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Work Groups, Structural Diversity, and Knowledge Sharing in a Global Organization

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Effective work groups engage in external knowledge sharing—the exchange of information, know-how, and feedback with customers, organizational experts, and others outside of the group. This paper argues that the value of external knowledge sharing increases when work groups are more structurally diverse. A structurally diverse work group is one in which the members, by virtue of their different organizational affiliations, roles, or positions, can expose the group to unique sources of knowledge. It is hypothesized that if members of structurally diverse work groups engage in external knowledge sharing, their performance will improve because of this active exchange of knowledge through unique external sources. A field study of 182 work groups in a Fortune 500 telecommunications firm operationalizes structural diversity as member differences in geographic locations, functional assignments, reporting managers, and business units, as indicated by corporate database records. External knowledge sharing was measured with group member surveys and performance was assessed using senior executive ratings. Ordered logit analyses showed that external knowledge sharing was more strongly associated with performance when work groups were more structurally diverse. Implications for theory and practice around the integration of work groups and social networks are addressed.

Key words: knowledge management; team diversity; social networks; organizational innovation
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Introduction

Organizations rely on many kinds of work groups to develop products, improve services, and manage operations. For these groups to be effective, structures and processes must be in place to foster members working together (Cohen and Bailey 1997, McGrath 1984). Numerous studies have demonstrated benefits for work groups that engage in information exchange and task-related communication within the group (Allen 1977, Tushman 1979). Though successful work groups take advantage of the perspectives, talents, and ideas of different members, a well-designed group also creates a common understanding of the organizational context through sharing knowledge externally about the work (Hackman 1987). Previous research has shown that knowledge sharing outside of the group is positively related to performance (Ancona and Caldwell 1992a, Brown and Utterback 1985). It is increasingly clear that knowledge transfer, both within and outside of groups, plays a fundamental role in the effectiveness of organizations (Argote et al. 2000, 2003).

The knowledge necessary for high performance in work groups can be tacit (Polanyi 1966), codified (Zander and Kogut 1995), or embodied in routines (Nelson and Winter 1982). Knowledge sharing is defined here as the provision or receipt of task information, know-how, and feedback regarding a product or procedure (Hansen 1999). Along with verbal communication about the task and the exchange of tangible artifacts, knowledge sharing includes the implicit coordination of expertise (Faraj and Sproull 2000) and information about who knows what in the group (Rulke and Galaskiewicz 2000). Knowledge sharing in work groups might entail providing task information to a client or receiving feedback on a project from senior managers.

The sources of knowledge for any given work group can range from customers to organizational experts to members themselves (von Hippel 1988). Moreover, because task-related knowledge from a customer and an organizational expert are likely to be nonoverlapping, group members can elicit new ideas and insights from different sources of knowledge (Ancona and Caldwell 1992b, Hansen 1999). Social network theories support the notion that unique knowledge sources can be more valuable than knowledge sources shared by everyone (Burt 1992, Granovetter 1973). However, theory and research have yet to address which types of diversity influence the value of knowledge sharing in work groups.

Structural Diversity vs. Demographic Diversity

Scholars examining diversity in work groups have primarily focused on the consequences of *demographic diversity* (e.g., member differences in sex, age, or tenure) for processes such as communication, conflict, or social integration (Jehn et al. 1999, Pelled et al. 1999, O'Reilly et al. 1989). The consistently negative effects of demographic diversity on group processes are likely the result of heightened member emphasis on social categories rather than project-relevant information (for a review, see Williams and O'Reilly 1998). Demographic diversity should not increase the value of intragroup knowledge sharing or external knowledge sharing unless it exposes members to unique sources of knowledge related to the work.

Relatively little attention has been given to member differences in organizational affiliations, roles, or positions. With the rise in labor costs, global expansion, and corporate mergers, work groups are often used as a means for connecting members who are dispersed across different geographic locations, who represent different functions, who report to different managers, or who work in different business units (DeSanctis and Monge 1999, Jarvenpaa and Leidner 1999, Maznevski and Chudoba 2000). This variation in features of the group structure is introduced here as *structural diversity* because of its potential to expose members to different sources of task information, know-how, and feedback. Four types of structural diversity in work groups are discussed in more detail below: geographic locations (e.g., Van den Bulte and Moenaert 1998), functional assignments (e.g., Bunderson and Sutcliffe 2002), reporting managers (e.g., Burns 1989), and business units (e.g., Hansen 2002). Furthermore, external knowledge sharing should be more valuable than intragroup knowledge sharing for structurally diverse groups because members are more likely to encounter unique knowledge that has not been shared previously within the group.

Proposition. *External knowledge sharing will be more strongly associated with performance when work groups are more structurally diverse.*

Geographic Locations

One form of structural diversity originates from differences in the geographic locations of group members who can communicate via computer technologies to accomplish their work across vast physical distances (Cramton 2001, Jarvenpaa and Leidner 1999, Maznevski and Chudoba 2000). The "eyes and ears" of members are in different environments, therefore they have access to a greater variety of task-related information, which can open up new opportunities for knowledge sharing (Monge et al. 1985). Work group members in different locations also likely have different social networks outside of the group because members run into different people in the hallways, see different people at meetings, and communicate socially with different people (Conrath 1973). However, different geographic locations will only enhance the value of knowledge sharing for work groups if members access unique information about the task through these outside social networks.

Hypothesis 1. *External knowledge sharing will be more strongly associated with performance when group members are dispersed across more geographic locations.*

Functional Assignments

Another form of structural diversity is based on member differences in functional assignments, which research suggests can facilitate the integration of expertise, contribute to the successful implementation of projects, and accelerate cycle time for new product development (Eisenhardt and Tabrizi 1995, Griffin and Hauser 1992, Pinto et al. 1993). Advantages are realized through this form of structural diversity because the mix of functional assignments in the group draws on differences in member training and experience (Bunderson and Sutcliffe 2002). The breadth of perspective in the work group can assist the reception and transmission of knowledge from outside of the group (Cohen and Levinthal 1990). Groups with members representing different functions can access diverse social networks they have established in their respective domains, such as marketing or manufacturing (Ancona and Caldwell 1992b). For different functional assignments to increase the value of knowledge sharing for work groups though, members must gain unique insight about the project through these external ties.

Hypothesis 2. *External knowledge sharing will be more strongly associated with performance when group members represent more functional assignments.*

Reporting Managers

A third form of structural diversity is derived from hierarchical reporting structures in organizations. For example, in matrix organizations, employees report through two or more command systems, one normally related to a function such as engineering and another often associated with a product, like cell phones (Davis and Lawrence 1977). There are several potential benefits to this form of organization, including increased communication channels and flexibility of resource use (Ford and Randolph 1992). The implication of having different reporting managers in groups is that members have access to diverse social networks through their managers. Through these networks, members can

exchange information that comes down from upper management or through other parts of the organization (Burt 1992). However, having different reporting managers will only improve the value of knowledge sharing for work groups if members share unique task knowledge through these hierarchical relationships.

Hypothesis 3. *External knowledge sharing will be more strongly associated with performance when group members report to more managers.*

Business Units

Finally, structurally diverse work groups can embody lateral structures in the organization, such as members working in different business units (Galbraith 1994). The capability to transfer best practices within the firm is linked to competitive advantage (Szulanski 1996), and formal integrative mechanisms (e.g., liaisons, task forces, permanent committees) have been shown to facilitate knowledge flow across the corporation (Gupta and Govindarajan 2000). In multiunit companies, this form of structural diversity in groups can result in faster project completion time when knowledge is shared effectively across units (Hansen 2002). Because task information available in one business unit may not be available in another, having members who work in different business units is a useful way to access diverse sources of knowledge outside of the group. For different business units to enrich the value of knowledge sharing for work groups, however, members must exchange unique project ideas with others in these external networks.

Hypothesis 4. *External knowledge sharing will be more strongly associated with performance when group members work in more business units.*

Data used to test the above hypotheses (see Figure 1 for a complete model) come from a sample of 182 work groups and include (1) corporate database records, (2) 20 group interviews, (3) 182 surveys of group leaders, (4) 957 surveys of group members, and (5) senior executives' ratings of group performance. Through extending ideas about external knowledge sharing to group diversity research, this investigation contributes to a growing literature on the importance of group context for effectiveness (Ancona and Caldwell 1992a, Hackman 1987). Furthermore, it develops the construct of structural diversity and tests a model of group performance that suggests external knowledge sharing is most valuable when work groups are structurally diverse.

Field Study

This study was part of a corporate-wide knowledge management initiative in a Fortune 500 telecommunications firm. The goal of the initiative was to improve knowledge sharing in a company that produces, among other things, communication technologies such as cell phones, digital pagers, and two-way radios. At the time of the research, the global organization employed more than 100,000 individuals, 40% of whom were engineers. Five divisions were organized by product-market segments, operated fairly autonomously, and were responsible for development, manufacturing, and sales. Group members in the sample were from recently completed projects across the United States–Canada (63%), Latin–South America (3%), Europe (15%), Middle East–Africa (5%), India-China (5%), and Japan-Korea-Malaysia (9%).

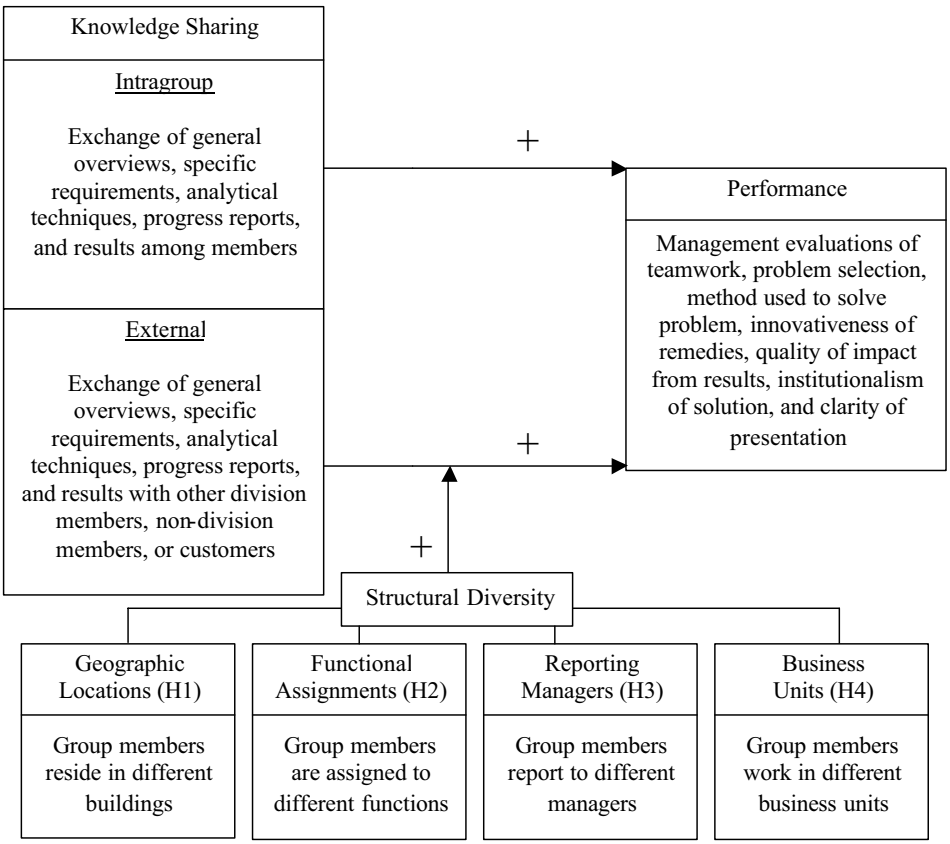
Groups worked on projects ranging from product development (e.g., design hand-held scanning device for a shipping company) to service improvement (e.g., convert client platform for car phones from analog to digital) to process management (e.g., execute separation and sale of business unit to another stakeholder) to manufacturing operations (e.g., modify existing factory to support new production of pagers). The type of project most often determined the composition of the work groups (average project size was eight members), and it was usually either a general manager or a group leader who decided project membership. After agreeing not to disclose the corporation identity, two senior executives gave me permission to contact the work groups.

Sample

Work groups in the sample participated in a corporate-wide reward and recognition program. The goal of the program was to publicly acknowledge the best-performing work groups in the company. General managers nominated work groups from regional sites around the world to participate in the competition. Each group was asked to make a 20–30 minute presentation to a panel of judges (5–12 senior executives) who were given specific training regarding the process. In most cases, judges were unfamiliar with the projects before they made their ratings, given the large size of the corporation. Performance for work group members was tied to raises, promotions, and reputation in the firm, so everyone involved took the events seriously.

Senior executives first rated 280 groups at more than 20 regional events worldwide. The 122 groups at each of the events that were judged the highest advanced to five separate division-level events, where a different panel of judges again rated the groups. The 21 division-level groups that were judged the highest moved on to a final corporate-level event, where they made presentations to the company CEO and senior vice-presidents. Background information could not be found for 98 of the 280 work groups, so this sample includes 84/137 (61%) of groups participating in

Figure 1 Model of Knowledge Sharing, Structural Diversity, and Performance in Work Groups



Note. "H" indicates hypotheses.

the regional events, 77/122 (63%) of groups participating in the division-level events, and 21/21 (100%) of groups participating in the corporate-level event.

In this sample of 182 work groups, members generally came from within the same division (5% of groups reported having a member from another division); almost all were company employees (8% of groups reported having one customer participate). Roughly 70% were male, the average age was 38, and members had an average of 7 and 13 years of company and industry experience, respectively. Ninety-four percent of the projects started and ended between January 1998 and January 2000 (average project length was 15 months).

Qualitative and Quantitative Evidence. Division managers provided archival data on the groups, including project documentation, presentation slides, and other available written materials. Exploratory interviews were conducted with all members of 20 work groups to learn about the nature of the projects and to develop surveys used later. I then contacted group leaders to verify project descriptions, member names, geographic locations, functional assignments, reporting managers, and business units. After gathering background information on the 182 work groups in the sample, I created a survey with questions about knowledge sharing within and outside of the group. I pretested the survey on employees in the corporate office before sending it out in June 2000 as an e-mail attachment to each group member who had a valid e-mail address (1,315/1,474 or 89%). The survey was sent an average of six months after groups had completed their projects, took approximately 20–30 minutes to complete, and included a cover letter describing the purpose of the study and ensuring confidentiality. The response rate for those who were sent an e-mail survey, including two follow-up reminders, was 73% (957/1,315).[1] There was at least one respondent from each work group, and responses were averaged across members and applied to the entire group.

[1] Selection bias analyses were conducted at the group level of analysis ($N = 182$). Analyses revealed no association between response rate and group size, available resources, environmental uncertainty, geographic locations, reporting managers, or business units. However, project length ($r = 0.21$, $p < 0.01$), functional assignments ($r = 0.17$, $p < 0.05$), and performance ($r = 0.24$, $p < 0.01$) were associated with a higher percentage of survey responses.

Measures

Control Variables. Previous research on work groups suggests that task type, group size, project length, availability of project resources, and environmental uncertainty may influence group performance. Based on labels used in the corporation, tasks were categorized as (1) Product Development (25%) (Product: Mean = 0.25; SD = 0.43); (2) Service Improvement (25%) (Service: Mean = 0.25; SD = 0.43); (3) Process Management (25%) (Process: Mean = 0.25; SD = 0.43); or (4) Manufacturing Operations (26%) (Operations: Mean = 0.26; SD = 0.44).

Group leaders indicated the number of members in the group (Size: Mean = 8.10; SD = 1.94) and the number of months from the start of the project to the end (Length: Mean = 14.96; SD = 10.53). They also assessed the availability of three project resources (Ancona and Caldwell 1992b): "On average, to what extent did the project have available resources . . .": (1) financial, (2) personnel, and (3) equipment (10-point scale: 1—not very available; 5—average; 10—very much available), which reliably loaded onto one factor ($\alpha = 0.80$; Resources: Mean = 6.22; SD = 2.04), and environmental uncertainty (Brown and Utterback 1985, Tushman 1979); that is, "On average, to what extent did the project need skills or information that were stable or rapidly changing" (10-point scale: 1—stable; 5—average; 10—rapidly changing) (higher value indicates greater uncertainty) (Uncertainty: Mean = 5.66; SD = 2.49).

Demographic Diversity. Consistent with previous research, the coefficient of variation (i.e., standard deviation of group members divided by the mean for the group) was used to compute demographic diversity (Allison 1978). At the end of the survey, group members reported their sex (1—male; 2—female), age (in years), company experience (in years), and industry experience (in years). The coefficient of variation ranged from 0.00 to 0.47 for variation in sex (Sex: Mean = 0.24; SD = 0.17), 0.00 to 0.58 for variation in age (Age: Mean = 0.29; SD = 0.12), 0.00 to 0.70 for variation in company experience (Company: Mean = 0.31; SD = 0.15), and 0.00 to 0.73 for variation in industry experience (Industry: Mean = 0.28; SD = 0.15).

Structural Diversity. An entropy-based index (Teachman 1980) was used to compute each measure of structural diversity

$$H = -\sum_{i-1}^{s} P_i(\ln P_i).$$

According to Ancona and Caldwell (1992b), "if there are N possible states $\{s\}$ in which the system can be, {and} P_i is the probability that the system will be found in state i, then the formula can be used to index the heterogeneity $\{H\}$ in the system . . . the only exception occurs when a {state} is not represented. In this case, the value assigned that state is zero" (p. 328). The greater the dispersion of group members across states, the higher the score on the index (the theoretical maximum depends on the number of states).

The data used for the four measures of structural diversity came from corporate database records. Geographic locations were defined as the building code where group members worked, and the index ranged from 0.00 to 2.04 (Locations: Mean = 0.52; SD = 0.52). Functional assignments were defined as the functions assigned in the work group: engineering (29%), manufacturing (20%), technical operations (14%), quality (7%), marketing/strategy (5%), customer service (4%), project management (4%), information technology (4%), administrative support (3%), sales (3%), human resources (2%), finance (2%), business administration (2%), and purchasing (1%). The index ranged from 0.00 to 1.89 (Functions: Mean = 0.90; SD = 0.47). Reporting managers were defined as the managers' members reported to in the work group, and the index ranged from 0.38 to 2.48 (Managers: Mean = 1.74; SD = 0.41). Finally, business units were defined as the business units where members worked, and the index ranged from 0.00 to 2.04 (Units: Mean = 0.52; SD = 0.48).

Knowledge Sharing. Three steps went into developing the measures of knowledge sharing reported here. First, I conducted 20 face-to-face interviews with group members to assess the different kinds of knowledge that they shared during their projects. Second, I analyzed the transcripts from group member interviews and reviewed previous research (Hansen 1999, Szulanski 1996, Zander and Kogut 1995). Together, they suggested five types of knowledge sharing in these work groups: (1) general overviews, (2) specific requirements, (3) analytical techniques, (4) progress reports, and (5) project results.[2] The frequency of knowledge sharing within and outside of the group was assessed on a 5-point scale (1—never; 2—rarely; 3—sometimes; 4—regularly; 5—a lot). The third step I took was to aggregate the five types of knowledge to form separate scales for intragroup (Intragroup KS: Mean = 3.90; SD = 0.39) and

[2] For purposes of reliability, members were asked questions about knowledge sharing during the planning phase and completion phase of their projects. Preliminary analyses did not reveal any knowledge sharing by phase interactions, so responses were averaged to assess overall knowledge sharing (average correlation for knowledge sharing between phases was $r = 0.83$). Furthermore, there were no identifiable differences among the targets of external knowledge sharing (nongroup employees inside the division, nongroup employees outside the division, and the customer), so they were combined for the analyses reported below ($\alpha = 0.78$).

Table 1 Factor Analysis for Intragroup and External Knowledge Sharing in Work Groups

Question	Type of knowledge	Intragroup sharing	External sharing
On average, how often did you share each type of knowledge during the project with *group members* (1—never; 2—rarely; 3—sometimes; 4—regularly; 5—a lot)?	General overviews (e.g., project goals, milestone estimates, or member responsibilities)	0.77	
	Specific requirements (e.g., numerical projections, market forecasts, or order requests)	0.66	
	Analytical techniques (e.g., statistical tools, detailed methods, or testing procedures)	0.75	
	Progress reports (e.g., status updates, resource problems, or personnel evaluations)	0.85	
	Project results (e.g., preliminary findings, unexpected outcomes, or clear recommendations)	0.85	
On average, how often did you share each type of knowledge during the project with *nongroup employees inside your division, nongroup employees outside your division, or the customer* (1—never; 2—rarely; 3—sometimes; 4—regularly; 5—a lot)?	General overviews (e.g., project goals, milestone estimates, or member responsibilities)		0.94
	Specific requirements (e.g., numerical projections, market forecasts, or order requests)		0.92
	Analytical techniques (e.g., statistical tools, detailed methods, or testing procedures)		0.89
	Progress reports (e.g., status updates, resource problems, or personnel evaluations)		0.94
	Project results (e.g., preliminary findings, unexpected outcomes, or clear recommendations)		0.94
Eigenvalue		2.15	5.47
Percentage of variance explained		0.22	0.55
Cronbach alpha		0.84	0.97

Note. Principal components analysis with varimax rotation. Loadings smaller than 0.24 are not shown.

external knowledge sharing (External KS: Mean = 2.38; SD = 0.58; see Table 1 for a factor analysis). Many employees reported sharing little external knowledge—39% (371/957) of members reported sharing knowledge outside of the group "rarely" (rating of 2/5) or less during their projects. Work groups shared significantly more knowledge within than outside of the group ($t(181) = 37.54$, $p < 0.001$).

Work Group Performance. Senior executives rated work groups in the corporate-wide reward and recognition program on seven dimensions: (1) teamwork, (2) clearly defined problem selection, (3) appropriateness of method used to solve problem, (4) innovativeness of remedies used to solve problem, (5) quality of impact from results, (6) institutionalization of solution, and (7) clarity of presentation. An analysis of a typical event ($N = 12$ judges and $N = 33$ groups) revealed that judges were able to reliably rate overall performance ($\alpha = 0.88$ across judges), and suggested a halo effect in which all seven dimensions loaded onto one factor ($\alpha = 0.80$ across dimensions). The performance measure used here is based on the highest level reached in the competition, therefore, the 182 groups were given a ranking of 0 (regional level, $N = 84$), 1 (division level, $N = 77$), or 2 (corporate level, $N = 21$) (Level: Mean = 1.65; SD = 0.68).

Results

Preliminary Analyses

Before testing the hypotheses discussed earlier, preliminary analyses were conducted on the data. First, descriptive statistics revealed that all variables were normally distributed, except for project length (which was skewed toward longer projects), thus, the natural log of project length is used in the analyses. Second, intraclass correlations justifying a group-level analysis were significant for intragroup and external knowledge sharing.[3] Further inspection of the intragroup and external knowledge sharing measures did not reveal the presence of individuals with particularly high levels of activity. For example, successful groups had an average of 3.6 members who reported sharing knowledge outside of the group at least sometimes,

[3] One-way analyses of variance (ANOVA) were conducted with intragroup and external knowledge sharing as the dependent variables and group membership as the independent variable (1–149) on groups where at least 50% of the members completed the survey ($N = 871$ cases). Intraclass correlations indicate the extent to which within-group responses are similar to one another but different from other groups, as determined by significance of the ANOVA (Kenny and LaVoie 1985). There was agreement among group members for external ($F(148, 870) = 3.51$, $p < 0.0001$, ICC = 0.24) and intragroup ($F(148, 870) = 1.75$, $p < 0.0001$, ICC = 0.09) knowledge sharing.

Table 2 Correlation Matrix with Main Study Variables ($N = 182$ Work Groups)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Control																			
1. Product	—																		
2. Service	−0.33	—																	
3. Process	−0.33	−0.33	—																
4. Operations	−0.34	−0.34	−0.34	—															
5. Size	−0.10	−0.03	0.02	0.11	—														
6. Length	0.10	−0.01	0.02	−0.11	−0.05	—													
7. Resources	0.22	0.02	−0.18	−0.06	−0.08	0.01	—												
8. Uncertainty	0.07	0.16	−0.16	−0.08	0.06	−0.05	0.08	—											
Demographic Diversity																			
9. Sex	−0.14	−0.07	0.15	0.05	0.16	−0.03	0.00	0.01	—										
10. Age	0.14	−0.05	−0.10	0.01	0.02	−0.02	0.08	0.06	0.09	—									
11. Company	0.14	−0.02	−0.01	−0.11	−0.09	−0.04	−0.12	0.07	0.10	0.35	—								
12. Industry	0.17	−0.07	−0.17	0.07	−0.01	0.06	0.01	−0.02	0.05	0.59	0.41	—							
Structural Diversity																			
13. Locations	0.02	0.07	0.10	−0.18	0.14	−0.07	−0.03	0.13	0.00	0.07	0.20	−0.03	—						
14. Functions	−0.20	0.25	0.02	−0.07	0.26	0.04	−0.02	0.02	0.11	−0.06	−0.06	−0.09	0.18	—					
15. Managers	−0.04	−0.05	0.10	−0.01	0.54	−0.14	−0.04	0.04	0.00	−0.01	−0.05	−0.03	0.28	0.35	—				
16. Units	0.01	0.00	0.14	−0.14	0.19	−0.08	−0.01	0.09	0.04	0.07	0.07	−0.01	0.40	0.19	0.33	—			
Knowledge Sharing (KS)																			
17. Intragroup	0.04	−0.02	−0.06	0.03	−0.13	−0.01	0.12	−0.06	−0.04	−0.07	−0.01	−0.01	−0.11	−0.11	−0.10	−0.16	—		
18. External	0.04	−0.05	−0.10	0.11	0.06	−0.09	0.16	0.00	0.02	−0.12	−0.11	−0.06	0.05	0.07	0.05	0.10	0.41	—	
Performance																			
19. Level	0.07	−0.05	−0.05	0.02	0.19	−0.04	0.11	0.06	0.11	−0.13	0.05	−0.02	0.07	0.14	0.13	0.08	0.27	0.36	—

Note. $r > 0.12$, $p < 0.10$; $r > 0.15$, $p < 0.05$; $r > 0.18$, $p < 0.01$.

thus, it was not limited to one member of the group. Third, correlations were calculated for the main variables in the study (see Table 2). It is important to note that while the four measures of structural diversity were significantly intercorrelated (average $r = 0.29$, $p < 0.01$), they were not strongly related to intragroup or external knowledge sharing (Intragroup: average $r = -0.12$, $p > 0.10$; External: average $r = 0.07$, $p > 0.10$).

Hypothesis Testing

Ordered logit analysis, appropriate when the dependent variable is ordinal, estimates the odds of reaching a higher level of the dependent variable. In the case of work group performance, the coefficient estimates indicate the probability of a work group reaching the regional level, division level, or corporate level of the competition. Table 3 (Model 1) shows the results of the ordered logit analysis, and for parsimony, the only significant control variable, group size ($b = 0.21$, $p < 0.01$). Models 2, 4, 6, and 8 show the effects of geographic locations, functional assignments, reporting managers, and business units, respectively, as well as intragroup and external knowledge sharing. In each case, intragroup (average $b = 1.14$, $p < 0.05$) and external knowledge sharing (average $b = 0.95$, $p < 0.01$) were significantly associated with performance, but the measures of structural diversity were not.

In support of Hypothesis 1, Table 2 (Model 3) shows that the interaction of external knowledge sharing and geographic locations was significantly associated with performance ($b = 0.37$, $p < 0.05$), and that the change in R^2 from Model 2 (0.20) to Model 3 (0.22) was marginally significant ($\Delta R^2 = 0.02$; $F = 2.60$, $p < 0.10$). The interaction plot shows that greater external knowledge sharing was related to better performance when there were more geographic locations (see Figure 2a). In support of Hypothesis 2, Table 2 (Model 5) shows that the interaction of external knowledge sharing and functional assignments was also significantly associated with performance ($b = 0.52$, $p < 0.01$), and the change in R^2 from Model 4 (0.21) to Model 5 (0.25) was significant ($\Delta R^2 = 0.04$; $F = 4.20$, $p < 0.05$). The interaction plot shows that greater external knowledge sharing was related to better performance when there were more functional assignments (see Figure 2b).

In support of Hypothesis 3, Table 2 (column 7) shows that the interaction of external knowledge sharing and reporting managers was significantly associated with performance ($b = 0.49$, $p < 0.05$), and the change in R^2 from Model 6 (0.20) to Model 7 (0.24) was significant ($\Delta R^2 = 0.04$; $F = 4.34$, $p < 0.05$).

Table 3 Ordered Logit Analyses Predicting Work Group Performance from Knowledge Sharing and Structural Diversity ($N = 182$ Work Groups)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Size	0.21**	0.23**	0.22**	0.21*	0.22**	0.22*	0.22**	0.23**	0.22**	0.22**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)
Locations		0.19	0.23							
		(0.30)	(0.31)							
Functions				0.51	0.63					
				(0.36)	(0.36)					
Managers						0.22	0.29			
						(0.45)	(0.45)			
Units								0.24	0.21	
								(0.33)	(0.35)	
(Composite)										0.76
										(0.57)
Intragroup KS		1.13*	1.24**	1.17**	1.17*	1.10*	1.25**	1.16*	1.18*	1.32**
		(0.45)	(0.46)	(0.45)	(0.46)	(0.45)	(0.45)	(0.45)	(0.47)	(0.47)
External KS		0.96**	0.97**	0.92**	0.99**	0.97**	1.02**	0.95**	0.93**	0.94**
		(0.30)	(0.30)	(0.30)	(0.31)	(0.30)	(0.30)	(0.30)	(0.30)	(0.31)
Locations X Intragroup KS			0.02							
			(0.18)							
Locations X External KS			0.37*							
			(0.18)							
Functions X Intragroup KS					−0.17					
					(0.17)					
Functions X External KS					0.52**					
					(0.18)					
Managers X Intragroup KS							0.00			
							(0.18)			
Managers X External KS							0.49*			
							(0.20)			
Units X Intragroup KS									−0.22	
									(0.18)	
Units X External KS									0.36^t	
									(0.20)	
(Composite) X Intragroup KS										−0.22
										(0.18)
(Composite) X External KS										0.66**
										(0.20)
Log likelihood	340.88	313.66	309.00	311.91	303.74	313.80	304.55	313.49	309.98	300.32
χ^2	11.6	33.7**	37.4**	34.7**	39.9**	33.5**	40.7**	34.0**	36.6**	42.1**
df	7.0	10.0	12.0	10.0	12.0	10.0	12.0	10.0	12.0	12.0
R^2	0.06	0.20	0.22	0.21	0.25	0.20	0.24	0.20	0.21	0.26
ΔR^2		0.14**	0.02^t	0.15**	0.04*	0.14**	0.04*	0.14**	0.01	0.20**

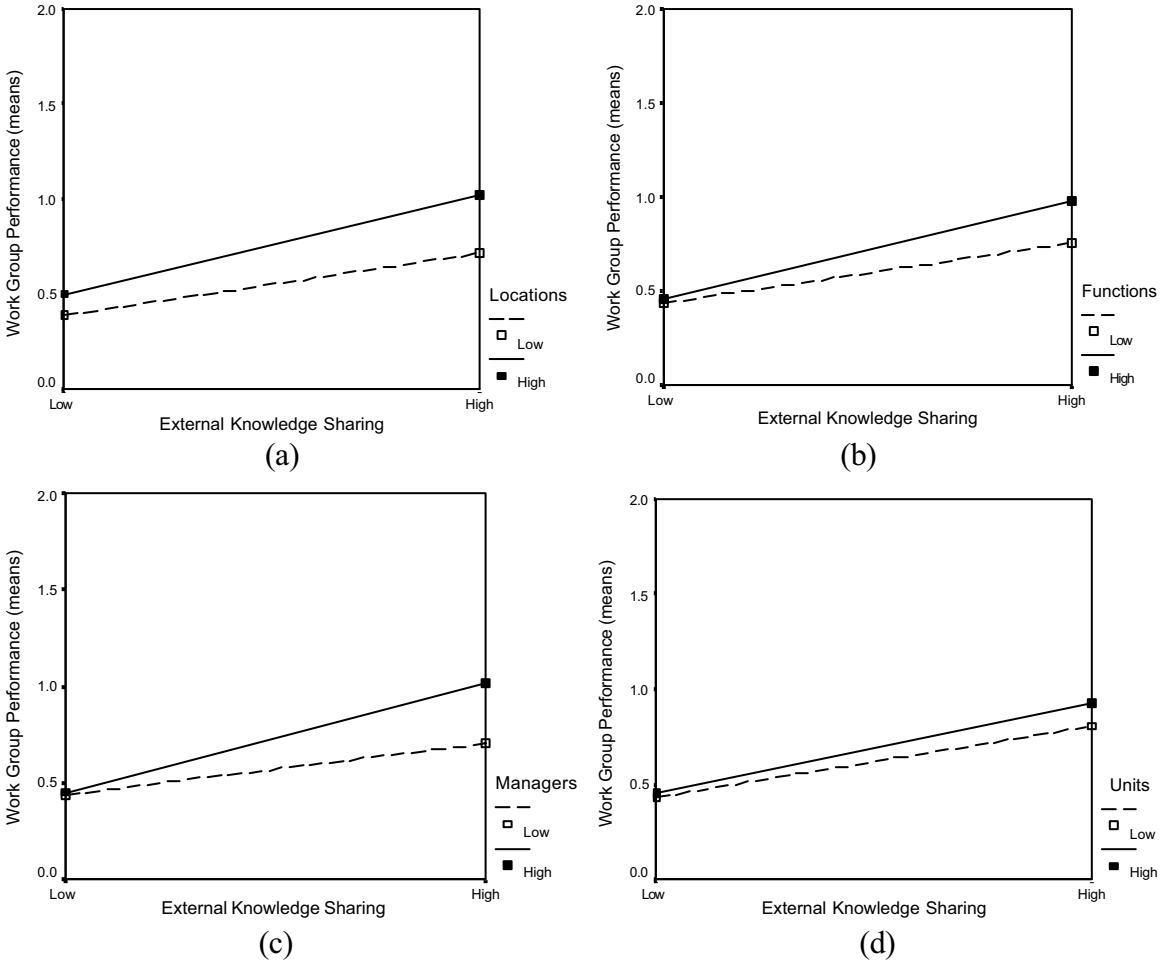
Notes. $^t p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$. Standard errors are in parentheses below unstandardized coefficients. Independent variables were centered before computing interactions. The degrees of freedom reflect the intercepts and nonsignificant control variables not report here. R^2 and ΔR^2 were computed in a separate analysis using ordinary least squares regression.

The interaction plot shows that external knowledge sharing was related to better performance when there was a greater number of reporting managers (see Figure 2c). Finally, in partial support of Hypothesis 4, Table 2 (column 9) shows that the interaction of external knowledge sharing and business units had a marginally significant association with performance ($b = 0.36$, $p < 0.10$). The interaction plot shows that more external knowledge sharing was related to better performance when there was a greater number of business units (see Figure 2d), however, the change in R^2 from Model 1 (0.20) to Model 4 (0.21) was not significant ($\Delta R^2 = 0.01$; $F = 1.51$, $p > 0.10$). The interaction of intragroup knowledge sharing and each measure of structural diversity was not related to performance in any of the models.[4]

Additional analyses were conducted to further explore the proposition made at the beginning of this paper, that external knowledge sharing will be more strongly associated with performance when work groups are more structurally diverse. First, I created a composite measure of structural diversity by standardizing each measure separately (i.e., geographic locations, functional assignments,

[4] When all main effects and interactions are entered into one model, none of the interactions are significant. This is probably a result of the mutual partialling that occurred among correlated interaction terms (average $r = 0.31$, $p < 0.05$).

Figure 2 **Interaction Plots of External Knowledge Sharing with (a) Geographic Locations, (b) Functional Assignments, (c) Reporting Managers, and (d) Business Units on Group Performance**



Note. To illustrate the direction and magnitude of effects, external knowledge sharing and each measure of structural diversity were dichotomized as low and high based on mean values.

reporting managers, and business units), and then averaging them together. As expected, Table 3 (column 10) shows the interaction between external knowledge sharing and a composite measure of structural diversity was significantly associated with performance ($b = 0.66$, $p < 0.01$), but the other interactions were not. Second, I substituted measures of demographic diversity (i.e., sex, age, company experience, industry experience) for measures of structural diversity. Table 4 shows the results of these ordered logit analyses with performance as the dependent variable. None of the interactions between intragroup and external knowledge sharing and measures of demographic diversity were related to performance.

Discussion

In this paper, I argue that external knowledge sharing is more valuable when groups are more structurally diverse. Members in different locations, who represent different functions, who report to different managers, and who work in different business units can benefit from unique sources of knowledge outside of the group. Two themes characterize the findings of this paper. First, consistent with previous research, both intragroup and external knowledge sharing are important for performance in work groups. The main effects of knowledge sharing on performance were reliably significant. Second, in support of the four hypotheses, external knowledge sharing was more strongly associated with performance when work groups were more structurally diverse. In contrast, demographic diversity did not yield the same benefits, suggesting that not all sources of diversity in work groups enhance the value of knowledge.

Several examples from the qualitative evidence collected in this study reinforce these results. For example, a product development group, with nine members spread across the United States, Israel, and Singapore, was charged with the task of creating a new electronics device. Instead of designing a chip

Table 4 Ordered Logit Analyses Predicting Work Group Performance from Knowledge Sharing and Demographic Diversity ($N = 182$ Work Groups)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Size	0.21**	0.22**	0.24**	0.24**	0.24**	0.25**	0.24**	0.24**	0.24**	0.24**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Sex		1.15	1.20							
		(0.93)	(0.95)							
Age				−1.96	−1.79					
				(1.36)	(1.37)					
Company						1.53	1.34			
						(1.05)	(1.08)			
Industry								−0.22	−0.35	
								(1.07)	(1.09)	
(Composite)										0.60
										(1.65)
Intragroup KS		1.10*	1.07*	1.10*	1.06*	1.07*	1.07*	1.10*	1.04*	1.08*
		(0.44)	(0.45)	(0.44)	(0.45)	(0.44)	(0.46)	(0.44)	(0.45)	(0.45)
External KS		0.98**	1.04**	0.91**	0.94**	1.06**	1.03**	0.97**	1.02**	1.01**
		(0.30)	(0.31)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)
Sex X Intragroup KS			−0.11 (0.13)							
Sex X External KS			−0.17 (0.14)							
Age X Intragroup KS					−0.12 (0.14)					
Age X External KS					0.13 (0.13)					
Company X Intragroup KS							−0.03 (0.11)			
Company X External KS							0.18 (0.13)			
Industry X Intragroup KS									−0.17 (0.13)	
Industry X External KS									0.17 (0.13)	
(Composite) X Intragroup KS										−0.16 (0.13)
(Composite) X External KS										0.10 (0.13)
Log likelihood	340.88	312.47	308.92	311.94	310.75	311.88	309.95	313.99	311.75	311.96
χ^2	11.6	34.8**	36.2**	35.2**	36.2**	35.0**	37.3**	33.7**	35.3**	35.0**
df	7.0	10.0	12.0	10.0	12.0	10.0	12.0	10.0	12.0	12.0
R^2	0.06	0.20	0.21	0.21	0.21	0.20	0.22	0.20	0.21	0.21
ΔR^2		0.14**	0.01	0.15**	0.01	0.14**	0.01	0.14**	0.01	0.15**

Notes. $^t p < 0.10$, $^* p < 0.05$, $^{**} p < 0.01$. Standard errors are in parentheses below unstandardized coefficients. Independent variables were centered before computing interactions. The degrees of freedom reflect the intercepts and nonsignificant control variables not report here. R^2 and ΔR^2 were computed in a separate analysis using ordinary least squares regression.

from scratch for use in the device, the group modified a chip design borrowed from another group in the same location as one of the members (Israel). Their device turned out to be innovative, in part, because of the knowledge shared through a local connection. In another example, a service improvement group was responsible for upgrading a wireless network. Members represented the functions of project management, quality, and engineering. Instead of conducting their own consumer research, the group gathered satisfaction data from employees who shared the same function as one of the members (quality). Their upgrade became a success, in part, because of information gathered through the functional ties of a group member.

In a third example, a manufacturing operations group needed to oversee the conversion from pagers to cell phones at a production facility in Ireland. Nine members were located in Ireland and Scotland and represented technical operations, quality, and engineering. Instead of generating their own documentation for next steps, members used their manager's contacts to benchmark another factory in Scotland. Their conversion was effective, in part, because of knowledge gained through a manager's social network. In a final example, a process management group was asked to streamline corporate communications to cut costs and reduce the potential of miscommunication with employees and customers. Ten members from human resources, marketing, and customer service worked in business units across three divisions. Instead of only relying on what they already knew, members ensured that management

boards from multiple divisions endorsed the proposal. Their recommendations were well received, in part, because of feedback gained through ties in the various business units.

While this paper focused on the potential benefits of structural diversity in work groups, several lines of research suggest there may be costs as well. For example, research has shown that geographic distance makes many aspects of intragroup communication more difficult because of the reduced opportunities for informal contact (Kiesler and Cummings 2002). In addition, the intragroup communication challenges for cross-functional groups are often strenuous because members cannot bridge different "thought worlds" (Dougherty 1992). And when members of work groups have to report to different managers, they may get contradictory demands or experience role ambiguity (Ford and Randolph 1992). Finally, members who work in different business units may find that knowledge transfer is difficult or "sticky" (Szulanski 1996). In work groups studied here, however, the benefits of structural diversity seemed to outweigh the potential costs of poor intragroup functioning, though additional evidence is needed on conflict, coordination, and cohesiveness, which were not measured in this study.

On average, members of structurally diverse groups in this study did not share less intragroup knowledge than members of homogeneous groups. Moreover, structurally diverse groups did not perform better or worse than homogeneous groups. The chances of better performance increase when more knowledge is shared among group members and with others in their external social networks. While previous work has addressed the role of gatekeepers or boundary spanners in sharing knowledge outside of the group (e.g., Allen 1977), there did not appear to be any patterns suggesting that successful groups in this sample had specialized members who engaged in this activity.

There are several alternative explanations for why external knowledge sharing was beneficial for performance when groups were more structurally diverse. First, performance was rated at each of the regional, division, and corporate events roughly six months before group members completed the surveys. Although senior executives did not give detailed feedback to groups regarding their performance, all groups knew whether or not they advanced to the next level. Participants could have responded to the survey in a way that conformed to their intuitions about performance, though it is unlikely that members were aware of an interaction effect of external knowledge sharing and each measure of structural diversity. Second, work groups with better performing members may have shared more knowledge because of opportunities they created, thus, it may not have been that knowledge sharing resulted in better performance, but rather that better performance resulted in more knowledge sharing. However, in either case, the data reported here are cross sectional, and claims about causality cannot be substantiated.

Limitations

There are also several limitations of this field study. The sample was chosen opportunistically; there is no documented information on how representative the work groups are in terms of size, membership, or capabilities. One reason for the low R^2 in the analyses testing the hypotheses (which ranged from 0.19 to 0.25, see Table 3) may be that variance was restricted on the dependent variable because only moderately to highly successful groups were examined. The sample bias in favor of successful groups also limits the generalizability of the results, though the hypothesis tests were likely conservative given the paucity of low-performing groups. Given these limitations, readers should proceed cautiously when interpreting the results.

Another concern involves the measurement of knowledge sharing, and the measurement error from the self-report survey in particular. Because surveys were administered an average of six months after the projects, distinctions between time periods, types of knowledge, and targets of external knowledge sharing were likely blurred in the minds of participants. Future research should examine different measures of knowledge sharing content and networks, as well as better metrics for capturing knowledge sharing (e.g., ways for members to count actual conversations, documents, or transfers of information).

This study examined only one aspect of the many kinds of interactions people can have in work groups. Interactions other than knowledge sharing are unaccounted for here. Evidence is also missing on the quality of the knowledge being shared. It is likely that diverse external sources may matter even more when the knowledge is timely or scarce. It also remains indeterminate under what conditions it is better to be the source or recipient of knowledge, and how knowledge sharing can negatively impact performance. Surely, all knowledge is not critical to have, and sometimes it is better to give than to receive. It is also uncertain how knowledge sharing would occur under conditions of competition or hostility among groups in the corporation. The culture of this organization may be special in that it encouraged diversity and knowledge sharing outside of work groups. Replicating these findings in other companies is recommended to fully understand the role of knowledge sharing in global organizations.

Implications

A theoretical contribution of this paper was the integration of ideas about knowledge sharing and diversity in work groups. In particular, structural diversity was introduced as an important concept for bridging group members to the larger organizational context. Geographic locations, functional assignments, reporting managers, and business units were linked together for the first time as critical features of group structure. Furthermore, the results suggest that there are performance benefits for structurally diverse groups when members share knowledge outside of the group. While previous research has primarily focused on the intragroup consequences of diversity, the external perspective discussed here builds on recent work emphasizing the significance of diverse knowledge networks throughout an organization (Hansen 2002). Viewing work groups as part of a broader organizational network has implications for how group members are selected to participate, where resources to support group processes come from, and why some groups are more effective than others. Additional research is needed at the intersection of work groups and social networks (Cummings and Cross 2003), including which network structures are most effective for facilitating knowledge sharing outside of the group.

A clear practical message from this study is that managers should be explicit about the importance of external knowledge sharing in work groups. When asked why group members did not share knowledge externally, there were three general responses: (1) "Why do I need to share knowledge externally, my group has everything it needs," (2) "I would like to share knowledge externally, but I don't know who to share it with," and (3) "I am not supported or rewarded for sharing knowledge externally." More generally, managers could (1) design work groups to include members with strong external networks who value interacting outside of the group, and can use their ties to the group's advantage, (2) look for ways to improve the connectivity among their employees, such as cross-functional workshops or knowledge fairs that offer an arena for bringing people together, and (3) foster a culture that supports knowledge sharing and provides incentives for employees to participate, either through their performance evaluation or public recognition. More specifically, when external knowledge sharing does not naturally occur, managers could assign extramural liaison roles in the group to connect with relevant parts of the organization. For multinational corporations that want to have successful work groups well into the twenty-first century, encouraging external knowledge sharing through structurally diverse groups is a fruitful possibility.

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