KNOWLEDGE WORKER TEAM EFFECTIVENESS: THE ROLE OF AUTONOMY, INTERDEPENDENCE, TEAM DEVELOPMENT, AND CONTEXTUAL SUPPORT VARIABLES

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This study investigated how autonomy, interdependence, and team development, along with process and contextual support variables, were related to the effectiveness of teams of "knowledge workers." The sample included 231 knowledge workers from 27 work teams. Team members completed surveys measuring the design, process, and contextual factors. Effectiveness measures included multiple key stakeholder evaluations of team performance and self-report measures of attitudinal outcomes. The results suggest that interactions among design, process, and contextual support factors have important implications for team effectiveness. In particular, the positive relationship between team autonomy and team job motivation was reduced as teams worked under more interdependent conditions. This interaction effect also varied across the types of autonomy (e.g., planning-related, product-related, and people-related) the team was given. Results also demonstrated that the relationship between job motivation and team process behaviors (helping, sharing, and innovating) was more positive in teams who were developmentally mature. Process behaviors were positively related to effectiveness, but those relationships became more positive in the presence of certain contextual factors (high-quality goals and efficient information transmission), and less positive in the presence of others (feedback and time pressure). Future research needs and practical implications of these results are discussed.

The increased use of work teams in today's organizations has received attention in both the academic and the popular press, and the theoretical analysis of teams and team-based issues has re-emerged (Goodman, Ravlin, & Schminke, 1987; Guzzo & Shea, 1992). Work teams can

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be configured in many ways (e.g., project teams, self-managing teams, semi-autonomous work groups) but can be defined more generally as an interdependent collection of individuals, each of whom shares responsibility for organizational outcomes (Hackman & Oldham, 1980; Sundstrom, DeMeuse, & Futrell, 1990). A variety of models have been proposed and explored to understand work team effectiveness (e.g., Campion, Medsker, & Higgs, 1993; Gladstein, 1984; Hackman, 1987; Hackman & Morris, 1975; McGrath, 1964, 1984). In a recent review of this literature, Guzzo and Dickson (1996) suggest that three types of variables relate to effectiveness: design (e.g., autonomy, interdependence); process (e.g., helping behavior, cooperation); and contextual (e.g., adequate resources).

Several gaps remain in the current team effectiveness literature, however. First, most studies have focused on teams of “blue-collar” workers (e.g., Cordery, Mueller, & Smith, 1991; Goodman, 1979; Kemp, Wall, Clegg, & Cordery, 1983; Wall, Kemp, Jackson, & Clegg, 1986; Wageman, 1995; Walton, 1972). Fewer studies have examined the effectiveness of teams composed of knowledge workers, despite the fact that such workers represent one of the fastest growing segments of the workforce, and one of the groups most likely to use teams (Beyerlein, Johnson, & Beyerlein, 1995). Knowledge workers are defined here as high-level employees who apply theoretical and analytical knowledge, acquired through formal education, to developing new products or services (Drucker, 1994). Those studies that have examined teams of knowledge workers have employed samples of research teams (Cheng, 1983; Cheng, 1984; Cheng & Miller, 1985), product development teams (Ancona & Caldwell, 1992; Katz, 1982; Katz & Allen, 1985; Keller, 1986), consulting teams (Ancona, 1990), insurance teams, administrative teams, and information systems teams (Campion, Papper, & Medsker, 1996; Henderson & Lee, 1992). Results have indicated that interdependence is critical in such teams (Campion et al., 1996; Cheng, 1983), as are coordination and innovativeness (Campion et al., 1996; Cheng, 1984; Keller, 1986). These studies also underscore the importance of the team’s context, particularly the degree to which it supplies necessary information (Ancona, 1990; Ancona & Caldwell, 1992; Campion et al., 1996; Cheng & Miller, 1985; Morrow, 1981). Extending team research to knowledge work contexts is important because many researchers have argued that some findings may be very context sensitive (e.g., McGrath, 1986). There is also evidence that knowledge workers’ responses to design, process, and contextual factors may differ from teams composed of other types of employees (Bartol & Martin, 1982; Cheney, 1984; Goldstein & Rockart, 1984). Put simply, what constitutes “effective team process” or “positive team context” may be different for teams of knowledge workers.
A second gap in the team effectiveness literature is that most models discuss only direct relationships between design, process, and contextual variables and team effectiveness, ignoring how such variables interact with each other (e.g., Campion et al., 1993; Hackman, 1987; Hackman & Morris, 1975; McGrath, 1964, 1984). This can have critical ramifications if two variables act as substitutes for each other or reduce each other’s positive effects. Consider the case of a manager supervising a team with high task and outcome interdependence (Shea & Guzzo, 1987). Should that manager increase the team’s autonomy as a means of raising motivation levels? The answer to such a question necessitates examining how autonomy and interdependence interact with each other in relating to motivation.

This study addresses these gaps in the literature by investigating the factors that are related to the success of teams of knowledge workers. We drew from the models of team effectiveness cited above to determine what design, process, and contextual variables would likely be important to the teams in our sample, which included 27 teams (231 members) working in information systems departments of 13 different organizations. Using data from both team members and key stakeholders of team performance, this study went beyond the “more is better” focus of past research to examine interactions among design, process, and contextual variables. We focused primarily on three design factors: the autonomy the team possesses, the degree of interdependence the team works under, and the developmental maturity of the team. Autonomy may be the most critical concern in knowledge worker teams, as knowledge workers prefer autonomy more than any other job characteristic (Cheney, 1984; Goldstein & Rockart, 1984). Interdependence, on the other hand, can be considered a defining characteristic of all teams (Sundstrom et al., 1990). Finally, team development is likely to be a concern in knowledge worker teams due to the complexity of the work they perform.

Process variables were chosen in accordance with Hackman and Morris (1975), who note that the team’s task is one of the most potent determinants of what constitutes effective team process. Given that knowledge workers are often called upon to deal with complex, new, and redesigned technologies, we concentrated on process behaviors such as the sharing of ideas and information, helping behavior, and innovating. Contextual support variables were chosen based on the complex and fast-paced work environments in which most knowledge workers exist. Specifically, we focused on the efficiency with which information is transmitted to the team, the frequency with which feedback is provided, the quality of the team’s goals, and the time pressure present.

Although direct effects of these design, process, and context factors were expected, the focus of this investigation was on interactions among
these factors. Specifically, we were interested in interactions related to: (a) team motivation; (b) team process; and (c) team effectiveness, constructs which form the foundation of many of the models found in the literature. The foundation for these interactions is based on the input-process-output model of team effectiveness (e.g., Hackman & Morris, 1975; McGrath, 1964) and job characteristics theory (Hackman & Oldham, 1976, 1980). Specifically, the literature suggests that (a) autonomy is positively related to job motivation; (b) job motivation is positively related to effective team process; and (c) team process is positively related to team effectiveness. However, this picture is incomplete because teams are not just given autonomy, but usually receive high levels of interdependence as well (Sundstrom et al., 1990). An important question is how the interaction of autonomy and interdependence relates to job motivation. Furthermore, the relationship between motivation and process behaviors may vary according to the developmental maturity of the team. Finally, beneficial process behaviors may only relate to team effectiveness given certain contextual conditions (Hackman & Morris, 1975). To further our understanding of team effectiveness the interactions among design, process, and contextual variables must be investigated. If these issues are not considered the theoretical models of team effectiveness will remain incomplete. The theoretical rationale for our predicted interactions are reviewed below.

**Interactive Effects in Teams of Knowledge Workers**

**Improving Team Motivation: Autonomy and Interdependence**

Few would argue with the notion that, to be effective, teams must find their work motivational (Hackman & Oldham, 1980). Autonomy and interdependence have been common leverage points for motivating teams, and are consequently included in most models of team effectiveness (e.g., Campion et al., 1993; Gladstein, 1984; Shea & Guzzo, 1987; Sundstrom et al., 1990). Turner and Lawrence (1965) define autonomy as “the amount of discretion the worker is expected to exercise in carrying out assigned work activities.” Interdependence can be defined as a general sense that team members must depend on each other at work (Wageman, 1995). Both have been linked to high levels of task motivation (Campion et al., 1993, 1996; Champoux, 1991; Hackman & Oldham, 1976, 1980; Johns, Xie, & Fang, 1992; Johnson & Johnson, 1989; Slavin, 1983; Stone, 1986; Wageman, 1995).

Despite the fact that autonomy and interdependence are among the most commonly studied team design features, their interactive effects
have yet to be assessed. Indeed, it seems that an interesting "Catch-22" develops when a team simultaneously possesses high levels of interdependence and autonomy—a very common scenario (Cannon-Bowers, Oser, & Flanagan, 1992; Sundstrom et al., 1990). The fact that interdependence places constraints on how a team does its work suggests that it undermines the team's autonomy. Consider the case of a team with autonomy over decisions including scheduling work, hiring/firing, and improving performance procedures. Consider further that this team has high interdependence due to the nature of the task it performs and the reward system under which it works. In such a case the team's decision making processes become much more complex. Scheduling changes must take each member's needs into account because difficulty for one member means difficulty for all. Adding or removing a member has domino effects on other members' task performance. Altering procedures at one point in the team's process impacts the process at all other points. Interdependence has made the team's decision-making responsibilities more difficult, so their discretion becomes less of a motivational asset. Rather than valuing membership in an autonomous team, members may dislike time spent in decision-making processes. Thus we hypothesize:

Hypothesis 1: Autonomy and interdependence interact in their effects on job motivation, such that the relationship between autonomy and job motivation will be more positive when interdependence is low than when it is high.

In addition to the above hypothesis we explored the impact of different forms of autonomy, because autonomy may be so critical to knowledge workers (Cheney, 1984; Goldstein & Rockart, 1984). Consistent with Breaugh (1985), we explored the notion that the "type" of autonomy may be just as important as the "amount." We focused on autonomy over product decisions, autonomy over planning decisions, autonomy over people decisions, and autonomy over work process decisions. Although not an exhaustive list, the teams in our sample did have discretion over decisions in each of these domains. No a priori predictions were made about whether the predicted interaction would manifest itself differently across the four autonomy types, but such differences were examined for future theory building efforts.

Improving Team Process: Team Job Motivation and Team Development

Many studies of team effectiveness suggest that teams who find work motivational and teams who are developmentally mature will engage in effective process behaviors (Hackman, 1987; Sundstrom et al., 1990;
Tuckman, 1965). Although motivation and development are usually examined as direct predictors, we would argue that they may have interactive effects. Consider Gersick's (1988) definition of team development as the "path a group takes over its life-span toward the accomplishment of its main tasks." Teams who find their work motivational may be more able to channel their efforts when they are "further along that path" than when they are in a "forming" stage (Tuckman, 1965).

Consider also Campbell and Hallam's (1994) framework for examining team development, which rejects the use of age or tenure as a proxy for development in favor of a more direct assessment. They define team development based on the mission clarity, coordination, and unity the team possesses. Mission clarity refers to the extent to which there is a shared understanding of the team's purpose, coordination refers to how organized the team is, and unity refers to how cohesive the team is. Teams who exhibit high levels of these three characteristics should be especially able to capitalize on high levels of job motivation. Mature teams will have to devote less attention to non-task activities (e.g., maintenance behaviors, reorganization of roles), thereby directing their efforts toward the types of process behaviors which contribute to effectiveness. Thus we hypothesize:

\textit{Hypothesis 2:} Team job motivation and team development interact in their effects on team process, such that the relationship between team job motivation and team process will be more positive when teams are mature rather than immature.

\textbf{Improving Team Effectiveness: Team Process and Team Support Variables}

Although improving team job motivation and team process are critical concerns, the focus of most investigations of work teams is improving team effectiveness. Team effectiveness includes team performance as well as members' satisfaction with and commitment to the team (Hackman, 1987). Both team process and contextual support variables have been shown to predict team effectiveness (e.g., Ancona & Caldwell, 1992; Campion et al., 1993, 1996; Gladstein, 1984; Guzzo & Dickson, 1996; Wageman, 1995), but the list of such variables is long and extensive. Thus, in choosing which variables to include in this study we kept in mind the nature of knowledge work. Beyerlein et al. (1995) suggest that knowledge work is characterized by unpredictable, multidisciplinary, and nonrepetitive tasks with evolving, long term goals which, due to their inherent ambiguity and complexity, require collaborative effort
in order to take advantage of multiple viewpoints. Thus, as noted earlier, we focused on process behaviors such as helping each other learn and sharing ideas and information, two of the most critical behaviors in collaborative efforts (Tjosvold & Tjosvold, 1995). We also focused on innovating behaviors, given the unpredictable and evolving nature of knowledge work.

We chose our contextual variables in a similar manner. Teams of knowledge workers require constant streams of information to gain knowledge about complex tasks demands, so information transmission seemed an important concern. Such teams also need specific and achievable goals to deal with the ambiguity inherent in such work. Similarly, frequent feedback can help teams deal with uncertain and evolving goals. Finally, knowledge worker teams will likely need adequate amounts of time to deal with complexity, so time pressure may be especially damaging.

Both Hackman's (1987) and Gladstein's (1984) models suggest that contextual support variables may interact with team process variables in relating to effectiveness. Such effects are relatively unexplored, however, and could assume two forms: Contextual variables could increase the relationship between team process and team effectiveness or they could decrease it. Variables fitting in the former category may include information transmission and goal quality. Without vital information and clear goals effective process behaviors may not relate to performance. In contrast, time pressure may stymie positive effects associated with team process by making sharing and innovating counterproductive in the face of pressing deadlines. Teams may be better served limiting such behaviors in favor of more standardized task conduct. Finally, feedback may serve as a “substitute” for effective process behaviors. That is, teams with poor process may still perform well if given consistent feedback. In such a case feedback would have a positive direct relationship with effectiveness, but would lower the strength of the process-effectiveness relationship. Thus we hypothesize:

**Hypothesis 3:** Team process and contextual support variables will interact in their effects on team effectiveness, such that the relationship between team process and team effectiveness will be more positive when high levels of information transmission and goal quality exist, and less positive when feedback and time pressure are present.
Method

Design

A cross-sectional survey method was used to test the hypotheses. Individual team members responded to measures of autonomy, interdependence, job motivation, team development, team process, and team contextual variables. Survey measures of team performance were assessed by key stakeholders of team performance, thereby avoiding same-source bias for linkages with performance. Team member and stakeholder surveys were administered at the same general time period.

Sample

Twenty-seven teams (231 members) were used; they averaged 10 members \( (SD = 3.59) \) and had existed an average of 23 months \( (SD = 5.30) \). Team sizes included 4 members \( (N = 1) \), 5 members \( (N = 6) \), 6 members \( (N = 2) \), 7 members \( (N = 4) \), 8 members \( (N = 2) \), 9 members \( (N = 2) \), 10 members \( (N = 5) \), 12 members \( (N = 2) \), along with teams of 13, 14, and 20 members. Teams worked in the information systems departments of 13 different Fortune 500 organizations in 6 industries: financial services \( (N = 1) \), manufacturing \( (N = 5) \), petroleum processing \( (N = 1) \), insurance \( (N = 4) \), public utilities \( (N = 1) \), and food services \( (N = 1) \). Although many of the organizations spanned multiple locations and operated in multiple countries, all members worked in the same location. Teams from information systems departments were ideal for study because they represent an exemplar of knowledge workers (Bartol & Martin, 1982). Also, many organizations are faced with failing information systems projects and teams have been considered a remedy for those failures (Henderson & Lee, 1992). Despite being from 13 different organizations, the missions of all 27 teams were similar in that all were involved in systems development (i.e., charged with supporting, maintaining, and enhancing information systems applications). Forty percent of team members were application developers, 21% were analysts, and 18% were technical support staff. Team members reported frequent interaction with other members \( (M = 5.04 \text{ on a 6-point scale, } SD = 1.04) \). They also clearly thought of themselves as a team \( (M = 4.73, SD = 1.21) \) and felt that team boundaries were clear and evident \( (M = 5.50, SD = .87) \). Seventy-five percent of team members had a college degrees or higher level of education, and 75% had at least 5 years of work experience and 3 years in the organization.

Because these teams had control over task assignments and maintenance functions, worked on tasks requiring a variety of skills, pro-
duced a whole, identifiable piece of work, and had an extended life cycle, Cannon-Bowers et al. (1992) would term them “self-managing teams” or “autonomous work groups.” Indeed, having an extended life cycle and producing an identifiable piece of work served as our operational criteria for defining a team as such. Teams were responsible for the planning, development, implementation, and follow-up support of information systems applications that were used within their respective organizations. The nature of systems development work in general is a mix of development projects of finite duration coupled with on-going support of the systems once developed. Functional areas within the organization (e.g., human resources, accounting, marketing, etc.) were typically the “end-users” or “customers” of these teams. Departments made use of the systems developed by the team, and requested system support from the team when necessary. It is critical to note that some knowledge workers may be employed in other types of teams. The findings demonstrated in the current study may differ when applied to teams of knowledge workers fitting other categories. Of course, to the degree that such differences are captured by autonomy, interdependence, development, and so forth, then these findings do have relevance. Similarly, self-managing teams composed of other types of knowledge workers less used to team philosophies (e.g., scientists) may exhibit different results.

Procedure

Organizations were invited to participate through written invitations that were distributed at two information systems development symposia. These invitations generated interest from 20 organizations. Follow-up phone interviews were conducted to gain information about the teams used in the organizations and to provide more information to the organizations regarding the survey process and expected time commitments. If an organization agreed to participate, all of their systems development teams participated. This helped ensure variance in our variables of interest and minimized the chances of biased selection of teams. This resulted in a sample of 270 team members from 28 work teams, with usable surveys returned from 231 members in 27 teams, representing an 86% response rate.

Two surveys were administered in the study, both at the same point in time. The first survey (148 total items), completed by team members, was designed to measure the design, process, and contextual variables, along with the satisfaction and commitment aspects of team effectiveness. The second survey (9 total items) assessed work team performance and was filled out by key stakeholders (e.g., customers, clients, etc.) of the team. Survey packs were assembled for each team and sent out to
the primary contact at each organization. Each “team pack” contained individual “member packs,” a cover letter explaining the research, an instruction sheet, and a prepaid mailer for the overnight delivery of the completed surveys. The cover letter was signed by the senior author, explained that the research was concerned with self-managed work teams in the information systems area, and reiterated details of the phone interviews concerning the number of teams that would participate. In order to maximize response rate, the primary contact was instructed to set up a team meeting for completion of the surveys. Each survey response form was encoded in order to keep track of the team from which it originated, but no attempt was made to ascertain individual identities, and anonymity was stressed in the cover letters. A team’s response was considered usable if at least three members completed the survey. In six cases there were multiple information systems teams in a given organization. When this occurred teams were distinguished from one another by the organization’s contact person, who was familiar with the specific projects on which the teams worked.

The stakeholder survey packs were similar to those distributed to team members. Each pack contained a cover letter and instructions for filling out the survey, the survey itself, and a prepaid mailer for returning the survey. Completed surveys were then forwarded to the primary contact for mailing. For each team, the input from five stakeholders was sought and all teams had at least three stakeholders respond (no stakeholders rated more than one team). To insure that the most logical stakeholders were chosen for each team, the responsibility for choosing team stakeholders was left up to the primary contact from each organization (usually the team’s manager). Surveys were received from 114 stakeholders out of a possible 135, representing an 84% response rate. Fifty-two percent of the respondents were “end-users” of the team’s product, 36% were team managers, while 12% were team vendors or consultants. There were no significant differences in the ratings provided by these stakeholder groups. Average interrater agreement for stakeholders was $r = .35$.

**Measures**

All self-report scales are listed below. Any previous reliabilities are indicated in parentheses.

*Autonomy.* As discussed previously, we sought to examine four distinct facets of autonomy: planning, product, people, and process-related. Twenty items from Beyerlein, Beyerlein, & Richardson (1993), a global autonomy measure without distinct facets, were sorted by three experts (Ph.D. Candidates with extensive work experience) into “product,”
“planning,” and “people” categories. A second five-person panel then blindly repeated that sorting task in an attempt to validate the first panel’s choices. If an item’s classification was not upheld by four of the five members in the second panel that item was dropped. No items from Beyerlein et al.’s (1993) measure fit the “autonomy for process” category, so three other experts (members of an Information and Decision Sciences department with extensive experience in systems development) wrote five items for that category. Of the 25 items in the original autonomy item pool, 12 were used in the final survey (to minimize length), with 3 in each category. These 12 items reflected the “strongest” items in terms of internal consistency and item-total correlations. For all items, participants were asked “How much responsibility does your team have for this dimension?” (1 = absolutely no responsibility to 5 = complete responsibility). Sample dimensions were “Solve product or service problems,” “Suggest new product or service ideas” (autonomy for products); “Schedule the team’s work,” “Determine the team’s training needs” (autonomy for planning); “Fire members of the team,” “Recruit/hire team members” (autonomy for people); and “Determine appropriate system quality and assurance procedures,” “Specify which development methods will be used by the team” (autonomy for process).

Interdependence. Ten items were adapted from Johnson, Johnson, Buckman, and Richards (1988) to assess interdependence. Five items originally assessed task interdependence (α = .74) and 5 items assessed outcome interdependence (α = .61). Sample items were “When we work together on the team, we have to share work materials in order to complete the project”; “When we work together on the team, everyone’s ideas are needed if we are going to be successful” (task interdependence); “When we work together on the team, we all receive the same performance evaluation”; and “When we work together on our team, our job is not finished until everyone on the team has finished his or her job” (outcome interdependence). (1 = completely false to 7 = completely true).

Team process. Seven items adapted from two “promotive interaction” scales (α = .78 and α = .67) from Johnson et al. (1988) were used to assess information sharing and helping behavior. Examples included “On this team I like to help my teammates learn,” and “On this team I like to share my ideas and work material with other members of the team.” Four items assessing innovating (α = .74; test-retest r = .84) were adopted from Campbell and Hallam (1994). Items assessed the degree to which team members were open to trying new and different approaches to work, hesitate to try something new, and have new and creative ideas. (1 = completely false to 7 = completely true).
Team development. Thirteen items taken from Campbell and Hallam (1994) were used to assess team development. Four items were designed to assess mission clarity ($\alpha = .81$, test-retest $r = .80$), 4 items measured team coordination ($\alpha = .69$, test-retest $r = .80$), while 5 items dealt with team unity ($\alpha = .77$, test-retest $r = .86$). Items assessed, for example, the degree to which the team had a clear purpose, was sure what it wanted to accomplish (mission clarity); had well organized meetings, had a difficult time reaching decisions (coordination); often laughed together, and worked out disagreements in a healthy way (unity). (1 = strongly disagree to 6 = strongly agree).

Job motivation. Twelve items from the Job Diagnostic Survey (Hackman & Oldham, 1975) were used to measure job motivation. Six items measured internal motivation ($\alpha = .76$) while 6 items assessed growth satisfaction ($\alpha = .84$). Sample items were “I feel bad or unhappy when I discover that I have performed poorly on this job,” “My opinion of myself goes up when I do this job well” (internal motivation); “I am satisfied with the amount of challenge in my job,” and “I am satisfied with the amount of personal growth and development I get from doing my job” (growth satisfaction). (1 = disagree strongly to 7 = agree strongly).

Contextual support variables. Several items taken from Campbell and Hallam (1994) were used to assess the following team contextual variables: goal quality (3 items; $\alpha = .61$; test-retest $r = .81$), time pressure (4 items; $\alpha = .68$; test-retest $r = .76$), information transmission (4 items; $\alpha = .67$; test-retest $r = .75$), and feedback (4 items; $\alpha = .68$; test-retest $r = .86$). Examples included asking to what extent members knew what they were supposed to be doing on the team, knew what they wanted to achieve on the team (goal quality); were burdened by too many responsibilities, were overwhelmed with things to do (time pressure); needed a better way to get news from outside the team, received critical information too late (information transmission); knew how well they were performing, and received frequent reports on performance (feedback). (1 = strongly disagree to 6 = strongly agree).

Team effectiveness. The following dimensions of team effectiveness were assessed: team performance, team commitment, and task satisfaction. Nine items from Henderson and Lee (1992) were used to assess three different facets of team performance ($\alpha = .73$ to .75). Thus, consistent with the operationalization advanced by Hackman (1987) and Hackman and Walton (1986), multiple stakeholders for each team were asked to evaluate (a) the quality of the team’s output; (b) the efficiency of the team’s work; and (c) the degree to which projects were completed in a timely fashion. Sample items included “How does this particular project team rate in terms of the quality of work the team produces?”
“How does this particular project team rate in terms of the efficiency of team operations?” and “The team met the goals as quickly as possible.”

Four items from Campbell and Hallam (1994) were used to assess team commitment ($\alpha = .66$; test-retest $r = .78$). Examples included items assessing how committed members were to superior performance, and to what degree members put their own interests before those of the team. Three items from Campbell and Hallam (1994) were used to assess team satisfaction ($\alpha = .85$; test-retest $r = .81$). Items assessed the degree to which members were unhappy on the team and liked being part of the team. ($1 = \text{strongly disagree}$ to $6 = \text{strongly agree}$).

Levels of Analysis

All variables, with the exception of team performance, were measured at the individual level. However, in all cases the unit of theory (i.e., focal level) was the team. That is, all predictions were posited at the team level of analysis and the focal criterion (i.e., performance) was a team construct. Thus the team level of analysis was used, given that conclusions from individual level data cannot be generalized to teams without committing a fallacy of the wrong level (Rousseau, 1985). As a result, individual team members’ perceptions were aggregated by taking the average team member response and expressing that as the team value. With the exception of items assessing helping and sharing behaviors, as well as satisfaction and job motivation, all items were worded with the team, not the individual, as the referent. This is consistent with recommendations by Rousseau (1985), who also advocates the use of composition theories which specify the functional similarities of constructs at different levels. We expected our individual-referenced variables (i.e., helping, sharing, satisfaction, and job motivation) to be functionally similar at the individual and team levels (i.e., occupying the same position in the nomological network). For example, “team job motivation” is simply a perceptual convergence among team members about how motivating their work is. Like Shea and Guzzo’s (1987) “potency,” it is a group-level motivation construct, but is based on perceptions of external work, not internal capabilities. There are many reasons to expect perceptual convergence for job motivation. First, because tasks are team-based there is less within-team variance in the nature of team members’ work. Second, members’ frequent interaction, the clear delineation of team boundaries, and the long tenure of most of the teams should allow the ambient and discretionary group processes reviewed by Hackman (1992) to influence members. Hackman (1992) reviews empirical research illustrating that such stimuli can prompt team members to adopt the views of the collective, thereby creating a shared norm which guides behavior. To the degree
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<td>72</td>
<td>-44</td>
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<td>93</td>
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Note: Decimals are omitted from correlations to conserve space. \( r \geq .58, p < .001; r \geq .47, p < .01; r \geq .37, p < .05 \). Coefficient alphas were assessed at the individual level of analysis, thus \( n = 231 \) for all such analyses.
that this occurs, perceptions (in the case of motivation and satisfaction) and behaviors (in the case of helping and sharing) become less and less "individual" and more and more "team."

Thus it was critical to demonstrate high within-team agreement in order to justify using the team average as an indicator of a team-level variable. Agreement was first assessed using the $r_{wg(j)}$ index (James, Demarree, & Wolf, 1984). Aggregation is usually justified by a median $r_{wg(j)}$ value of .70 or greater (George, 1990, by James personal communication). All scales exceeded this criterion. Values are given in Table 1, which also lists median intraclass correlation values (Shrout & Fleiss, 1979).

**Data Analysis Strategy**

As noted in the introduction, we sought to gain a more thorough understanding of the role of autonomy in knowledge worker teams by testing the notion that "type" of autonomy is as critical as "amount." Thus the dimensionality of our autonomy measure was tested via the confirmatory factor analysis routine in LISREL 8 (Jöreskog & Sörbom, 1993). Zero-order correlations among the autonomy facets and other relevant variables were also examined to provide evidence of discriminant validity.

All study hypotheses were tested using moderated multiple regression. Analyses indicated that the components of the interaction terms, for the most part, demonstrated effect sizes ($f^2$) in the "large" range, while the interaction terms' effect sizes could be characterized as "medium" (Cohen, 1988). Thus employing the $\alpha = .05$ convention left us with a 66% chance of rejecting the null hypothesis (Cohen, 1988). In an effort to increase our statistical power we therefore adopted the $p < .10$ significance criterion level.

Organizational differences were investigated as covariates using two different methods. First, we used dummy coding to contrast manufacturing, insurance, financial services, petroleum/utilities, and food service organizations. In no cases did this four-term dummy code explain significant variance in an outcome variable (mean $R^2 = .06$), and controlling for the dummy code altered the increment in $R^2$ due to our interaction terms an average of +.01. Second, we used Litwin and Stringer's (1968) organizational climate scale as a means of capturing organizational differences. Again, in no case did climate explain significant variance in an outcome variable (mean $R^2 = .02$), and controlling for climate changed the variance explained by our interactions an average of -.003. Finally, controlling for organizational differences in these manners did not alter the results of any of our interaction significance tests. Taken together,
these results suggest that the results presented below are not an artifact of organizational differences.

Results

Descriptive Statistics

The means, standard deviations, zero-order intercorrelations, and indexes of within-group agreement for all variables are shown in Table 1. Coefficient alphas for all scales are shown in the diagonal. Although the focus of this study was on interactions among design, process, and contextual variables, the contents of the correlation matrix can be used to illustrate many relationships not explicitly included in our hypotheses. That is, similar to Campion et al. (1993, 1996), the correlations can be used to support linkages between effectiveness and various findings of past research. In that regard, several correlations are of note, particularly relationships with team performance which are not method-bound. For example, teams high in interdependence performed at a higher level (and were also more motivated and exhibited more beneficial process behaviors), further suggesting that this traditional variable is critical in knowledge work contexts as well (Campion et al., 1996; Cheng, 1983). Furthermore, team performance was associated with high quality goals, frequent feedback, and low time pressure, but less so with efficient information transmission. This suggests that the context in which the team works is critical to its effectiveness, consistent with the admonitions of past researchers (e.g., Campion et al., 1993, 1996; Gladstein, 1984; Guzzo & Dickson, 1996; Hackman, 1987).

The Dimensionality of Autonomy

To assess the dimensionality of our autonomy items, we compared the fit of a four-factor, specific-facet autonomy model with that of a one-factor, general autonomy model. Our results indicated a moderate fit for the four-factor structure ($\chi^2 (48) = 167.20, p < .001; \text{RMSEA} = .098, p < .001; NFI = .88; RMR = .063; PGFI = .56; PNFI = .64$). The one-factor model demonstrated very poor fit ($\chi^2 (54) = 450.06, p < .001; \text{RMSEA} = .17, p < .001; NFI = .67; RMR = .12; PGFI = .52; PNFI = .50$). Comparison of the two models indicated that the four-factor model was significantly superior in fit ($\chi^2$ difference (6) = 282.6, $p < .001$). An examination of the correlations among the four autonomy facets showed that autonomy for planning and autonomy for process were highly correlated ($r = .92$), and the item content seemed to overlap conceptually. Thus we tested the fit of a three-factor autonomy model
by combining planning and process into one factor labeled "planning." The fit statistics for this model were comparable to those of the four-factor model ($\chi^2 (51) = 171.18, p < .001$; $RMSEA = .095, p < .001$; $NFI = .87$; $RMR = .065$; $PGFI = 60$; $PNFI = .67$) and the difference in fit between the two models was not significant ($\chi^2$ difference (3) = 3.98, ns). Because the three-factor model is more parsimonious we used that structure in testing Hypothesis 1. Further evidence of discriminant validity among the three facets of autonomy can be seen in Table 1, where autonomy for planning had higher relationships with job motivation, team process, team commitment, and team satisfaction than the other two facets.

**Tests of Hypotheses**

Hypothesis 1 predicted that autonomy (as measured by the three autonomy facets) and interdependence would interact in their effects on team job motivation. Table 2 presents the results for all moderated regressions. Hypothesis 1 was partially supported. The interaction term explained significant variance in job motivation with both autonomy for planning and autonomy for products. To aid in the interpretation of significant interactions, the effects were plotted using the derived regression equation. Equation inputs for the independent variables consisted of their mean +1SD (for the "high" case) and their mean −1SD (for the "low" case). The plots of the interactions were in the predicted direction (see Figure 1), as the pattern indicated a more positive relationship between autonomy for planning/products and job motivation when teams worked under low interdependence conditions.

Hypothesis 2 predicted that team job motivation and team development would interact in their effects on team process. This was supported (see Table 2). The plot of the interaction is shown in Figure 2 and is in the predicted direction. The relationship between team job motivation and team process was more positive for teams who were developmentally mature.

Hypothesis 3 predicted that team process and contextual support variables (information transmission, goal quality, feedback, and time pressure) would interact in their effects on team outcomes. Due to the high correlation between team satisfaction and team commitment (see Table 1), we combined the two measures, creating a "team attitudinal outcomes" variable. As shown in Table 2, Hypothesis 3 was partially supported for all four of the context variables with the interaction patterns in the predicted directions (see Table 2). As shown in Figures 3 and 4, the relationship between team process and both team performance and team attitudinal outcomes was more positive in the pres-
**TABLE 2**

<table>
<thead>
<tr>
<th>Step one:</th>
<th>Step one:</th>
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<th>Step two:</th>
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<td>AutProd</td>
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<tr>
<td>Interdep</td>
<td>.43**</td>
<td>Interdep</td>
<td>.55***</td>
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<tr>
<td>A × I</td>
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<td>A × I</td>
<td>-7.88***</td>
</tr>
<tr>
<td>F-Overall</td>
<td>9.83***</td>
<td>F-Overall</td>
<td>11.50***</td>
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</table>

### H2: Job Motivation × Team Development with Team Process

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<td>Job Mot</td>
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</tr>
<tr>
<td>Develop</td>
<td>.72***</td>
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</table>

### H3: Team Process × Contextual Support with Team Effectiveness

**DV = Team performance**

<table>
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<td>Process</td>
<td>.61***</td>
</tr>
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<td>Goal qual</td>
<td>.34*</td>
<td>Goal qual</td>
<td>.59*</td>
</tr>
<tr>
<td>P × G</td>
<td>5.91*</td>
<td>P × G</td>
<td>-5.91***</td>
</tr>
<tr>
<td>F-Overall</td>
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<td>F-Overall</td>
<td>11.82***</td>
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</table>

**DV = Team attitudinal outcomes**

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<td>Goal qual</td>
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<td>.39***</td>
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<tr>
<td>P × G</td>
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<td>P × G</td>
<td>-6.42***</td>
</tr>
<tr>
<td>F-Overall</td>
<td>34.72***</td>
<td>F-Overall</td>
<td>47.47***</td>
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* p < .10, ** p < .05, *** p < .01.

...ence of high quality goals. Similarly, the relationship between team process and team attitudinal outcomes was more positive where information transmission was efficient. In contrast, the relationship between team process and attitudinal outcomes was less positive in teams who were given frequent feedback. Finally, the link between team process and team performance was less positive where time pressure was high.
The practical significance of our results can be seen by comparing predicted criterion values when interaction effects are ignored with predicted criterion values when interactions are taken into account. This was done using Campion et al.'s (1996) methodology where the “top” third and “bottom” third of the teams were selected based on the average of the autonomy, interdependence, development, job motivation, and contextual characteristic measures. The difference in criterion values was then expressed in standard deviation units. Accounting for interaction effects changed criterion values an average of .30 SD units and as much as .38 SD units.
Figure 2: Plot of the Interaction of Team Job Motivation with Team Development for Team Process.
Discussion

Guzzo and Dickson (1996) note that “it is probably most justifiable to conclude that the greatest changes in team effectiveness are most likely to be realized when changes in teams’ organizational context are supported by the appropriate team design and process” (p. 335). Our results offer empirical support for their assertion. Perhaps the most important result was that autonomy and interdependence, two of the most widely used team design characteristics, reduced the positive effects associated with each other. Indeed, for teams placed in
Figure 4: Plots of the Interactions of Team Process with Goal Quality, Information Transmission, and Feedback for Team Attitudinal Outcomes.
highly interdependent circumstances, there was virtually no relationship between autonomy and team job motivation, whether that autonomy was planning-related or product-related. This suggests that it is difficult to create a "win-win scenario" for autonomy and interdependence. However, it should be noted that autonomy for people was positively related to job motivation regardless of interdependence levels. Furthermore, supplementary analyses conducted by breaking down our interdependence measure into task and outcome categories suggest that win-win cases may be possible. Specifically, these analyses showed that task interdependence acted as the primary constraint on autonomy for planning, not outcome interdependence.

These results suggest that there is value in examining autonomy from a multidimensional perspective, especially when decisions about levels of autonomy are made concurrently with decisions about levels of interdependence. The zero-order correlations with the autonomy facets suggest this as well, as autonomy for planning had the most positive relationships with team motivation, process, and outcomes. Autonomy for people also had many positive relationships, but autonomy for products did not. Perhaps giving product-related autonomy to work teams does not represent a marked increase in discretion over more traditional forms of work, so does not relate highly to relevant outcomes.

Although the interaction between autonomy and interdependence was shown to be critical in teams of knowledge workers, our results also highlighted the importance of team development. Although high levels of job motivation were associated with positive team process, that relationship was shown to be contingent on the developmental maturity of the team. It may be that mature teams are more capable of channeling high levels of motivation into positive team process. This suggests that team performance, as with individual performance, can be a multiplicative function of ability and motivation. Teams must be motivated to engage in effective process behaviors, but must also have the organization and unity that comes with development. Indeed, such maturity may be especially critical to knowledge worker teams because of the increased complexity inherent in the work they perform.

Traditionally, models of team effectiveness suggest that team process behaviors are the important, proximal influence on team effectiveness. Our results offer insight into when process behaviors are related to effectiveness. In particular, our results showed that factors such as goal quality and information transmission can increase the positive relationship between team process and team effectiveness. Process and performance variables were more highly related when high quality goals were present—the lack of such goals may have prevented teams from capitalizing on good process behavior. Similarly, process was more highly
related to attitudinal outcomes for teams that received efficient transmission of information. In contrast, factors such as feedback and time pressure reduced the positive relationship between process and effectiveness. Frequent feedback seemed to act as a substitute for effective internal functioning, though such a practice could potentially act as a "crutch" which prevents a team from developing as it otherwise might. Time pressure, on the other hand, may change the way a team of knowledge workers should go about its tasks. It may be that pressing deadlines reduce the practicality of large degrees of helping, sharing, and innovating behaviors. Teams may be better off "falling back on" traditional methods in an effort to "just get the job done."

Practical Implications

The results of this study offers many practical implications for the design of team-based knowledge work, especially where managers can accurately identify and diagnose relevant design, process, and contextual factors. For example, conventional wisdom suggests that the more autonomy a manager provides to a team of knowledge workers, the greater the team's perception of job motivation. Our results suggest that, to maximize team member motivation, managers need to consider what type of autonomy they are willing (or able) to give. Providing discretion over goals, budgets, training needs, and scheduling (i.e., autonomy for planning) may be an especially effective means of instilling job motivation. However, any positive effects associated with such discretion may be constrained by highly interdependent conditions (particularly if that interdependence is a product of the team's task). In such cases, managers would do well to provide discretion over staffing the team (i.e., autonomy for people) because that form of autonomy related to job motivation regardless of interdependence levels.

Managers who are concerned with enhancing the level of information exchange, helping, and innovating behaviors among team members should help the team increase its maturity through facilitating mission clarity, organization, and cohesiveness. This will allow the team to capitalize on high levels of job motivation. Team-building exercises may aid such development if managers are unable to give the team the time to develop on its own. However, if the team struggles with these process behaviors the manager could provide frequent feedback on team performance, as that may lessen the impact of poor process behaviors. In contrast, if the team does engage in effective process behaviors the manager should create the positive working conditions necessary to capitalize on them. These conditions include specific goals and low levels of time pressure, consistent with the recommendations of others (e.g.,
Katzenbach & Smith, 1993). If the product or service market dictates that teams are under high degrees of time pressure, managers may not wish to encourage helping, sharing, and innovative behaviors, because such behaviors have negligible effects in such circumstances. Although not present in our data, it may be that standardized task behaviors are more beneficial in such cases.

Suggestions for Future Research

The generalizability of these findings should be examined in other types of teams and with other types of knowledge workers. It is critical to assess any such differences so prescriptions can be tailored to specific circumstances. Researchers should also examine the within-team dynamics of teams of knowledge workers. For example, as noted by a reviewer, high levels of interdependence may be even more constraining to individual members' (as opposed to the overall team's) discretion, because each member must keep the whole in mind when making his/her decisions. Thus especially talented members may find interdependent conditions particularly frustrating, making it imperative to find ways to capitalize on the inputs and ideas of such members, despite their frustrations. Given the importance of collaboration in knowledge work (Tjosvold & Tjosvold, 1995) it seems likely that the most effective knowledge worker teams will be those who make the most of each member's ideas and abilities. Finally, team researchers should continue to examine interactions among design, process, and context characteristics, so that win-win scenarios can be created in team-based contexts.

Limitations

There are some limitations to this study which should be noted. First, our sample consisted of only 27 teams, possibly preventing us from detecting some interaction or direct effects that might be evident with a larger sample. However, this limitation should be examined in light of the fact that we did discover enough significant effects to at least partially support each of our hypotheses. Also, no regression model used to test our hypotheses employed more than three predictors, so unreliability of regression coefficients should not be a concern. Second, most of our variables were assessed with team members as the respondents, raising the issue of inflation of effect sizes due to common method bias. However, it should be noted that all of our hypotheses tested moderation effects—method bias is unlikely to produce such effects (Schmitt, 1994)—and our measure of team performance was not completed by
team members. Finally, our data was cross-sectional, thereby preventing us from testing the causal nature of our relationships.

REFERENCES


