greatly limit the autonomy of a team and must be managed proactively. Furthermore, when a team's mission is a "moving target," its power is diminished. In addition, coordination with other cross-functional teams is often required. Finally, many needed resources and rewards, as this example illustrates, are controlled by the functional organizations rather than the team itself.

Table 1 presents the exploratory factor analysis (principal components with varimax rotation) for the context domain. Factor loadings above .50, our cutoff point for including an item in a factor, are presented in bold type.

The results show six dimensions with eigenvalues greater than 1.0: coordination with other teams; autonomy and power; linkage to functions; resources; mission and direction; and reward for team performance.

**Team Processes**

The conflicting demands inherent in the organizational context place a premium on a team's internal processes. Team members need to be both representatives of their functional authority structures and creative problem-solvers. Meeting both of these demands requires a broad and flexible team process. The following story, taken from a process improvement team, illustrates some of these dynamics:

> Our formalized approach to managing cross-functional teams can really get in the way. [For example,] . . . our organization has several common practices that make an effective team process difficult. [First,] . . . we always meet in large horseshoe shaped conference rooms and take turns making presentations to each other. Very few of these meetings actually lead to creative problem solving. Sometimes, a representative from one of the chimneys will come in and "drop the bomb," (deliver unexpected bad news) and then leave. [Second,] . . . the team is really a collection of subteams that come and go during a meeting depending on what's on the agenda. The "heavy breathers" (bosses) back home in the functions will sometimes even send a delegate to our meetings with instructions to just watch and "make sure nothing happens." The result is that the group doesn't take collective responsibility, and that can be very demotivating. [Third,] . . . many teams are assigned "content" leaders and "process" leaders. The content leader is the technical expert—the "real" boss—and the process leader helps run meetings and manage the team. The problem is that an effective team has to have flexible leadership—leadership and expertise need to change according to the issue and get passed around as needed.

This example illustrates the demands for both functional representation and creativity and the need to develop team identity and normative expectations if a team is to take collective responsibility for resolving a diverse set of demands. Leaders who facilitated flexible problem solving and team development seemed to have an advantage.

Table 2 presents the analysis for the team process domain. It reveals six factors: norms; the importance of the team's work; effort; efficiency; creative strategy; and breadth.

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## TABLE 1
## Results of Factor Analysis of the Organizational Context Domain

| Factors and Items | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Coordination with other teams ($\alpha$ = .813) | | | | | | |
| Our team is good at coordinating work with other teams in the program. | **.624** | .215 | .215 | .192 | .109 | .227 |
| The team is well-informed about activities of other teams doing related work. | **.549** | .143 | .143 | .184 | −.005 | .116 |
| Our team has difficulty working with other teams in the program.[a] | **.500** | −.410 | −.191 | −.183 | .077 | −.011 |
| Our team is isolated from the rest of the program.[a] | **.548** | −.191 | −.410 | −.099 | .146 | −.151 |
| Autonomy and power ($\alpha$ = .802) | | | | | | |
| The team's leader is effective at "going to bat" with upper management to get what is needed for the team. | .166 | **.807** | .109 | .228 | .014 | −.012 |
| Our team leader is a role model for the way that the job should be done in the future. | .218 | **.862** | .001 | .085 | .037 | .070 |
| Our team leader has the "clout" necessary to make things happen. | .012 | **.706** | **.077** | .172 | .132 | −.086 |
| Linkage to functions ($\alpha$ = .685) | | | | | | |
| Members of this team have enough authority to make important decisions for their home organization. | .243 | .143 | **.558** | .141 | .035 | .621 |
| Our team is able to resolve problems between the different home organizations effectively. | .048 | .070 | **.707** | .050 | .110 | .035 |
| Disputes between the different home organization represented on our team make it difficult to do our work.[a] | −.059 | −.080 | **.712** | −.146 | −.002 | −.191 |
| Resources ($\alpha$ = .721) | | | | | | |
| My home organization provides teams with the resources that they need to perform well. | .243 | .159 | .159 | **.780** | .098 | .035 |
| My home organization's control over budgets makes it difficult for the team to do its work.[a] | .004 | −.011 | −.011 | **.822** | −.094 | −.021 |
| Mission and direction ($\alpha$ = .757) | | | | | | |
| I have a clear understanding of the program's mission. | .014 | .021 | .021 | .090 | **.535** | .035 |
| I have a clear understanding of the team's mission. | .215 | .165 | .215 | .105 | **.719** | .056 |
| There is a clear mission statement or charter for my team. | .037 | .171 | .171 | .055 | **.746** | −.131 |
| The team has a clear idea what is expected from them. | .145 | .219 | .219 | .148 | **.658** | .229 |
| Reward for team performance ($\alpha$ = .665) | | | | | | |
| My performance review depends upon my performance as a member of the team. | .114 | −.209 | .209 | .055 | .154 | **.786** |
| My performance review depends upon the performance of the team. | .086 | −.115 | −.115 | .172 | .045 | **.837** |
| Effective work in support of teams is critical to my advancement within the organization. | .396 | .229 | .229 | −.085 | −.065 | **.607** |
| Eigenvalues | 6.751 | 1.940 | 1.503 | 1.313 | 1.171 | 1.04 |

[a] Item was reverse-coded.

## TABLE 2
## Results of Factor Analysis of the Team Process Domain

| Factors and Items | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Norms ($\alpha$ = .859) | | | | | | |
| It is clear in our team what is acceptable behavior and what is not acceptable. | **.835** | −.051 | .115 | .315 | .315 | .174 |
| Behavior in our team is very orderly—it is clear what members are expected to do and they do it. | **.719** | −.041 | .271 | .367 | .187 | .112 |
| Our group has clear standards for the behavior of group members. | **.833** | −.054 | .142 | .148 | .219 | .175 |
| The team has a strong process leader. | **.695** | .447 | −.015 | .195 | .076 | −.111 |
| Importance of the team's work ($\alpha$ = .808) | | | | | | |
| It was exciting for me to participate on this team. | .272 | **.571** | .085 | .071 | .014 | .186 |
| I am highly challenged by working on this team. | .115 | **.646** | .077 | .064 | .062 | .264 |
| The team's work is highly important to my own career. | .196 | **.773** | −.115 | −.012 | .194 | −.257 |
| The team's work is highly important to the company. | −.071 | **.791** | .002 | .195 | .176 | .195 |
| The team's work is highly important to my department. | .021 | **.743** | .146 | .032 | .095 | .064 |
| Effort ($\alpha$ = .690) | | | | | | |
| Some individuals do not pull their share of the workload.[a] | −.051 | .059 | **.826** | −.187 | −.313 | .127 |
| Everyone on our team cares about the team and works to make it one of the best. | .312 | .076 | **.802** | −.006 | .164 | .006 |
| Core team members give the team's work highest priority. | .347 | .015 | **.340** | .039 | .181 | .189 |
| Efficiency ($\alpha$ = .759) | | | | | | |
| In our team meetings we often get sidetracked into discussing peripheral issues. | −.125 | −.176 | −.251 | **.784** | −.029 | −.084 |
| After an issue is raised, we quickly reach a decision as to what to do about it. | .115 | .195 | .192 | **.746** | .195 | .395 |
| Team meetings are well organized and productive. | .378 | .296 | .215 | **.534** | .061 | .175 |
| Creative strategy ($\alpha$ = .832) | | | | | | |
| Our team frequently experiments with alternative ways we might carry out our work. | .185 | .194 | .374 | .176 | **.745** | .063 |
| Our team is highly imaginative in thinking about new or better ways we might perform our task. | .214 | .115 | .259 | .299 | **.779** | .117 |
| When a non-routine matter comes up in our work, we often invent new ways to handle the situation. | .287 | .198 | .115 | .176 | **.725** | .094 |
| Breadth ($\alpha$ = .618) | | | | | | |
| I feel that this team integrates diverse viewpoints. | .405 | .086 | .021 | −.395 | .258 | **.590** |
| My perspective is well-integrated into the team's outcome. | .131 | .142 | .156 | .084 | .127 | **.551** |
| I understand how our team's work fits into the whole product. | .059 | .415 | −.115 | .336 | .046 | **.503** |
| Eigenvalues | 8.870 | 2.470 | 1.590 | 1.347 | 1.117 | 1.068 |

[a] Item was reverse-coded.

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## Outcomes

The criteria of effectiveness for cross-functional teams are many and varied. As the example below illustrates, success can often require that *all* criteria be met, since failure on any criterion may mean failure for the entire project.

> For one "high profile" new product, a program manager and core team were selected and given the responsibility for hitting specific "targets" for cost, weight, and timing. Since program management represented a new way of working, the team members necessarily "invented it as they went along," to a great extent. The excitement surrounding this new effort generated a great deal of learning and innovation, both about the product and how to work in a cross-functional environment. The team members greatly expanded their abilities and understandings over the course of the program. Despite several false starts and blind alleys, the product ultimately won "Car of the Year" honors upon its introduction. However, because the program missed the cost and weight targets established by upper management, the program managers never survived to apply their skills to a second program.

This story points to the wide range of outcomes expected from cross-functional teams: Not only are they expected to produce innovation, learning, and new capabilities, but they are also called upon to compress time and hit stringent task targets. Member satisfaction is also a key outcome if the team approach is to remain a viable way to organize future product development efforts.

Table 3 presents the analysis for the outcome domain. It reveals seven factors: information creation, time compression, image expansion, learning, growth satisfaction, overall effectiveness, and capability development.

Table 3 also shows that information creation and time compression items loaded on the same factor, as did learning and growth satisfaction items. A more detailed analysis of each of these sets of items showed that they separated into two factors when analyzed alone. Since some potentially important theoretical issues distinguish these constructs, they are reported separately in Table 3.

Figure 1 presents the three-domain model and the factors included in each domain. We examined the validity of these three domains by performing a second-order confirmatory factor analysis. In this analysis, we took the indexes from the exploratory analyses reported in Tables 1–3 as observed variables and the three domains as latent variables. Table 4 presents a correlation matrix for these indexes.

Table 5 presents the results of this confirmatory factor analysis. These analyses were performed with LISREL VI (Jöreskog & Sörbom, 1984). Factor loadings (ksi) are presented for each index. All measures have high loadings in the expected domain, and all are statistically significant. The fit statistics (GFI = .829, $\chi^2$ = 343.02, $df$ = 149) indicate that the data fit the model reasonably well, although there is some room for improvement. In addition,

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## TABLE 3
## Results of Factor Analysis of the Outcome Domain

| Factors and Items | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Information creation ($\alpha$ = .839)[a] | | | | | |
| The team developed many new ways to look at our task and took an innovative approach to solving the problem. | **.748** | .000 | .138 | .075 | .076 |
| This team made major innovations along the way. | **.696** | .070 | .207 | −.109 | .170 |
| Our team produces an outcome that was greater than the sum of the individual contributions. | **.666** | .207 | .054 | −.170 | .234 |
| The team produces knowledge or information that did not exist before the team was formed. | **.714** | .135 | .133 | .029 | .181 |
| Time compression ($\alpha$ = .745)[a] | | | | | |
| Our team identified ways to speed decisions and remove bureaucratic roadblocks. | **.640** | .035 | .048 | −.092 | .096 |
| Our team has been able to cut the amount of time it takes to accomplish the task. | **.723** | .035 | .000 | −.015 | .215 |
| Working on the team was a slow and cumbersome process.[b] | **.468** | −.054 | −.035 | .366 | −.184 |
| Image expansion ($\alpha$ = .819) | | | | | |
| Participation on this team altered my conception of the complexity of the task. | .174 | **.896** | .053 | .053 | −.076 |
| Participation on this team altered my conception of the scope of the task. | .121 | **.903** | .176 | .002 | .059 |
| Participation on this team altered my conception of the uncertainty associated with the task. | .073 | **.881** | −.000 | .034 | −.038 |
| Learning ($\alpha$ = .730)[a] | | | | | |
| I've developed many new skills from working with members from other functions. | .339 | .133 | **.645** | .023 | .105 |
| I've learned things working in this group that I will use in other groups. | .291 | .028 | **.685** | −.103 | .237 |
| Growth satisfaction ($\alpha$ = .843)[a] | | | | | |
| I am highly satisfied with the personal growth and development I get working on this team. | .260 | .039 | **.562** | −.358 | .054 |
| I get a feeling of worthwhile accomplishment from working on this team. | .385 | .038 | **.621** | −.216 | .047 |
| I have the opportunity for lots of independent thought and action working on this team. | .165 | −.060 | **.718** | −.099 | .001 |
| Overall effectiveness ($\alpha$ = .757) | | | | | |
| We are sometimes told that our team does not produce enough work.[b] | −.105 | .142 | −.060 | **.845** | .068 |
| We are sometimes told that the quality of the work we produce is not satisfactory.[b] | −.195 | .152 | −.061 | **.847** | −.027 |
| The process of this team is effective. | .462 | .048 | .209 | **.519** | .088 |
| Capability development ($\alpha$ = .776) | | | | | |
| Now that our team has worked together for a while, our capacity to do work has improved. | .456 | .061 | .278 | −.298 | **.656** |
| This team keeps getting more effective all the time. | .472 | .112 | .215 | −.253 | **.728** |
| A lot of learning went on in this team. | .221 | .211 | .477 | .076 | **.517** |
| People in our team share their special knowledge and expertise with each other. | | | | | **.723** |
| Eigenvalues | 5.580 | 1.657 | 1.447 | 1.292 | 1.203 |

[a] When information creation and time compression are combined, $\alpha$ = .862. When learning and growth satisfaction are combined, $\alpha$ = .816.
[b] Item was reverse-coded.

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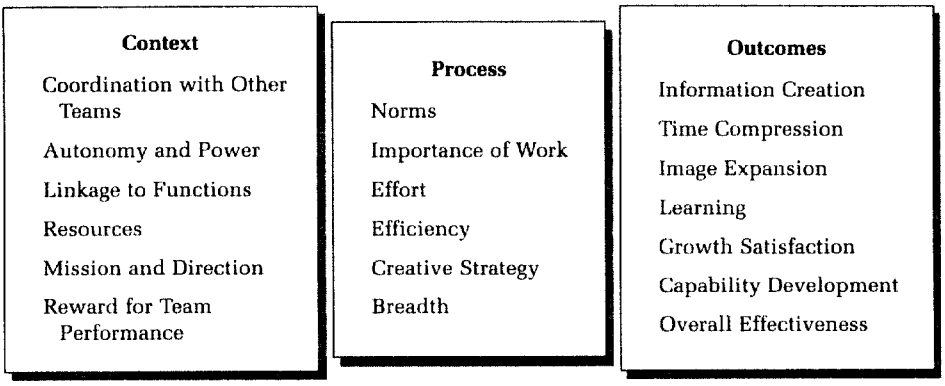
**FIGURE 1**
**A Model of Cross-Functional Team Effectiveness**




when the fit of the domain model was compared to the fit of the nested null model, the normed-fit index (Bentler & Bonett, 1980) was .891. The highest modification index value was 22.14 for the satisfaction index and the context domain. No other modification index values exceeded 10.0. No respecification of the model was done since our purpose in this analysis was simply to confirm the plausibility of the three-domain model suggested by the literature and by our qualitative analysis.

## DISCUSSION

This study has examined a new, rapidly spreading organizational phenomenon, the cross-functional team, and has developed a grounded model and set of measures of the influences on team effectiveness. This model is framed in terms of the three domains—team context, internal team processes, and team outcomes—that are prominent in current research on team effectiveness. Thus, we have attempted to present a comprehensive model that can be used to inform both future research and practice.

The most original contributions from this research are in the context and outcome domains. In the context domain, a primary contribution is the focus on the highly differentiated organizational environment in which CFTs exist. In particular, the identification of hierarchical, lateral, and function-specific links represents a worthwhile extension of the research presented by other researchers (Ancona, 1990; Ancona & Caldwell, 1992b; Hackman, 1987). The second area of contribution, in the outcome domain, is the identification of a broader set of outcome measures than appears in existing models of team effectiveness. The contributions in the process domain are clearly less unique, but the inclusion of an extensive set of process measures in this context-process-outcome model makes it a useful resource for future researchers and practitioners.

The strengths of this study include its focus on a new and little-understood organizational phenomenon, its grounding in an inductive re-

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**TABLE 4**
**Correlation Matrix of Indexes**

| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Coordination | | | | | | | | | | | | | | | | | | |
| 2. Autonomy | .46 | | | | | | | | | | | | | | | | | |
| 3. Linkage | .43 | .36 | | | | | | | | | | | | | | | | |
| 4. Resources | .26 | .23 | .32 | | | | | | | | | | | | | | | |
| 5. Mission | .48 | .39 | .35 | .21 | | | | | | | | | | | | | | |
| 6. Reward | .32 | .46 | .38 | .16 | .37 | | | | | | | | | | | | | |
| 7. Norms | .40 | .35 | .27 | .10 | .39 | .27 | | | | | | | | | | | | |
| 8. Importance | .54 | .49 | .38 | .15 | .52 | .65 | .41 | | | | | | | | | | | |
| 9. Effort | .45 | .18 | .32 | .18 | .31 | .23 | .42 | .34 | | | | | | | | | | |
| 10. Efficiency | .30 | .17 | .30 | −.05 | .28 | .24 | .36 | .31 | .35 | | | | | | | | | |
| 11. Creativity | .44 | .37 | .27 | .18 | .42 | .44 | .36 | .58 | .38 | .36 | | | | | | | | |
| 12. Breadth | .61 | .42 | .37 | .26 | .53 | .36 | .36 | .60 | .39 | .35 | .57 | | | | | | | |
| 13. Information | .43 | .39 | .32 | .22 | .41 | .50 | .42 | .61 | .35 | .35 | .68 | .66 | | | | | | |
| 14. Time | .50 | .40 | .33 | .17 | .41 | .41 | .47 | .64 | .42 | .36 | .65 | .60 | .68 | | | | | |
| 15. Image | .14 | .23 | .06 | .06 | .24 | .20 | .01 | .29 | .12 | .09 | .13 | .29 | .25 | .23 | | | | |
| 16. Learning | .47 | .42 | .27 | .14 | .40 | .54 | .32 | .69 | .29 | .26 | .50 | .56 | .62 | .56 | .30 | | | |
| 17. Satisfaction | .53 | .50 | .47 | .24 | .51 | .66 | .44 | .74 | .43 | .36 | .52 | .64 | .61 | .65 | .34 | .60 | | |
| 18. Effectiveness | .44 | .36 | .43 | .18 | .42 | .31 | .38 | .41 | .39 | .37 | .38 | .49 | .45 | .48 | .08 | .33 | .51 | |
| 19. Capability | .55 | .46 | .31 | .23 | .48 | .45 | .45 | .64 | .53 | .39 | .62 | .62 | .70 | .73 | .25 | .62 | .62 | .51 |

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**TABLE 5**
**Results of Second-Order Confirmatory Factor Analysis**

| Index | Context ksi 1 | Process ksi 2 | Outcome ksi 3 |
|---|---|---|---|
| Coordination | .72 | .00 | .00 |
| Autonomy | .62 | .00 | .00 |
| Linkage | .54 | .00 | .00 |
| Resources | .31 | .00 | .00 |
| Mission | .65 | .00 | .00 |
| Reward | .63 | .00 | .00 |
| Norms | .00 | .53 | .00 |
| Importance | .00 | .81 | .00 |
| Effort | .00 | .51 | .00 |
| Efficiency | .00 | .43 | .00 |
| Creativity | .00 | .71 | .00 |
| Breadth | .00 | .76 | .00 |
| Information | .00 | .00 | .80 |
| Time | .00 | .00 | .81 |
| Image | .00 | .00 | .31 |
| Learning | .00 | .00 | .73 |
| Satisfaction | .00 | .00 | .82 |
| Effectiveness | .00 | .00 | .59 |
| Capability | .00 | .00 | .83 |

search process, the generality of findings across a wide variety of teams, and the application to an intact set of product development teams. Potential limitations of the study include the fact that the data were all collected from a single organization and that the final validation of the measures reported here relied upon a sample of one type of CFT, product development teams. Although the data summarized here represent literally hundreds of teams and contexts from many different countries, future validation of this model would benefit by using data from multiple organizations. The focus on product development teams, on balance, may also be more of a strength than a limitation, since such teams are one of the most demanding forms of cross-functional team (Nonaka, 1991). In addition, such teams are of continuing interest to group researchers (Ancona, 1990; Ancona & Caldwell, 1992b; Donnellon, 1995) and figure in important ways in the future research agenda in this area.

Several relationships identified in the model suggest important future research. Three examples help to illustrate: First, the results suggest that information creation and time compression are closely related. This finding appears to contradict traditional group research on speed and innovation and tends to support Eisenhardt's (1989) observation that innovation and speed can occur jointly. This issue clearly warrants further analysis. Second, more general questions in the literature can also be addressed within this model. For example, Gladstein (1984) and Ancona (1990) studied the relationship between organizational context and team processes, concluding that contextual factors were more important determinants of team effectiveness

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than team process. The broad definition of context, process, and outcomes in this model provides the basis for a more robust test of the relative influences of context and process on outcomes.

Third, the multidimensional definition of the outcome domain suggests another interesting set of research questions. For example, several of the dimensions, such as time compression, task achievement, and information creation, are task-focused and relatively short-term. Other outcome dimensions, such as learning, capability development, image expansion, and growth satisfaction, are longer-term contributions to the future capacity of the organizational system. Are different aspects of context and process associated with these different types of outcomes? Do they differ in their prediction of "objective" indicators of performance and effectiveness?

This study also collected data about the specific functional organizations represented by each of the team members. Thus, we could aggregate the data presented in this study by function rather than by team to create measures of the linkage problems associated with each specific functional organization. The presentation of these data would be well beyond the scope of this article, but the availability of quantitative and qualitative data about each of the functions that assign members to these teams offers an alternative way for future research to examine the multifaceted context in which teams exist.

A final important issue for future research is the effect of different structural arrangements on team effectiveness (Galbraith & Kazanjian, 1986; Gobeli & Larson, 1987). Cross-functional teams can, for example, exist within a matrix structure, with part-time commitment and temporary assignment of members to teams, or within a more autonomous team structure in which team assignments are full-time and long-term. The alleged merits and dynamics of more fully dedicated teams are the subject of heated debate in the literature (Clark & Fujimoto, 1987, 1991; Denison, Hart, & Ichijo, 1994; Takeuchi & Nonaka, 1986) and among practitioners, but very few data currently exist to inform these discussions.

This brief discussion of the future research agenda reveals only a few of the many interesting research topics that can inform the theoretical and practical understanding of cross-functional teams. Since the evolution of these teams in organizations is rapidly outstripping scholarly research on the topic, this situation represents a unique opportunity to researchers who aspire to inform both theory and practice.

## REFERENCES

Alderfer, C. P. 1987. An intergroup perspective of group dynamics. In J. W. Lorsch (Ed.), ***Handbook of organizational behavior:*** 190–222. Englewood Cliffs, NJ: Prentice-Hall.

Alderfer, C. P., & Smith, K. K. 1982. Studying intergroup relations embedded in organizations. ***Administrative Science Quarterly,*** 27: 35–65.

Ancona, D. G. 1990. Outward bound: Strategies for team survival in an organization. ***Academy of Management Journal,*** 33: 334–365.

Ancona, D. G., & Caldwell, D. 1987. Management issues facing new project teams in high-technology companies. ***Advances in Industrial and Labor Relations,*** 4: 199–221.

**Copyright © 1996. All rights reserved.**

Ancona, D. G., & Caldwell, D. 1988. Beyond task maintenance: Defining external functions in groups. ***Group and Organizational Studies,*** 13: 468–494.

Ancona, D. G., & Caldwell, D. 1990. Improving the performance of new product teams. ***Research Technology Management,*** 33: 25–36.

Ancona, D. G., & Caldwell, D. 1992a. Cross-functional teams: Blessing or curse for new product development. In T. A. Kochan & M. Useem (Eds.), ***Transforming organizations:*** 154–166. New York: Oxford University Press.

Ancona, D. G., & Caldwell, D. 1992b. Bridging the boundary: External activity and performance in organizational teams. ***Administrative Science Quarterly,*** 37: 634–665.

Barker, J., Tjosvold, D., & Andrew, R. 1988. Conflict approaches of effective and ineffective project managers: A field study of matrix organization. ***Journal of Management Studies,*** 25: 167–178.

Bentler, P., & Bonett, D. G. 1980. Significance tests and goodness of fit in the analysis of covariance structures. ***Psychological Bulletin,*** 88: 588–606.

Brown, L. D. 1983. ***Managing conflict at organizational interfaces.*** Reading, MA: Addison-Wesley.

Clark, K., & Fujimoto, T. 1990. The power of product integrity. ***Harvard Business Review,*** 68(6): 107–118.

Clark, K., & Fujimoto, T. 1991. ***Product development performance: Strategy, organization, and management in the world auto industry.*** Boston: Harvard Business School Press.

Cohen, S., & Ledford, G. 1991. ***The effectiveness of self-managing teams: A quasi-experiment.*** Working paper, Center for Effective Organizations. University of Southern California, Los Angeles.

Davis, S. M., & Lawrence, P. R. 1977. ***Matrix.*** Reading, MA: Addison-Wesley.

Denison, D., Hart, S., & Ichijo, K. 1994. ***Up against the walls: Cross-functional management of product development in U.S. and Japanese automobile companies.*** Working paper, University of Michigan, Ann Arbor.

Donnellon, A. 1995. ***Teamtalk.*** Boston: Harvard Business School Press.

Eisenhardt, K. 1989. Making fast strategic decisions in high-velocity environments. ***Academy of Management Journal,*** 32: 543–576.

Ford, R. C., & Randolph, W. A. 1992. Cross-functional structures: A review and integration of matrix organization and project management. ***Journal of Management,*** 18: 267–294.

Fruin, M. 1996. ***Knowledge works.*** New York: Oxford University Press.

Galbraith, J. 1973. ***Designing complex organizations.*** Reading, MA: Addison-Wesley.

Galbraith, J. R. 1994. ***Competing with flexible lateral organizations*** (2nd ed.). Reading, MA: Addison-Wesley.

Galbraith, J., & Kazanjian, R. 1986. ***Strategy implementation: Structure, systems, and process.*** St. Paul, MN: West.

Gersick, C., & Hackman, R. 1990. Habitual routines in task performing groups. ***Organizational Behavior and Human Decision Processes,*** 47: 65–97.

Gladstein, D. 1984. Group in context: A model of task group effectiveness. ***Administrative Science Quarterly,*** 29: 497–517.

Glaser, B., & Strauss, A. 1967. ***The discovery of grounded theory: Strategies for qualitative research.*** Chicago: Aldine Press.

Gobeli, D., & Larson, E. W. 1987. Relative effectiveness of different project structures. ***Project Management Journal,*** 18(2): 81–85.

**Copyright © 1996. All rights reserved.**

Guzzo, R. A., & Shea, G. P. 1993. Group performance and intergroup relations in organizations. In M. D. Dunnette & L. M. Hough (Eds.), ***Handbook of industrial and organizational psychology*** (2nd ed.), vol. 3: 269–314. Palo Alto, CA: Consulting Psychologists Press.

Hackman, J. R. 1987. The design of work teams. In J. W. Lorsch (Ed.), ***Handbook of organizational behavior:*** 315–342. Englewood Cliffs, NJ: Prentice-Hall.

Hackman, J. R. 1990. ***Groups that work (and those that don't).*** San Francisco: Jossey-Bass.

Hackman, J. R., & Morris, C. G. 1975. Group tasks, group interaction process, and group performance effectiveness: A review and proposed intergration. In L. L. Beckowitz (Ed.), ***Advances in experimental social psychology,*** vol. 8: 47–101. New York: Academic Press.

Hackman, J. R., & Walton, R. 1986. Leading groups in organizations. In P. Goodman (Ed.), ***Designing effective work groups:*** 72–119. San Francisco: Jossey-Bass.

Hart, S. L. 1985. Toward quality criteria for collective judgments. ***Organizational Behavior and Human Decision Processes,*** 36: 202–228.

Hitt, M. A., Hoskisson, R. E., & Nixon, R. D. 1993. A mid-range theory of interfunctional integration, its antecedents, and outcomes. ***Journal of Engineering and Technology Management,*** 10: 161–185.

Imai, K., Nonaka, I., & Takeuchi, H. 1985. Managing the new product development process: How Japanese companies learn and unlearn. In K. Clark, R. Hayes, & C. Lorenz (Eds.), ***The uneasy alliance:*** 533–561. Boston: Harvard Business School Press.

Jöreskog, K. G., & Sörbom, D. 1984. ***LISREL VI: Analysis of linear structural relationships by the method of maximum likelihood.*** Chicago: National Education Resources.

Katz, R. 1982. The effects of group longevity on project communication and performance. ***Administrative Science Quarterly,*** 27: 81–104.

Katz, R., & Allen, T. 1985. Project performance and the locus of influence in the R&D matrix. ***Academy of Management Journal,*** 28: 67–87.

Katzenbach, J. R., & Smith, D. 1993. ***The wisdom of teams: Creating the high performance organization.*** Boston: Harvard Business School Press.

Knight, K. 1976. Matrix organization: A review. ***Journal of Management Studies,*** 17: 111–130.

Larson, E. W., & Gobeli, D. H. 1987. Matrix management: Contradictions and insights. ***California Management Review,*** 29(4): 126–138.

Larson, E. W., & Gobeli, D. H. 1988. Organizing for product development projects. ***Journal of Product Innovation Management,*** 5(2): 180–190.

Leavitt, H. J. 1975. Suppose we took groups seriously. In E. L. Cass & F. G. Zimmer (Eds.), ***Man and work in society:*** 67–77. New York: Van Nostrand Reinhold.

Manz, C. 1992. Self-leading work teams: Moving beyond self-management myths. ***Human Relations,*** 45: 1119–1140.

Manz, C. C., & Sims, H. P. 1987. Leading workers to lead themselves: The external leadership of self-managing work teams. ***Administrative Science Quarterly,*** 32: 106–129.

Mowday, R. T., & Sutton, R. I. 1993. Organizational behavior: Linking individuals and groups to organizational contexts. In L. W. Porter & M. R. Rosenzweig (Eds.), ***Annual review of psychology,*** vol. 44: 195–229. Palo Alto, CA: Annual Reviews.

Nonaka, I. 1990. Redundant overlapping organization: Japanese approach to managing the innovation process. ***California Management Review,*** 32(2): 27–38.

Nonaka, I. 1991. The knowledge-creating company. ***Harvard Business Review,*** 69(6): 96–104.

Ohmae, K. 1990. ***The borderless world: Power and strategy in the interlinked world economy.*** New York: Harper Business.

**Copyright © 1996. All rights reserved.**

O'Reilly, C. 1991. Organizational behavior: Where we've been, where we're going. In L. W. Porter & M. R. Rosenzweig (Eds.), ***Annual review of psychology,*** vol. 42: 427–458. Palo Alto, CA: Annual Reviews.

Pasmore, W. A. 1988. ***Designing effective organizations: The sociotechnical systems perspective.*** New York: Wiley.

Pelz, D. C., & Andrews, F. M. 1976. ***Scientists in organizations: Productive climates for research and development.*** Ann Arbor, MI: Institute for Social Research.

Pinto, J. K., & Prescott, J. E. 1988. Variations in critical success factors over the stages of the project life cycle. ***Journal of Management,*** 14: 5–18.

Pinto, J. K., & Slevin, D. P. 1988a. Project success: Definitions and measurement techniques. ***Project Management Journal,*** 19(1): 67–72.

Pinto, J. K., & Slevin, D. P. 1988b. Critical success factors across the project life cycle. ***Project Management Journal,*** 19(3): 67–75.

Sundstrom, E., DeMeuse, K., & Futrell, O. 1990. Work teams: Applications and effectiveness. ***American Psychologist,*** 45: 120–133.

Takeuchi, H., & Nonaka, I. 1986. The new new product development game. ***Harvard Business Review,*** 64(1): 137–146.

Tushman, M. L. 1977. Special boundary roles in the innovation process. ***Administrative Science Quarterly,*** 22: 587–605.

Tushman, M. L. 1978. Technical communication in R&D laboratories: The impact of project work characteristics. ***Academy of Management Journal,*** 22: 482–500.

Tushman, M. L., & Katz, R. 1980. External communication and project performance: An investigation into the role of gatekeeper. ***Management Science,*** 26: 1071–1085.

Tushman, M. L., & Nadler, D. A. 1986. Organizing for innovation. ***California Management Review,*** 28(2): 74–92.

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