Individual Participation in Organizational Information Commons
The Impact of Team Level Social Influence and Technology-Specific Competence

YU YUAN
Cornell University
JANET FULK
University of Southern California
MICHELLE SHUMATE
North Dakota State University
PETER R. MONGE
University of Southern California
J. ALISON BRYANT
Indiana University
MATTHEW MATSAGANIS
University of Southern California

This research extended earlier public goods research on individual incentives to use an organizational information commons that was based in Marwell and Oliver's (1993) collective action model. A revised theoretical model that incorporated team-level social influence and technology-specific competence was proposed. The model was tested using online survey data from 150 individuals in 13 work groups across 5 organizations. The research demonstrated that perceived team member behavior and technology-specific competence were positively related to individual use of intranets, over and above the collective level influences modeled in earlier research. These findings supported a more "socialized" model of individuals' motivations to participate in organizational information sharing via collective repositories and suggested that management could boost levels of intranet usage through group level social influence and technology-specific training.

Yu Yuan (Ph.D., University of Southern California, 2004) is an assistant professor in the Department of Communication at Cornell University. *Janet Fulk* (Ph.D., The Ohio State University, 1978) is professor of communication in the Annenberg School for Communication and Professor of Management & Organization in the Marshall School of Business at University of Southern California. *Michelle Shumate* (Ph.D., University of Southern California, 2003) is an assistant professor in the Department of Communication at North Dakota State University. *Peter Monge* (Ph.D., Michigan State University, 1972) is professor of communication in the Annenberg School for Communication, and Professor of Management and Organization at the Marshall School of Business at University of Southern California. J. Alison Bryant (Ph.D., University of Southern California, 2003) is an assistant professor in the Department of Telecommunications at Indiana University, Bloomington. Matthew Matsaganis (M.A., Emerson College, 2001) is a doctoral student in the Annenberg School for Communication at the University of Southern California. Address correspondence to the first author of the paper at Department of Communication, 308 Kennedy Hall, Cornell University, Ithaca, NY 14850; email: yy239@cornell.edu.

Human Communication Research, Vol. 31 No. 2, April 2005 212–240

In recent years organizations have implemented more collective-oriented forms of organization and management, making collective action theories increasingly relevant to organizational communication studies (Robertson & Tang, 1995). These forms include self-managed teams (Lawler, 1981), technology-supported group work (e.g., O'Hara-Devereaux & Johansen, 1994), and network organizational structures (Monge & Fulk, 1999). The new collective-oriented forms mirror some of the voluntarism and self-organization long attributed to other types of collectives, such as the United Nations, public broadcasting, professional associations, and social movements (Knoke, 1990).

A critical challenge is that *social dilemmas* threaten the success of collectives. Social dilemmas are situations that pit the interests of the collective against the self-centered interests of individual members (Dawes, 1980; Messick & Brewer, 1983; Rutte & Wilke, 1992; Van Lange, Liebrand, Messick, & Wilke, 1992). Social dilemmas account for well-known societal problems involving collectively shared goods and resources, in terms of both undersupply (e.g., public radio is under-funded when people do not contribute to pledge drives even though they receive the benefits of public radio; Kropf & Knack, 2003) and overconsumption (e.g., overfishing of scarce species such as Chilean sea bass; Hardin, 1982). In the organizational realm, such dilemmas account for a host of dysfunctions, such as social loafing in team contexts, interunit conflicts over shared resources, hoarding of information and other resources, or individual resistance to organizational innovation (Kalman, Monge, Fulk, & Heino, 2002). Social dilemmas related to participation in communication and information systems have been labeled *communication dilemmas* (Kalman et al., 2002).

Communication dilemmas produce undersupply of collectively held information and knowledge stores (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996) on which new collective-oriented organizational forms heavily rely (DeSanctis & Fulk, 1999). Organizations need to motivate individuals effectively to resolve communication dilemmas in favor of contributing to organizational information stores. Such stores are discretionary resources in that users voluntarily stock them with discretionary information. Information is discretionary if it is "initially under the control of one organizational member, who can choose whether or not to make it available to others" (Connolly & Thorn, 1990, p. 219). For example, project management tools such as Metaphase™ enable design engineers to elect when and how much of their design work is entered into the "vault" of information available to other members of their team. Such engineers exercise discretion in deciding when their designs are sufficiently complete and accurate to be shared. Communication dilemmas arise for discretionary resources when potential contributors cannot envision individual benefits that derive from collective ones, and thus they are not motivated to participate in collective knowledge sharing (Connolly & Thorn, 1990; Markus, 1990).

In response to this type of challenge, researchers have developed modifications of classic theories of collective action and public goods for "information public goods" (Connolly & Thorn, 1990; Fulk et al., 1996; Markus, 1990; Monge, et al., 1998). These formulations consider the unique nature of information as a nonmaterial resource possessed by individuals—a resource that could benefit a collective (e.g., team, network, organization, or consortium) if the individuals could be induced to contribute their information to a shared information repository. Examples include intranets, project Web sites, bulletin boards, Web boards, expert databases, groupware, data warehouses, "lessons learned" databases, and interorganizational information exchange systems.

Theories of collective action have been criticized by some scholars as undersocialized (Granovetter, 1985), focusing solely on a rational cost–benefit calculus to the exclusion of potentially powerful social and emotional factors. Fulk, Heino, Flanagin, Monge, and Bar (2004) take one step to remedy this problem by considering how people conceptualize and use discretionary information in a community differently from how they use material resources such as money or tangible products. Their model takes a major step forward toward individualizing the collective action model to organization information sharing. Nevertheless, that model is relatively faithful to the core economic logic of collective action theory. The model developed in this article takes one additional step toward socializing the collective action model by incorporating propositions regarding social influences on participation in discretionary information repositories over and above the explanation based in the cost–benefit calculus. The model integrates collective action principles with theories of organizational social influences. The primary focus is on social influences activated by formal work team affiliations. This model also incorporates an additional predictor that has been found to be relevant to studies of technology use: *technology-specific competence* (Schmitz & Fulk, 1991).

The next section of this article briefly summarizes Fulk et al.'s (2004) model of discretionary information sharing for collective knowledge repositories. The subsequent section proposes an extension of the model that derives from theory and research on social influences in work groups and technology-specific competence. The remainder of the article reports results of an empirical test of the revised model.

INDIVIDUAL MOTIVATION TO PARTICIPATE IN COLLECTIVE INFORMATION SHARING

The *individual action component* of collective action theory poses a model of incentives to individual participation or nonparticipation in collective action at a particular point in time. Marwell & Oliver (1993) offer a

detailed mathematical formulation of the individual action component based upon the core collective action premise that behavior is responsive to cost–benefits analyses. That is, when the value of participation exceeds its costs, the marginal gains that accrue to potential participants favor the choice to participate (see Appendix A for a mathematical formulation).

Fulk et al. (2004) modify Marwell and Oliver's individual action component to apply to information collective action. Based on a series of arguments regarding how information repositories differ from more tangible collective action, they recalibrate the cost–benefits model as displayed in bold in Figure 1. Fulk et al. (2004) present empirical evidence supporting their model of the individual action component based on studies of intranet participation in three different organizations.

In keeping with Oliver and Marwell's (2001) assertion that their theory offers a framework for pointing to crucial factors rather than a fixed model, the research reported here offers two additional modifications to the individual action component for information collectives. First, the model incorporates team level social influences on choices to participate. Second, the model proposes that technology-specific competence has a direct relationship with participation in information repositories, as has been found in prior research on communication technologies (e.g., Schmitz & Fulk, 1991). The revised theoretical model of the individual action component is displayed in Figure 1.

Socialized Individual Action Component

Collective action theories argue that some organizing force is required to mobilize collective action (Samuelson, 1954). That force could be a person or a coalition of motivated people who are willing to pay the costs of organizing collective action in the absence of direct individual gain (Hardin, 1982). The organizational context can facilitate mobilization by creating opportunities and requirements for communication among its members. Research has shown that communication among potential participants facilitates collective action (Marwell & Oliver, 1993). Organizations also provide incentives and disincentives for working together and for sharing or hoarding information (Connolly & Thorn, 1990). In particular, assignment to a specific work team charged with specific task goals offers some degree of organization toward collective goals. At the same time, the work team takes on the status of a collective itself, whose motivations do not always coincide fully with those of the organization as a whole (Janis, 1982; Levy, 2001).

The challenge of motivating contributions from work team members to organizational information repositories mirrors in some ways what evolutionary theory calls *whole–part competition* (Aldrich, 1999; Baum,

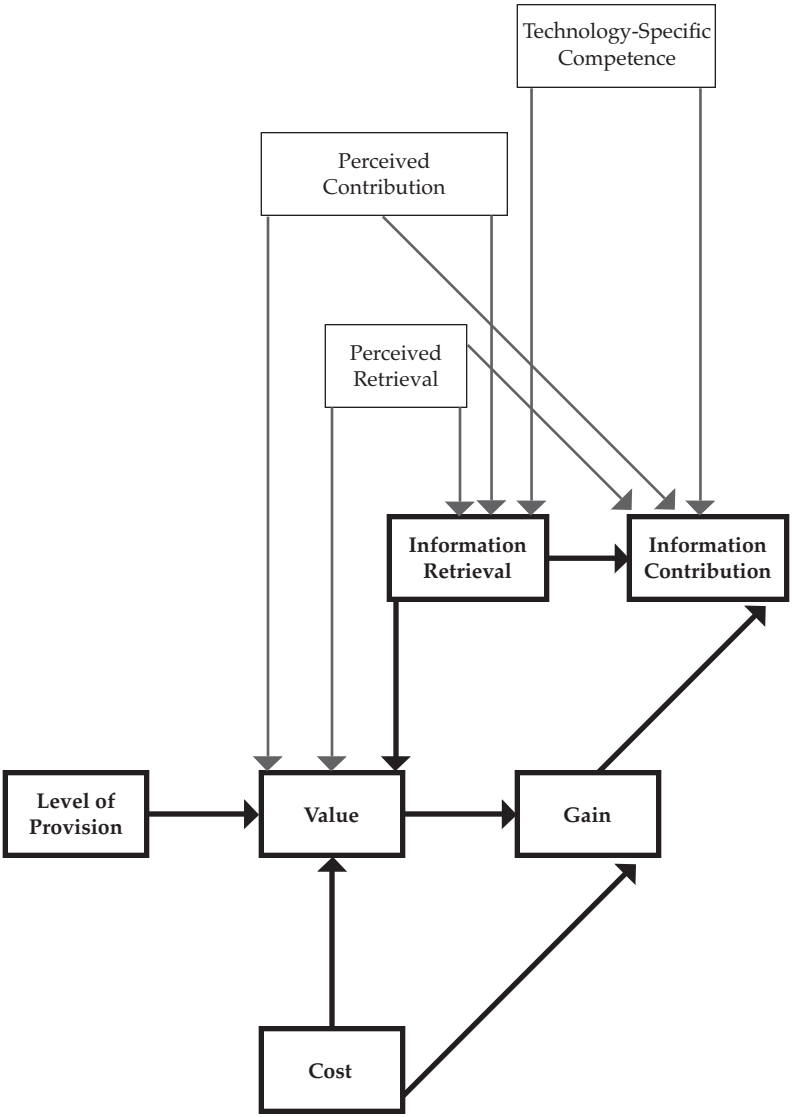

Figure 1. Baseline Conceptual Model That Added Perceived Contributions, Perceived Retrieval and Technology-Specific Competence to Fulk et al. (2004) Model.
NOTE: Original Fulk et al. (2004) model is shown in bold.

1999; Monge & Contractor, 2003). Co-acting self-interested work teams may each try to maximize their own gains, making optimization of the global interests of the organization as a whole difficult to achieve. In social dilemma terms, the incentives at the work team level favor self-interested actions that can conflict with the best interests of the organization as a whole.

Just as organizations face social dilemmas from whole–part competition, work groups attempt to counter social dilemmas that result from pursuit of individual member's self-interest. Decades of research has shown that groups can exert strong social influences on members' cognitions and behaviors (e.g., Arrow, McGrath & Berdahl, 2000; Hollingshead et al., 2004; McGrath, 1984). Social influences have been found to be present in members' interactions with technology (e.g., McGrath & Hollingshead, 1994). From a social influence perspective technologies are equivocal (Weick, 1990) because they can be interpreted and experienced in multiple different ways. Users construct and give meaning to technologies (Poole & DeSanctis, 1990) based on a variety of social influence processes. Among these are adaptive structuration (Poole & DeSanctis, 1990), social learning (Bandura, 1986), social information processing (Fulk, Schmitz, & Steinfield, 1990; Walther, 1996), network effects (Kraut, Rice, Cool & Fish, 1998), symbolic interaction (Trevino, Daft, & Lengel, 1990), and attribution (Fulk et al., 1990).

The formal work team is a major locus for such social influence. Team members share collective identities based on team and organizational citizenship. Collective identities support "local" social influence processes that can produce patterns of similar cognitions and behaviors across team members (Abrams, Hinkle, Otten & Hogg, 2001). In this section, we review several different models of social influence processes. The models propose somewhat different underlying processes; nonetheless, they converge in predicting that members of teams will share patterns of cognitions and behaviors that are best explained by local social influence.

Classic studies of groups demonstrate that convergent patterns across group members result from two key processes: *internalization* and *compliance* (Deutch & Gerard; 1955; Festinger, 1953; Janis, 1982; McCauley, 1989). Internalization occurs when individuals privately accept other group members' attitudes, behavioral norms, beliefs, and construction of events, typically because of high attraction to the group. Compliance occurs when individuals conform behaviorally in response to group pressure and out of fear of recrimination. Compliance produces shared patterns of behavior but not shared cognitions, whereas internalization produces convergence in both behaviors and cognitions, including those related to the use of technologies (Fulk, 1993).

Social cognitive theory (Bandura, 1986) describes five processes of social influence, all of which originate in work teams as well as other sources of social stimuli. Observational learning occurs when people learn new attitudes and behaviors from directly observing others. Response facilitation occurs when people's behaviors cue existing latent behaviors or attitudes in others. Inhibition and disinhibition occur from observing the consequences of others' behaviors and estimating the likelihood of experiencing those same consequences. Environmental enhancement is present when other persons' behavior "channels the observer's attention to particular stimuli or draws observers into setting which elicit similar behavior" (Bandura, 1986, p. 49). Arousal occurs when people react emotionally to emotional reactions displayed by others. Bandura (1986) reviews extensive research that provides support for social cognitive theory.

Social information processing theory (Salancik & Pfeffer, 1978) proposes several other social influence processes: (a) direct statements and interpretations of events by others that are assimilated by an individual, (b) communications that call attention to aspects of the work environment and thus increase the saliency of those aspects, and (c) communication of standards for judging behaviors. Fulk et al. (1990) extended this model to consideration of social influences on cognitions and behaviors specifically related to information technologies in organizational contexts. Several studies have provided empirical evidence of social influences in work teams specifically related to the use of electronic media (e.g., Fulk, 1993; Kraut, Rice, Cool, & Fish, 1998; Rice & Aydin, 1991; Schmitz & Fulk, 1991).

Behavioral Convergence

Even though the various theories propose somewhat different underlying mechanisms, they agree that a key outcome is convergence of behaviors in collectives. Convergence could result, for example, from internalization, compliance, observational learning, or direct communications from team members. Thus, we propose that an individual will contribute to an information repository to the extent that the person believes that other members of the work team contribute to that repository. This local social influence factor will explain additional variation in individual behavior over and above the calculus of the individual action component.

H1: Individuals' contributions to organizational information repositories will be positively related to their perceptions of team members' contributions to repositories.

H2: Individuals' retrieval from organizational information repositories will be positively related to their perceptions of team members' retrieval from repositories.

Network effects (Kraut et al., 1998; Shapiro & Varian, 1999) also may be present in information repositories. Network externalities exist when an information repository acquires value due to factors external to the information it contains. The external factor is the number of other participants in the repository. The cost–benefit calculus of the individual action component produces effects that resemble network effects. The perceived level of provision from individual's network impacts individual's valuation of the repository. Network effects have been conceptualized and studied at the level of the collective—but not at the level of the local work teams. Shared behaviors described above as resulting from local social influence would also be consistent with the presence of network effects at the team level. Little attention has been paid to small group and team networks in recent decades (Katz, Lazer, Arrow, & Contractor, 2004); however, network effects at this level offer an interesting additional potential explanation for shared behaviors among group members that is consistent with explanations based on social influence theories.

Behavior Cueing Cognitions

Others' behaviors also can cue a focal individual's attitudes via internalization or response facilitation. Attribution theories also support such predictions by arguing that individuals attribute cognitions to themselves and others based on observations of their own and others' behaviors (Bem, 1972; Heider, 1958). For information repositories, we argue that people's observations of contribution behaviors by other team members will cue inferences about other team members' perceptions of the value of information repositories. These attributed value perceptions will, in turn, influence focal individuals' cognitions. Thus, when others fail to contribute or retrieve information, focal individuals are likely to conclude that others do not value a repository. This conclusion is likely to dampen individuals' own values for the repository. Similarly, contributions and retrievals by other team members are likely to lead to increases in the focal individuals' values for the repository. Thus, perceived behaviors can cue cognitions via attribution, response facilitation, and internalization. These local social influences are likely to exert effects over and above those specified by the rational cost–benefit component underlying the individual action model.

H3: Individuals' values for the current level of provision of organizational information repositories will be positively related to their perceptions of team members' contributions to those repositories.

H4: Individuals' values for the current level of provision of organizational information repositories will be positively related to their perceptions of team members' retrieval from those repositories.

Cueing Between Behaviors

Team member retrieval behavior can also cue a focal individual's contributions. Drawing on Staw's (1984) formulation of expectancy theory of motivation, Kalman et al. (2002) argue that *connective efficacy* influences individual motivation to contribute. Connective efficacy is the belief that "other people who can use contributed information will in fact receive it" (p. 131). That is, other members of the collective would be willing and able to retrieve information that the individual contributed to the shared repository. The belief is likely to be sensitive to the frequency of effective information retrieval modeled within the work team. Team members who retrieve information demonstrate skills and motivation to access others' information. By a process of generalization, individuals may conclude that such levels of skill and motivation are present at an acceptable level within the collective, and spark the focal individual to contribute such information.

A similar logic applies to expect team member contributions to influence a focal individual's retrieval, since team members can demonstrate skill and motivation to contribute information. Local modeling of efficacious contribution is likely to lead an individual to retrieve information in the belief that others can and do effectively contribute to the information store. Team member influence is likely to be heightened to the extent that an individual finds it difficult to assess provision level with confidence. As Fulk et al. (1996) noted, it can be difficult to assess the overall provision level of an information repository, because (a) there is no fixed capacity limit against which to assess cumulative information contributions and (b) systems typically do not offer information on overall levels of participation by others in the organization. People typically must rely on other sources to infer participation levels, and the local work team would be an important barometer.

Furthermore, to the extent that teams have developed a division of labor regarding information domains, as in a group level transactive memory system (Hollingshead, 1998; Hollingshead & Brandon, 2003; Wegner, 1986, 1995), information interdependence will require that team members rely on each other for information and expertise in their respective domains. Information repositories can support an effective transactive memory system in the team that experiences such information interdependence (Hollingshead, Fulk & Monge, 2002). Thus, we propose that over and above the influence of the cost–benefit calculus:

H5: Individuals' contributions to organizational information repositories will be positively related to their perceptions of team members' retrieval from those repositories.

H6: Individuals' retrieval from organizational information repositories will be positively related to their perceptions of team members' contributions to those repositories.

Technology-Specific Competence

When participation in a collective involves technology, individuals must achieve competence in using the technology in order to participate. Even in a supportive social environment, lack of skills may hamper individuals' abilities to navigate repositories, post information, retrieve the postings of others, and participate in forums and conferences. Considerable research has shown a positive relationship of technology-specific expertise to communication technology use (Kerr & Hiltz, 1982; Johansen, 1988; Schmitz & Fulk 1991; Fulk, 1993). Research also has linked computer self-efficacy to the adoption of new computer-based technologies and to perceptions about the ease of use of those technologies (Venkatesh, 2000; Venkatesh & Davis, 1996). Even individuals who only retrieve information posted by others without contributing information of their own must master the technology sufficiently to be able to access the information in repositories. Thus, we propose:

H7: Individuals' contributions to organizational information repositories will be positively related to their perceived technology-specific competence in using those repositories.
H8: Individuals' retrieval from organizational information repositories will be positively related to their perceived technology-specific competence in using those repositories.

Fulk et al.'s (2004) model does not incorporate technology-specific competence in technology into the concept of costs of contributing and retrieving information. It is reasonable to suggest that incompetence is costly to an individual, increasing the time and effort needed both to access information and submit contributions, and thus increasing costs. Alternatively, competence might be considered an access issue, in that incompetence can bar participation altogether for some persons rather than increase their costs. In order to identify the unique contribution of technology competence beyond cost factors described by Fulk et al. (2004), we propose H7 and H8. If the competence factor varies empirically with participation in similar ways as cost, there may be reason to consider consolidating technology-specific competence with other concepts of cost.[1]

METHOD

Sample and Procedure

The sample included a total of 150 individuals in 13 work teams from five different organizations. The organizations were obtained from five industries, specifically, aerospace, hospitality, consulting, legal, and military. Two of the teams were located in nonprofit organizations. Teams ranged in size from 5 to 17 and had been working together for an average of 3 years. Tenure in the organization ranged from 3 months to 27 years, and age ranged from 24 to 73, with an average of 39. All but one team were multidisciplinary project teams; one team was a functional grouping. All teams had access to intranet databases to assist with their information sharing and group tasks.

Data were collected using a knowledge asset mapping exercise (KAME). A KAME is an online survey instrument designed to collect data about knowledge flow among team participants. The KAME is distinct from a traditional paper and pencil survey due to its interactivity and customization. Respondents entered much of their perception data through interactive java applets. Additionally, the KAME instrument was customized for each team based on a detailed protocol completed by the team leader. Responses to the protocol provided information regarding the team's key knowledge topics and tasks. The KAME included questions regarding self-reported expertise, information allocation and retrieval among team members and with the intranet databases, and task assignments.

Measures

Several scales were created to measure key variables in the study. The scales are provided in Appendix B. Each variable in the model is described in the paragraphs that follow.

Perceived team member contributions to and retrieval from the intranet were collected as network data in java applets. Respondents were asked to report their perceptions about how often each of their team members had provided information to and acquired information from the intranet. The responses were on a five-point scale where 1 = *never* and 5 = *very often*. An individual's mean perception of all other team members' contributions to and retrieval from the intranet was examined. This measure was consistent with measures of social influence used by Schmitz and Fulk (1991) and Fulk (1993).

Technology-specific competence was measured by one item assessing proficiency of using the intranet. The responses were on a five-point scale ranging from *not at all proficient* to *extremely proficient*. This measure

was adapted to intranets from the measure used by Schmitz and Fulk (1991) and Fulk (1993).

Perceived level of provision was measured by six items assessing individuals' perceptions of the extent to which other employees in their organizations both provided and used information through the intranet. Cost was measured by seven items focusing on the recurring costs of time and effort. An example is, "Locating specific information on the intranet was too time consuming," with five-point Likert response categories ranging from *strongly disagree* to *strongly agree.* Value was assessed by three items asking respondents to consider the level of provision just described and report how valuable it was to them now. Gain was measured by three items evaluating how much respondents had benefited from the intranet. These three variables were measured on 10-point scales where 1 = *none* and 10 = *totally*.

Information retrieval was measured by a seven-item scale focusing on how frequently subjects obtain information from the intranet for different goals during a week. An example is, "During your last full week of work, how often did you use the intranet to access a database to obtain information needed for your job that was not available elsewhere?"

Information contribution was measured by a three-item scale focusing on the frequency of uploading information to the database during a typical week. An example is, "During your last full week of work, how often did you use the intranet to contribute information to a database that otherwise would not readily be available to others who need it?" Both had five-point Likert-like response categories, where 1 = *never* and 5 = *very often*.

Analysis

The model displayed in Figure 1 was analyzed using the LISREL 8.54 structural equation modeling program (Joreskog & Sorbom, 1996). LISREL provides global tests of the adequacy of the entire model, simultaneous estimation of all structural coefficients, and tests of statistical significance for all coefficients (Joreskog & Sorbom, 1988). The χ^2 goodness of fit statistic is reported as an index of model adequacy, where a nonsignificant value indicates good fit of the model to the data. Research has shown χ^2 to be sensitive to sample size (Bollen, 1989); therefore, the χ^2 to degrees of freedom ratio is also reported, where a value less than five indicates a good fit. Other common fit indices that show how well the specified model accounts for the data include the root mean squared residual (RMSR), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), and comparative fit index (CFI). RMSR values less than .05

typically indicate good fit. For GFI, AGFI and CFI indices, values range from 0 to 1.00, with higher values indicating better fit; .90 and above is generally considered to represent good fit. Regression coefficients for the hypothesized structural relations are also reported along with their statistical significance. The alpha level for all tests was set at the .05 level.

The LISREL 8.54 program provides a set of modification indices for each possible parameter that was not specified in the original theoretical model. A large modification index indicates that model fit would likely be improved by addition of that path to the model (Joreskog & Sorbom, 1996). Modification indices are usually employed in conjunction with theory to determine whether addition of any paths to the model is defensible. A typical procedure is to delete nonsignificant paths if such deletion is theoretically defensible and then to add theoretically defensible paths that have large modification indices one at a time, reviewing the results after the addition of each parameter (Byrne, 1998).

RESULTS

The correlation matrix, descriptive statistics, reliabilities, and number of valid cases are displayed in Table 1. Correlations were calculated using pairwise exclusion when there were missing values in the data. The number of valid responses for individual questions used for this study ranged from 104 to 146. The number of cases for pairwise correlations ranged from 93 to 141. Only 4 out of 36 pairwise correlations had fewer than 100 cases. Of these four correlations, only one related to proposed relationships in the baseline conceptual model (the link from perceived retrieval to value). Paths were tested for significance based upon the actual number of cases for each pair of variables.

The Cronbach's alpha reliabilities reported in Table 1 ranged from a low of .78 for the cost variable to a high of .94 for the gain variable. The remaining reliabilities were a point or two above or below .90. Overall, the reliabilities for the scales used were very high.[2]

Tests of the Baseline Conceptual Model

The results for the global tests of the baseline conceptual model are presented in Table 2. The χ^2 value was 26.47 ($df = 12$, $p < .05$). The significant p value indicated a less than adequate fit between the baseline conceptual model and the observed data, while the χ^2/df ratio of less than 5 showed a good model fit for the sample size. AGFI was below the .90 conventional criterion while GFI and CFI were above .90. RMSR of the baseline conceptual model was .10, somewhat higher than the conventional criterion of .05. Overall, these results show only a moderate fit of the model to the data.

TABLE 1
Pearson Correlation Coefficients, Descriptive Statistics, Scale Reliabilities, and Number of Valid Cases

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Perceived retrieval	—	.62	.21	.33	.03	.25	.27	.37	.25	.91	.34
2. Perceived contribution		—	.09	.16	.03	-.05	.04	.34	.29	.92	.33
3. Technology-specific competence			—	.14	.19	.05	.21	.53	.49	.17	.56
4. Level of provision				—	.20	.60	.52	.10	.16	.28	.12
5. Cost					—	.17	.14	.22	.14	-.02	.20
6. Value						—	.78	.02	-.01	.15	.02
7. Gain							—	.25	.18	.22	.23
8. Individual retrieval								—	.72	.36	.91
9. Individual contribution									—	.28	.94
10. Perceived use										—	.39
11. Actual use											—
Mean	1.13	1.11	3.90	4.94	2.26	5.05	5.56	3.37	1.44	1.14	2.83
Standard deviation	0.98	0.97	1.43	2.20	0.72	2.75	2.83	1.40	0.70	0.93	1.05
Range	1–5	1–5	1–5	1–10	1–5	1–10	1–10	1–5	1–5	1–5	1–5
Cronbach's alphas	—	—	—	.90	.78	.90	.94	.91	.88	—	—
Number of valid cases	120	104	146	121	127	120	123	146	141	124	146

The results of the statistical tests for the individual paths, including the magnitude and significance of the coefficients for the baseline conceptual model, appear in Figure 2. There is some evidence of suppressor effects due to multicollinearity, making it difficult to interpret the paths proposed by H1 through H6 independently of each other. Perceived team member contribution was highly correlated with perceived team member retrieval ($r = .62$, $p < .05$) and actual individual contribution was highly correlated with actual retrieval ($r = .72$, $p < .05$). H1 and H5 predicted that perceived team member contribution and team member retrieval would impact individual contributions. Zero order correlations were .29 and .25, respectively, both $p < .05$. LISREL regression coefficients were 0.17 ($p < .05$) and -.10 (p = ns), respectively, supporting H1 but not H5. The sign change of the LISREL coefficient for H5 in the presence of multicollinearity suggests, however, that suppressor effects influenced the results. H2 and H6 proposed that perceived team member contributions and team member retrieval would impact individual retrieval. The zero order correlations were .34 and .37, respectively, both $p < .05$. The LISREL regression coefficients were .21 ($p < .05$) and .14 (p = ns),

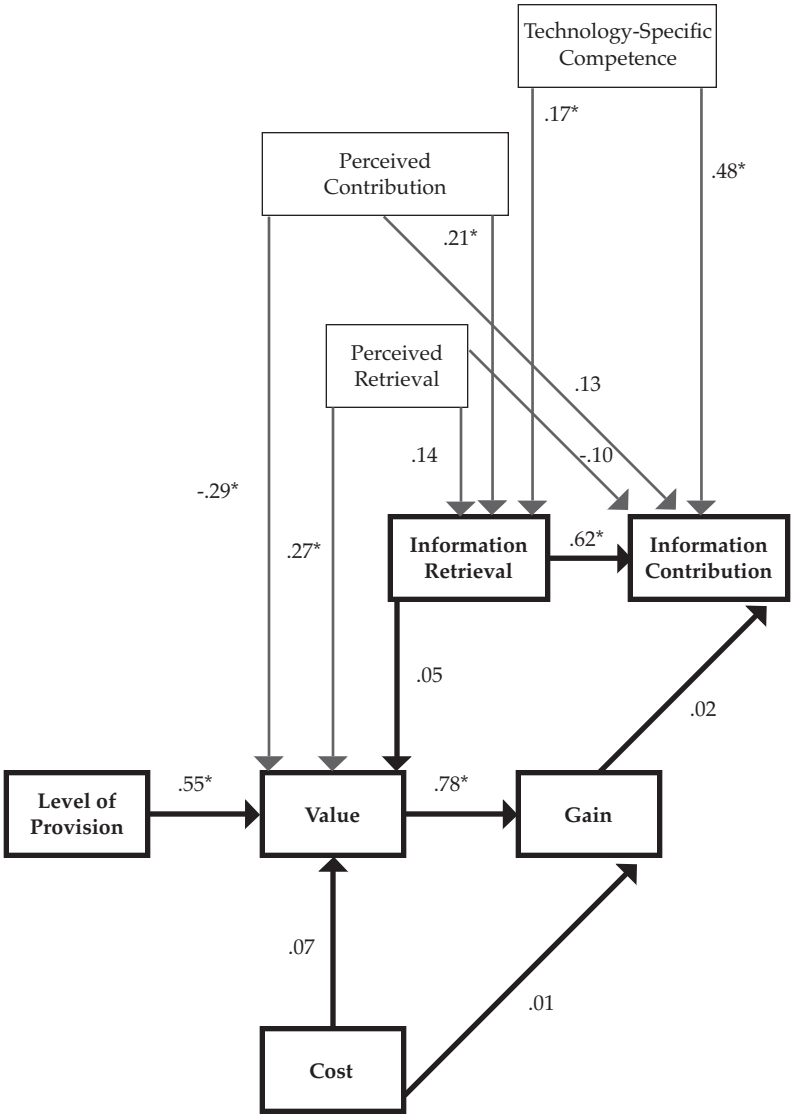

Figure 2. Results for the Test of the Baseline Conceptual Model Displayed in Figure 1.
NOTE: Original Fulk et al. (2004) model is shown in bold.

supporting H2 but not H6. Nevertheless, suppressor effects cannot be ruled out given the change in results from zero-order correlations for H6. H3 and H4 predicted that perceived team member contribution and perceived team member retrieval would positively impact value. The zero order correlations were -.05 (ns) and .25 ($p < .05$), respectively. The LISREL regression coefficients were -.29 and .27, both $p < .05$, supporting H4 but not H3. The change from a nonsignificant to a significant negative relationship for H3 is particularly notable. These results also may reflect suppression. Technology-specific competence was significantly related to both contribution ($\beta = .17$, $p < .05$) and retrieval ($\beta = .48$, $p < .05$), supporting H7 and H8.

Model Revisions and Tests

To adjust for multicollinearity between the two exogenous variables, we combined perceived team member contribution and perceived team member retrieval to form a single variable measuring perceived usage of intranet by a focal subject's team members ($M = 1.14$, $SD = .93$). Table 1 (variable 10) displays correlations between this new variable and the other variables in the revised model. This combination appeared justified, because both coworker variables were specified to have the same exact relationships with value, individual retrieval, and individual contribution. The two variables measuring actual usage of the intranet were kept apart in initial model revisions for three reasons. First, the Fulk et al. (2004) model specifies different dynamics for retrieval versus contribution; their predicted paths are not the same. One purpose of the present study was to replicate the model proposed by Fulk et al. (2004), and combining the two variables would prevent exact replication. Second, individual contribution and individual retrieval do not predict the same endogenous variables, where suppression effects would otherwise be most likely to appear. Third, a conservative approach suggests implementing changes incrementally. Thus, if there continued to be suppressor effects after the initial combination of the coworker variables, then the next step would be to combine the individual retrieval and use variables. Thus, the following two hypotheses replaced H1, H2, H5 and H6: Perceived usage will be positively related to (H1a) individual retrieval, and (H1b) individual contribution.

The results of the global fit of this revised model were similarly mixed. The χ^2 was 26.77 ($df = 10$, $p < .05$). The significant χ^2 indicated less than adequate fit between the baseline conceptual model and the observed data, although the χ^2/df ratio was close to the criterion of less than 5 ($\chi^2/df = 5.4$). While GFI and CFI were above the .90 criterion; AGFI was .81. RMSR of the baseline conceptual model was .06, slightly higher than the conventional criterion of .05.

The results of tests of the individual paths supported Fulk et al. (2004) in these ways: level of provision predicted value ($\beta = .59$, $p < .05$) and value predicted gain ($\beta = .78$, $p < .05$); information retrieval predicted information contribution ($\beta = .63$, $p < .05$). The results did not support the relationship of cost to value ($\beta = .06$, $p =$ ns) or cost to gain ($\beta = .00$, $p = ns$), nor did gain predict information contributions ($\beta = -.02$, $p =$ ns). Overall, the results supported all but the cost portion of the Marwell and Oliver (1993) model. Of the modifications proposed by Fulk et al. (2004), only the link from individual retrieval to individual contribution was supported. For the revised social influence hypothesis (in which perceived retrieval was combined with perceived contribution), perceived usage predicted individual retrieval ($\beta = .34$, $p < .05$), but not individual contribution ($\beta = -.02$, $p =$ ns).

A number of factors suggested that we needed to take the next step and combine individual retrieval with individual gain. First, the link from perceived usage to individual contribution dropped to nonsignificance compared to its zero order correlation ($r = .27$, $p < .05$, see Table 1). Second, the largest modification indices were for individual retrieval to gain (15.82) and individual contribution to gain (13.69). Given their high intercorrelation, it was clear that only one of these paths would be significant if added to the model. To test this assumption, we analyzed a model that added the path from individual retrieval to gain, and the modification index for individual contribution dropped substantially.

To create a model that adjusted for the multicollinearity of individual retrieval with individual contribution we combined individual retrieval and individual contribution into a single measure[3] ($M = 2.83$, $SD = 1.05$). Correlations with other variables are reported in Table 1. The following hypothesis replaced H1a and H1b: Perceived usage will be positively related to individual usage. This change also deletes the following paths from the Fulk et al. (2004) model: the nonsignificant link from gain to individual contribution, and the significant link between individual retrieval and individual contribution.

We then removed all remaining nonsignificant links, including the paths from perceived use to value, from cost to value, and from cost to gain. Finally, we added a link from actual use (combined retrieval and acquisition) to gain as suggested by the modification index. These changes were done one at a time following the procedure described above.

Results of the global tests of the final model are presented in Table 2. The χ^2 value of 2.53 ($df = 7$, $p =$ ns) was nonsignificant. The χ^2/df ratio of .28 was considerably less than 5. GFI, AGFI and CFI were all above the .90 conventional value. RMSR was approximately zero, meeting the target of less than .05. All these tests indicated an excellent fit. A χ^2 difference test between baseline conceptual model and the final model showed that improvement of model fit was significant ($\chi^2_{\text{difference}} = 7.98$, $df = 1$, $p < .05$).

TABLE 2
Summary of Fit Indicators

Models	χ^2	df	p	χ^2/df	*RMSR*	*GFI*	*AGFI*	*CFI*
1. Baseline conceptual model	26.47	12	.0092	2.21	.10	.95	.82	.96
2. Revised model	2.53	9	.92506	.28	.000	.99	.98	1.00

NOTE: RMSR = root mean squared residuals; GFI = goodness of fit index; AGFI = adjusted goodness of fit index; CFI = comparative fit index. Revisions from model 1 to model 2 in order of application: (a) Combined perceived retrieval with perceived contribution to create perceived usage variable and reanalyzed the model; (b) Deleted nonsignificant paths and combined individual retrieval and individual contributions to create an individual usage variable and reanalyzed the model (c) Added path from individual usage to gain based on modification index and theoretical rationale and reanalyzed the model

The results of the statistical tests for the individual paths, including the magnitude and significance of the coefficients, are shown in Figure 3. The structural coefficient from perceived intranet usage to actual intranet usage was significant and positive ($\beta = .31$, $p < .05$), supporting the social influence rationale related to compliance. The structural coefficient of the impact of intranet competence on actual usage was also significant and positive ($\beta = .50$, $p < .05$), supporting the technology-specific competence argument. All other remaining structural coefficients of the revised individual action component were also significant at the $p < .05$ level. Squared multiple correlations for each endogenous variable were .64 for value, .60 for actual usage, and .33 for gain, showing a high level of variance accounted for in all three dependent variables.

DISCUSSION

The goal of this study was to develop and test a more socialized model of individuals' motivations to participate in organizational information sharing via collective repositories. Fulk et al.'s (2004) collective action model was expanded to investigate the impact of team social influence and technology-specific competence on individuals' participation in their information commons. Results of this study indicate that social influence and technology-specific competence are positively related to individual intranet use over and above the collective level influences modeled in earlier research.

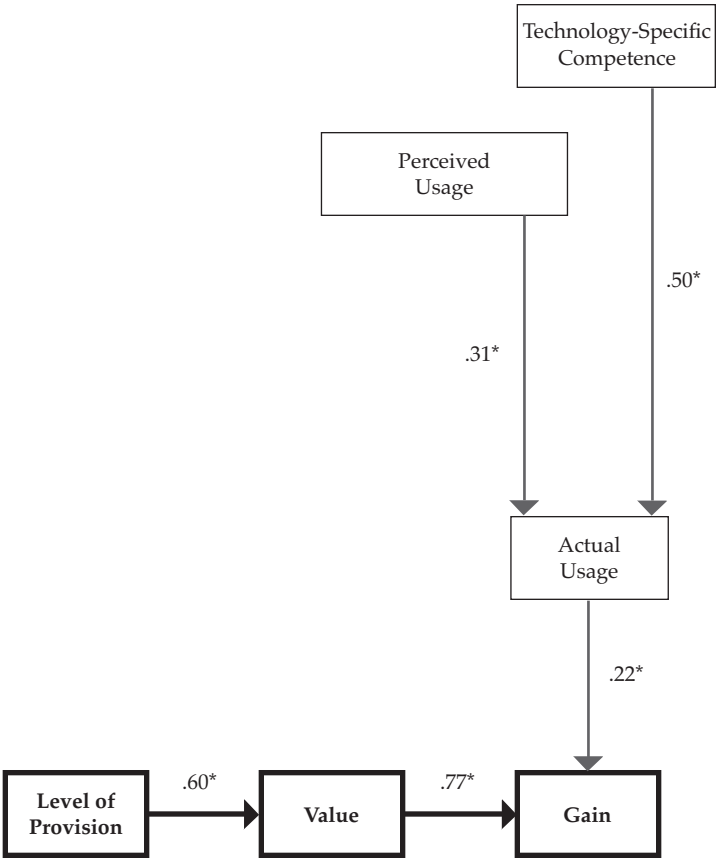

Figure 3. Results of the Final Revised Model That Combined Actual and Perceived Usage Variables, Removed Nonsignificant Links, and Added a Link from Actual Usage to Gain.
NOTE: Significant paths from original Fulk et al. (2004) model are displayed in bold.

Replication of Previous Results

The direction and magnitude of the structural coefficients from the present analyses were consistent with the earlier Fulk et al. (2004) research in four respects. First, perceived value of the information commons increased with perceived level of provision at the collective level. Second, perceived gain from the information commons increased with perceived value of the commons. Third, frequency of information retrieval was associated with frequency of information contribution. Fourth,

the value portion of the model was supported much more strongly than the cost portion.

There were, however, four major differences. First, in the prior research cost had small but statistically significant relationships to value and gain in two of the three organizations, but in the current study cost was not related to either value or gain. Second, in the same two out of the three organizations Fulk et al. (2004) studied, the relationship between gain and individual contribution was significant, albeit of low magnitude, but in the present research this relationship was not significant. In these two ways the current results closely resemble those of the third organization in the prior study, where the model was not as strongly supported on the cost side. Third, although information retrieval and information contribution activities were strongly correlated in both studies, in the current research the correlation had suppression effects, leading to a need to combine the two correlated measures into a single measure of usage. Fourth, the results showed that actual usage predicted gain but not vice versa.

Socialized Individual Action Component

H1–H6 posed that individuals' information retrieval, contributions, and value perceptions would be positively related to those individuals' perceptions of team member retrieval and contribution to the information commons. Due to high correlations between retrieval and contribution scales, these scales were combined into measures of overall usage. The behavioral convergence portion of the social influence argument was strongly supported. Individuals' usage was predicted by their perceptions of team members' usage. At the same time, and contrary to H3 and H4, individuals' value of the information commons was not predicted by their perceptions of team members' use. Value was influenced only by perceptions of the higher level collective, as proposed from collective action theory. The higher level collective in this study is the organization. These results are consistent with explanations based on both compliance and network externalities rather than internalization through attributions based on observation of coworker behavior. In combination these results suggest that the perceived gain from an information commons is determined by two factors: (a) value of the public good, which is a function of perceived level of provision; and (b) individuals' actual usage of the intranet for both contribution and retrieval, which is a function of perceived usage at the work team level.

Technology-Specific Competence

H7 and H8 predicted that individuals' technology-specific competence would be positively related to participation in the information

commons. The hypotheses were strongly supported. Competence was related to both information contribution and information retrieval in the initial model, and to the combined usage variable in the final model. It appears that technological competence was a major factor influencing people's decisions to retrieve and contribute information to the intranet.

In this study technology-specific competence was modestly but positively ($r = .19$, $p < .05$) related to the cost measure based on system availability and ease of use. To the degree to which technology-specific incompetence can be conceptualized as a type of cost, these findings recommend further investigation of what specific costs are implicated in decisions to participate. Reconceptualizing technology-specific competence as a cost variable in the collective action rationale would require a structural model in which competence was hypothesized to predict value, rather than to directly predict behavior as in prior studies. Clearly, much work needs to be done in conceptualizing and measuring the costs of participation in information commons.

Limitations of the Current Research

There are three major limitations of the current research. First, although data were collected from five different industries, the sample size at the industry level was too small to allow any meaningful statistical tests to study cross-industry variations. Second, out of the 13 groups sampled in the current research, only 2 were from nonprofit organizations. Even though social influences on individual decision making are prevalent everywhere, it is possible that individuals working in the nonprofit sector have different motivations and follow different behavioral models regarding contributions to collective goods. With only two groups, we could not conduct a meaningful multigroup structural equation model to study the differences in decision-making processes between profit and nonprofit organizations. Third, technology-specific competence was measured by only one item. This item has shown predictive validity in other research (Schmitz & Fulk, 1991; Fulk, 1993); however, single items are of unknown reliability (Nunnally, 1978).

Directions for Future Research

There are four issues that future research should explore. The first relates to the influence of organizational culture on individual participation in intranets. Fulk et al. (2004) studied high technology firms, two of which were pioneers in intranet deployment, and two of which were in the computer software industry. People in these companies did not feel that the costs of contributing information to the intranet were a significant hurdle, as measured by the time and effort needed to post documents to the intranet. Particularly in the two intranet pioneers, application

software to contribute and retrieve information from the intranet was typically very easy to use. People were excited about generating positive name recognition after posting valuable information to the intranet. By contrast, the work teams in this study operated in organizational cultures less focused on pioneering intranet deployment, and in which the intranets were less integrated into everyday work practices and routines. The differences in organizational culture between the two studies may explain some of the discrepancies in results. Future research should include measures of organizational culture and norms related to information sharing.

The second valuable future direction is to investigate the conditions that foster internalization as well as compliance. In the revised model we found patterns consistent with compliance but not internalization. Fulk (1993) found compliance to be a more compelling explanation for convergence in email participation when the group was less rather than more cohesive. Moreover, because people may be more likely to make quality contributions out of internalization rather than compliance, it is worth exploring how social influence can motivate people via the former route rather than the later. Future research also should explore other contingency factors that might influence the nature of local social influence in combination with more global concerns such as organizational culture.

Third, future studies might benefit from assessing the relative strength of influence from different team members. In this study, social influence was operationalized as the average perceived frequency of information allocation and retrieval activities of focal persons' team members. The operationalization did not weight the average by strength or quality of relationship between them. Future research would benefit from collecting relational data that permit such weighting.

Finally, future research on individual participation in collective commons would benefit from longitudinal field data. Kalman et al. (2002) and Fulk et al. (2004) found that people were more likely to contribute to intranets when the perceived gain was high. In the present research, however, intranet usage (contribution plus retrieval) influenced perceived gain. Longitudinal data may help to explain these differences. The temporal aspect of the provision level in the individual action component (i.e., how value of the collective changes over time in relation to level of provision) has been studied via simulation models (Marwell & Oliver, 1993). These models, however, have not considered nonrecursivity among the other variables. A first step would be theoretical refinement of the individual action component to consider mutual causality. Perceived gain and actual usage may mutually influence each other in iterative processes. Perceived gain from the information commons may motivate new usage which may then, in turn, increase perceived gain directly over and above any effects from the new level of provision afforded

by the individual's usage of the information commons. Structural equation modeling of panel data can provide important information about the directionality of the causal relationships and the possibility of mutual causality, though a longitudinal design would provide better data to test these possibilities.

Practical Implications

One practical implication of these results is that organizations should invest more in training programs that can boost people's competence in using information technology that is the gateway to collective information repositories. Raising employees' technical skills increases the probability of actual intranet use. And such a growth in individual skills may even offset some costs for using the technology.

A second practical implication is that organizations could boost intranet usage via group-level social influence. Even in the absence of internalization of the group values for participation in collective repositories, compliance out of group pressure alone could motivate contribution. Organizations can provide information on active usage of the repository by group members. Such a strategy may create peer pressure for widespread contribution which, according to collective action theory, should increase overall levels of participation. Beyond the critical mass threshold, such participation should be self-sustaining (Markus, 1990).

CONCLUSION

In the knowledge economy, successful knowledge management practices provide the basis for building and sustaining an organization's competitive edge. Knowledge sharing is an essential process for organizational knowledge management, because it is through sharing that individual knowledge is externalized and transformed into organizational knowledge (Argote & Ophir, 2002). Generating wide-scale support from potential contributors is nonetheless a major challenge for collective information repositories such as intranets (Head, 2000). Attention to both local social influences and technology-specific training, in combination with cost–benefits analyses, offers organizations additional tools to stimulate information sharing.

Finally, as demonstrated by the present research, much can be gained by moving tests of collective actions premises to the real world of organizational information practices. Computer simulations such as those developed by Marwell and Oliver (1993) are invaluable tools to help us better understand the evolutionary processes of complex adaptive systems as they unfold over time (Carley & Gasser, 1999; Yuan & McKelvey,

2004). Like theories, however, the results obtained from computer simulations and laboratory studies need to be validated by empirical research in naturally occurring organizational contexts before we can speak with confidence about how information and communication processes work in human organizations.

APPENDIX A

Marwell and Oliver's (1993) version of the individual action component is captured in the following model:

$$g_i = v_i [P(R)] - c_i(r_i) \quad (1)$$

The gain g_i for the i^{th} individual equals the value of the good $v_i[P(R)]$ minus its cost $c_i(r_i)$. P is the current level of provision of the good as a function of the total resources contributed, R (i.e., the production function). The total resources, R, is the sum of the individual resources contributed Σr_i. Individual costs c_i are a function of the resources that the individual has contributed, r_i. A key implication of this model is that the value of a collective action to an individual is a direct function of the number of other contributions to it [P(R)]. There will be few or no contributors in the early phases; as a result, no individuals' value (v_i) will be high enough to induce contribution at the outset. Supplemental incentives for contribution are often necessary in order to increase gain for a sufficient number of individuals to create what Hardin (1982) called a privileged group, where increasing participation feeds upon itself in bandwagon fashion (Rolphs, 2001).

APPENDIX B

Measurement Items

Perceived Team Members' Retrieval from the Intranet

How often you think you and other members of your group retrieved information from the intranet during the past week about (certain knowledge area)?

Perceived Team Members' Contributions to the Intranet

How often you think you and other members of your group provided information to the intranet during the past week about (certain knowledge area)?

Technology-Specific Competence

How proficient do you consider yourself at using the intranet?

Perceived Level of Provision

Select one number from 0 to 10 that describes how you see the [intranet] being used today.

1. To what extent do people in X company provide all their work-related information on the intranet?
2. To what extent is that information used by everyone else?
3. To what extent are you able to access everyone's work-related information?
4. To what extent are employees willing to share work-related information with everyone else?
5. To what extent is everyone able to access everyone's work-related information?
6. To what extent are employees willing to use work-related information that others have made available via the intranet?

Recurring Costs

1. I could not gain access to the intranet when I wanted to because the system was very slow.
2. Locating specific information on the intranet was too time consuming.
3. Using the intranet was so time consuming that I wasn't able to complete other tasks.
4. I felt overwhelmed with requests for help or information from others.
5. I invested a lot of time and energy in sorting out valuable information from among the information that was available via the intranet.
6. I spent a fair amount of time making my own information accessible to other people via the intranet.
7. I took the time to update information that I had recently posted to sites and/or databases on the intranet.

Value

1. Given the way you have described how the intranet is being used today in the previous question, to what extent is this level of use valuable to you now?
2. To what extent would you lose a valuable resource if people didn't contribute information to the intranet in the way that they do today?
3. To what extent would you lose a valuable resource if people didn't access and use information they obtained via the intranet in the way they do today?

Perceived Gain

1. Think about how valuable the intranet has been in helping to share your work-related information. Given the time and effort you have expended using it, to what extent do you think the intranet is worth it?
2. Taking into account the time and effort you have expended in learning and using the intranet, how much has your work life improved compared to not having an intranet?
3. Overall, how much would you say you have benefited from having an intranet?

Information Retrieval

During your last full week of work, how often did you use the intranet to . . .

1. access a database to obtain information needed for your job that was not available elsewhere?
2. access a database to obtain information needed for your job from persons you did not know?
3. access a database to obtain information needed for your job that was from persons you did know?

4. locate someone who could get you needed information for your work?
5. find information posted by others?
6. access information to find out who was knowledgeable about a particular problem, issue, or topic?
7. identify experts in a particular area?

Information Contribution

During your last full week of work, how often did you use the intranet to. . .
1. contribute information to a database that otherwise would not readily be available to others who need it?
2. contribute information to an intranet site without knowing who, specifically, might find it useful?
3. contribute information to an intranet site for use by people with whom you were already acquainted?

NOTE: "Intranet" was replaced with the specific name of the intranet in each company.

NOTES

1. We are indebted to Tom Malone and to an anonymous reviewer for this alternative conceptualization of technological competence as potentially an additional dimension of cost.
2. Following Fulk et al. (2004) we also conducted a set of supplemental statistical analyses to test for the presence of common method variance, using procedures suggested by Podsakoff, MacKenzie, Lee, and Podsakoff (2003). The results showed no significant common method effect. Details of the analysis and results can be obtained from the second author.
3. To reduce correlation between measures of individual retrieval and individual contribution, we tried deleting the two individual items from the retrieval scale that correlate highest with the contribution items. The resulting shorter retrieval scale still correlated .64 with the contribution scale. We then decided to combine the two scales together.

REFERENCES

Argote, L., & Ophir, R. (2002). Intraorganizational learning. In J. A. C. Baum (Ed.), *Companion to organizations* (pp. 181–207). Oxford, UK: Blackwell.

Abrams, D., Hinkle, S., Otten, S., & Hogg, M. (2001). *The social identity perspective on groups: The interface of social and individual processes*. Paper presented to conference on Assessing Theory and Research on Groups: What Do We Know and What Do We Need to Know, College Station, TX.

Aldrich, H. E. (1999). *Organizations evolving*. Thousand Oaks, CA: Sage.

Arrow, H., McGrath, J., & Berdahl, J. (2000). *Small groups as complex systems: Formation, coordination, development, and adaptation*. Thousand Oaks, CA: Sage.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.

Baum, J. A. (1999). Whole-part coevolutionary competition in organizations. In J. A. Baum and B. McKelvey (Eds.), *Variations in organizational science: In honor of Donald T. Campbell* (pp. 113–135). Thousand Oaks, CA: Sage.

Bem, D. J. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology*, Vol. 6. (pp. 1–62). New York: Academic Press.
Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.
Bryne, B. (1998). *Structural equation modeling with LISREL, Prelis, and Simplis: Basic concepts, applications, and programming*. Mahwah, NJ: Erlbaum.
Carley, K. M., & Gasser, L. (1999). Computational organization theory. In G. Weiss, ed. *Multiagent systems: A modern approach to distributed artificial intelligence* (pp. 299–330). Cambridge, MA: MIT Press.
Connolly, T., & Thorn, B. K. (1990). Discretionary databases: Theory, data, and implications. In J. Fulk & C. W. Steinfield (Eds.), *Organizations and communication technology* (pp. 219–233). Newbury Park, CA: Sage.
Dawes, R. M. (1980). Social dilemmas. *Annual Review of Psychology*, *31*,169–193.
DeSanctis, G., & Fulk, J. (1999). *Shaping organizational form: Communication, connection and community.* Newbury Park, CA: Sage.
Deutch, M., & Gerard, H. B. (1955). A study of normative and informational social influence upon individual judgment. *Journal of Abnormal and Social Psychology*, 51, 629–636.
Festinger, L. (1953). A study of compliant behavior. In M. Sherif & M. O. Wilson (Eds.) *Group relations at the crossroads* (pp. 232–256). New York: Harper.
Fulk, J. (1993). Social construction of communication technology. *Academy of Management Journal*, *36*, 921–950.
Fulk, J., Flanagin, A., Kalman, M. E., Monge, P. R., & Ryan, T. (1996). Connective and communal public goods in interactive communication systems. *Communication Theory*, *6*, 60–87.
Fulk, J. Heino, R., Flanagin, A., Monge, P., & Bar, F. (2004). A test of the individual action model for organizational information commons. *Organization Science, 15*(5), 569–585.
Fulk, J., Schmitz, J., & Steinfield, C. (1990). A social influence model of technology use. In J. Fulk & C. Steinfield (Eds.), *Organizations and communication technology* (pp. 116–142). Newbury Park, CA: Sage.
Granovetter, M. (1985). Economic action and social structure: The problem of embeddness. *American Journal of Sociology, 91*, 481–510.
Hardin, R. (1982). *Collective action*. Baltimore: Johns Hopkins University Press.
Head, A. J. (2000). Demystifying intranet design: 5 guidelines for building usable sites.
Online, 24, 36–42.
Heider, F. (1958). *The psychology of interpersonal relations*. New York: Wiley.
Hollingshead, A. B. (1998). Communication, learning, and retrieval in transactive memory systems. *Journal of Experimental Social Psychology, 24,* 423–442.
Hollingshead, A. B., & Brandon, D. P. (2003). Potential benefits of communication in transactive memory systems. *Human Communication Research*, 29(4), 607–615.
Hollingshead, A. B., Fulk, J., & Monge, P.R. (2002). Fostering intranet knowledge sharing: An integration of transactive memory and public goods approaches. In P. Hinds & S. Kiesler (Eds.), *Distributed work* (pp. 335–355). Boston, MA: MIT Press.
Hollingshead, A. B., Wittenbaum, G. M., Paulus, P., Hirokawa, R., Ancona, D., Peterson, R. S., et al (2004). The functional perspective as a lens for understanding groups. *Small Group Research, 35*, 17–43.
Janis, I. I. (1982). *Groupthink* (2nd ed.). Boston: Houghton-Mifflin.
Johansen, R. (1988). *Groupware: Computer support for business teams*. New York: Free Press.
Joreskog, K. G., & Sorbom, D. (1988). *LISREL 7: A guide to the program and applications*. Chicago: SPSS.
Joreskog, K. G., & Sorbom, D. (1996). *LISREL 8: User's reference guide*. Chicago: Scientific Software International.
Kalman, M., Monge, P., Fulk, J., & Heino, R. (2002). Motivations to resolve communication dilemmas in database-mediated collaboration. *Communication Research, 2,* 125–154.
Katz, N., Lazer, D., Arrow, H., & Contractor, N. (2004). Network theory and small groups. *Small Group Research, 35*(3), 307–332.

Kerr, E., & Hiltz, S. R. (1982). *Computer-mediated communication systems*. New York: Academic Press.

Knoke, D. (1990). *Political networks: The structural perspective*. New York: Cambridge University Press.

Kraut, R. E., Rice, R., Cool, C., & Fish, R. (1998). Varieties of social influence: The role of utility and norms in the success of a communication medium. *Organizational Science, 9*(4), 437–453.

Kropf, M., & Knack, S. (2003). Viewers like you: Community norms and contributions to public broadcasting. *Political Research Quarterly 56*(2), 187–195.

Lawler, E. E., III. (1981). *Pay and organizational development*. Menlo Park, CA: Addison-Wesley.

Levy, P. (2001). The Nut Island effect: When good teams go wrong. *Harvard Business Review*, *79*(3), 5–13.

Marwell, G., & Oliver, P. (1993). *The critical mass in collective action: A micro-social theory.* New York: Cambridge University Press.

Markus, M. L. (1990). Toward a "critical mass" theory of interactive media. In J. Fulk & C. Steinfield (Eds.) *Organizations and communication technology* (pp. 194–218). Newbury Park, CA: Sage.

McCauley, C. (1989). The nature of social influence in groupthink: Compliance and internalization. *Journal of Personality and Social Psychology*, *57*, 250–260.

McGrath, J. E. (1984). *Groups: Interaction and performance*. Englewood Cliffs, N J: Prentice Hall.

McGrath, J. E., & Hollingshead, A. B. (1994). *Groups interacting with technology: Ideas, issues, evidence, and an agenda.* Thousand Oaks, CA: Sage.

Messick, D. M., & Brewer, M. B. (1983). Solving social dilemmas: A review. In L. Wheeler & P. Shaver (Eds.), *Review of Personality and Social Psychology, 4*, (pp. 11–44). Beverly Hills, CA: Sage.

Monge, P. R., & Contractor, N. S. (2003). *Theories of communication networks*. New York: Oxford University Press.

Monge, P., & Fulk, J. (1999). Communication technology for global network organizations. In G. DeSanctis & J. Fulk (Eds.), *Shaping organizational form: Communication, connection and community* (pp. 71–100). Newbury Park, CA: Sage.

Monge, P. R., Fulk, J., Kalman, M. E., Flanagin, A. J., Parnassa, C., & Rumsey, S. (1998). Production of collective action in alliance-based interorganizational communication and information systems. *Organization Science*, *9*, 411–433.

Nunnally, J. C. (1978). *Psychometric theory*, 2nd ed. New York: McGraw-Hill.

O'Hara-Devereau, M., & Johansen, R. (1994). *Globalwork: Bridging distance, culture, & time*. San Francisco: Jossey-Bass.

Oliver, P., & Marwell, G. (2001). Whatever happened to Critical Mass Theory: A retrospective and assessment. *Sociological Theory, 19(3),* 292–311.

Podsakoff, P., MacKenzie, S., Lee, J., & Podsakoff, N. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88* (5), 879–903.

Poole, M. S., & DeSanctis, G. (1990). Understanding the use of group decision support systems: The theory of adaptive structuration. In J. Fulk & C. Steinfield (Eds.), *Organizations and communication technology* (pp. 173–191). Newbury Park, CA: Sage.

Rice, R., & Aydin, C. (1991). Attitudes toward new organizational technology: Network proximity as a mechanism for social information processing. Administrative Science Quarterly, 36(2), 219–244.

Robertson, P. J., & Tang, S. Y. (1995). The role of commitment in collective action: Comparing the organizational behavior and rational choice perspectives. *Public Administration Review*, *55*, 67–80.

Rolphs, J. H. (2001). *Bandwagon effects in high technology industries*. Cambridge, MA: MIT Press.

Rutte, C. G., & Wilke, H. A. M. (1992). Goals, expectations, and behavior in a social dilemma situation. In W. B. G. Liebrand, D. M. Messick, & H.A.M. Wilke (Eds.), *Social dilemmas: Theoretical issues and research findings* (pp. 289–305). New York: Pergammon.

Salancik, G., & Pfeffer, J. (1978). A social information processing approach to job attitudes and task design. *Administrative Science Quarterly*, *23*, 224–253.

Samuelson, P. (1954). The pure theory of public expenditure. *Review of Economics and Statistics*, *36*, 387–390.

Schmitz, J., & Fulk, J. (1991). Organizational colleagues, information richness and electronic mail: A test of the social influence model of technology use. *Communication Research*, *18*, 487–523.

Shapiro, C., & Varian, H. (1999). *Information rules: A strategic guide to the network economy*. Boston, MA: Harvard Business School Press.

Staw, B. M. (1984). Organizational behavior: A review and reformulation of the field's outcome variables. *Annual Review of Psychology*, *35*, 627–66.

Trevino, L. K., Daft R. L., & Lengel, R. H. (1990). Understanding managers' media choices: A symbolic interactionist perspective. In J. Fulk & C. Steinfield. (Eds.), *Organizations and communications technology* (pp. 71–94). Newbury Park, CA: Sage.

Van Lange, P. A. M, Liebrand, W. B. G., Messick, D. M., & Wilke, H. A. M. (1992). Introduction and literature review. In W. B. G. Liebrand, D. M. Messick, & H. A. M. Wilke (Eds.), *Social dilemmas: Theoretical issues and research findings* (pp. 3–28). New York: Pergammon.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, *11*(4), 342–365.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, *27*(3), 451–481.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal and hyperpersonal interaction. *Communication Research, 21*(10), 3–43.

Wegner, D. M. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behavior* (pp. 185–208). New York: Springer-Verlag.

Wegner, D. M. (1995). A computer network model of human transactive memory. *Social Cognition*, *13*(3): 319–339.

Weick, K. (1990). Technology as equivoque: Sense-making in new technologies. In P. S. Goodman & L. S. Sproull, *Technology and organizations* (pp.1–44). San Francisco: Jossey-Bass.

Yuan, Y., & McKelvey, B. (2004). Situated learning theory: Adding rate and complexity effects via Kauffman's *NK* model. *Nonlinear Dynamics, Psychology, and Life Sciences*, *8*(1), 65–10.