Center for
Effective
Organizations

INTRANET FUNCTIONALITY AS COLLECTIVE ACTION

CEO PUBLICATION
G 00-11 (384)

JANET FULK
REBECCA HEINO
University of Southern California

ANDREW J. FLANAGIN
University of California, Santa Barbara

PETER MONGE
KIJUNG KIM
WAN-YING LIN
University of Southern California

June 2000

This research was made possible by grants from the National Science Foundation (SBR 94-22537 and SBR 96-02055) and a collaborative research partnership with the Stanford Computer Industry Project. Special thanks are extended to our SCIP partners, Francois Bar, Emily Murase, Christian Sandvig, Li Gong, Leslie Sept, Guilliame Vambenepe, and to Noshir Contractor (University of Illinois, Urbana-Champaign.) Thanks to Anita Elberse for early conceptual contributions.

Abstract

This study sought to provide insight into the collective action necessary to create a viable organizational knowledge-sharing network in the form of an Intranet. Intranets were conceived as offering the functionalities of public goods to organizational members, due to their connective and communal functions. A public goods model was developed showing the relationships between the level of information provision, resources contributed and acquired, and individual value, costs, and gain. A second expanded model was also proposed that considers the role that trust plays in public goods provision. The model was tested using survey data gathered from Intranet users in a large organization in the western US. LISREL analyses showed that individual gain was a function of the perceived value of the good mitigated by the perceived costs of participation in the production of the good. Level of provision of Intranet functionality strongly correlated with perceived value. A significant relationship was found between costs and obtaining information, but not providing information. The trust individuals placed in the system and in other users had a no significant relationship with information provision. Yet, trust did negatively correlate with costs. As trust decreased, costs increased. This model of the production function of an Intranet as a public good was mostly supported, with a few areas presented for further thought and research.

Intranet Functionality as Collective Action

Forty-five years ago, well-known economist Paul Samuelson argued that it is impossible for decentralized populations to create a collectively shared resource spontaneously; some central coordinating authority is required (Samuelson, 1954). His postulate sparked decades of research into collective action and the provision of so-called "public goods". The issues have been addressed by scholars across a variety of academic disciplines including economics, political science, sociology, psychology, international relations, environmental science, public administration, decision science, and communication. Collective action challenges have been identified for such diverse arenas as the United Nations, charitable endeavors, environmental cleanup, and various forms of interorganizational networks (Monge, Fulk, Kalman, Flanagin, Parnassa, & Rumsey, 1998).

Samuelson's postulate is particularly relevant to organizations today as they experiment with new forms of organizing their core processes and structures. New organizational forms showcase extreme decentralization, under such labels as adhocracy (Malone & Rockart, 1991; Mintzberg, 1983), technocracy (Burris, 1993), heterarchy (Hedlund, 1986), virtual corporation (Davidow & Malone, 1992), and global network organization (Monge & Fulk, 1999; Powell, 1990). New forms also require spontaneity, as in spherical forms in which teams continuously form and disband as projects arise and terminate (Miles & Snow, 1992), postbureaucratic forms which achieve coordination on the fly via "institutionalized dialogue" (Heckscher, 1994), or emergent structures (Holland, 1998; Monge & Contractor, in press). These new organizational forms and process are made possible by complex information and communication systems that not only support new work processes, but also demand them (Fulk & DeSanctis, 1999).

Nowhere is the collective action challenge more evident than in creation and maintenance of the knowledge sharing systems that undergird new organizational forms. Consider, for example, the "lessons learned" databases found in such diverse organizations as the U.S. Navy and major management consulting firms. These systems serve as repositories of learning acquired from experience and mistakes. Users stock the databases with information on a voluntary basis as they acquire experience. Users also may tap the database in order to benefit from the lessons of others whom they may neither know nor otherwise have direct access to in their decentralized organizations. The relative failure of many such "discretionary" databases (Connolly & Thorn, 1990), due to the inability to garner wide scale support from potential contributors, would seem to reinforce Samuelson's classic postulate that such public goods cannot be provided among individuals spontaneously. Yet, some knowledge sharing systems do succeed, despite these challenges.

Our purpose in this study is to develop and test a model of the development of successful organizational knowledge sharing systems that is based on an integration of traditional theories of collective action and public goods with theories of communication in organizations. Our goal is to contribute to a better understanding of the conditions and processes that can energize effective knowledge sharing in organizations. Toward this end, we begin with key propositions from public goods theories and modify them, based on communication theory, to apply to the situation of organizational knowledge sharing. This conceptual development produces a set of integrated hypotheses in the form of a structural model that we test with data collected from an organization that has implemented a corporate Intranet for sharing knowledge. We conclude with suggestions for theoretical development and future research directions.

Theories of Collective Action and Public Goods

A public good is simply a resource accessible to members of the "public" affected by that good (e.g., a team, organization, interorganizational network, community, nation, or other grouping). Two features define a resource as accessible and, therefore, as a public good (Barry & Hardin, 1982; Head, 1972). First, the resource must be nonexcludable, in that all members of the specified public have the opportunity to benefit from the resource, without exception. For example, clean air is a nonexcludable resource to the world's population. Second, the resource must be nonrival, such that members' uses of the resource do not compete with each other; i.e., use of the good does not reduce the amount available to others. For example, one person's breathing clean air does not mean that other persons cannot also breathe clean air. Traditionally public goods are defined as material goods, such as parks, bridges, and libraries that the members of a community can all enjoy (Oliver, Marwell, & Teixeira, 1985; Marwell & Oliver, 1993).

The creation of a public good depends on collective action by members of the "public". Collective action requires coordination toward a common goal by individuals, groups, and/or organizations that comprise the specified public for that good. The coordinated action necessary for building a public good is not only associated with government or the larger society. There is, in fact, "no good reason to disregard the private sector in public goods provision…[public goods] are all around us" (Shmanske, 1991, p. 4). Increasingly, for example, technical developments such as the infrastructure provided by the Internet enable organizations with modest resources to establish information and communication systems that serve as public goods. Before this, such systems were the province of only larger organizations with ample resources (in the form, for example, of local or wide area network systems).

The ability of the private sector to also create public goods opens up a fertile research area of public goods in organizations. Within organizations, the focus has moved away from material public goods to a focus on communication and information public goods (Fulk, Flanagin, Kalman, Monge, & Ryan, 1996; Monge et al., 1998). Fulk et al. propose that interactive communication systems offer two functionalities than can be considered to be public goods: connectivity and communality. Connectivity is the ability for members to link together directly. In other words, connectivity specifies the ability for all members to communicate privately with each other. An example of connectivity is the functionality provided by an email system in which any member can directly access anyone else. Communality exists where members have access to a body of information that is held by all. This concept is at the core of data repositories. Examples of systems that can offer communality are company bulletin boards, census records, and "lessons learned" databases. Intranets are a form of organizational technology that can support both connective and communal goods. Note that the public good is not the communication or information system itself, but rather the functionality provided by its effective use.

Collective action is important in the success of a communal public good because individual members must contribute sufficiently to form a critical mass of users and information. Particularly when each member holds unique information, everyone's contribution is important because "when information resources are distributed, participation in the information system by each member is a necessary condition for the success of the communal endeavor" (Fulk et al., 1996, p.73). This implies that personal motivations for contributing (such as perceived gain and interest), as well as individual perceptions of the good (such as its utility), are important to understand because the success or failure of a communal good can hinge on them. The model

developed below focuses on the individual motivations to contribute and how they are linked with perceptions of the accumulation of collective contributions. The specific arena of these public goods is corporate Intranets.

Intranets as Facilitators of Public Good Creation

An Intranet is a complex organizational communication and information system whose features will vary by implementation. The most common core features of Intranets tend to fall into four categories. The first is the provision of static information electronically in read-only form. This would include information such as the organization's personnel manual, phonebooks, newsletter, and other documents that change only periodically. The second is the capability for users to interact with a database and make changes to it. This might include changing allocations of a 401K, updating one's personnel file, ordering new office supplies, and similar tasks. A third function permits individuals to communicate with and disseminate documents to other people, or to share document files. Integrated email systems and electronic bulletin boards for posting materials or project websites fall into this category. Finally, an advanced Intranet may support decision-making by offering additional tools for teamwork and shared tasks. This would include such features as shared whiteboards and conferencing tools, as well as the capability to access expert repositories.

Each implementation will have its own specific mixture of these support systems that will vary in terms of the requisite sophistication of users and hardware. The basic concern is to support both static and dynamic information sharing as well as both private work and teamwork. Organizational sites will vary as to whether they are linked to key external constituencies via an "extranet," and whether they permit authorized users (the "public") to access them freely from offsite in order to support remote work.

An effective Intranet is designed to support both connectivity and communality. Aspects of the system that permit any user to directly interface with any other user support connectivity. As with any connective system, the capability for direct access to all other users is crucial, even though no individual would be expected to actually use each possible connection. When properly used, Intranets can also support communality by providing the hardware and software through which members of the community can establish data repositories for themselves that can serve as collective resources for the community. These data repositories can be in the form of databases of accumulated knowledge, such as expert databases or electronic storage of the latest stages of a product design. They can also be in the form of social capital, such as web pages that list who has what expertise and how to contact them.

The key collective action issues in providing the public goods of connectivity and communality are that the users themselves must stock as well as use the databases, and must demonstrate the "communication discipline" (Markus, 1987) to respond to messages from other members of the public. As Fulk et al. (1996) note, connectivity goes beyond the hardware and software to include human behavior—what they label "social connectivity." It is this latter form of connectivity, as well as communality, that poses the greatest collective action challenge of the type indicated by Samuelson (1954). Because benefits are unclear with nascent public goods, there exist considerable obstacles to participation in collective action efforts, and garnering wide scale support is problematic. We begin our conceptualization of this challenge with the rich literature that has accumulated on collective action and public goods in other realms. With this foundation, we propose and modify our model to apply to social connectivity and communality in the context of Intranets.

Public Goods and the Production Function

Theory and research on public goods typically target one or the other of two stages of public goods development. The first is production—the initial creation of the public good. Production is the key concern in Samuelson's postulate. A key dilemma, however, arises from the nonexcludability criterion: members of the public cannot be excluded from enjoying the benefit of the public good even if they have not contributed to its creation. At the level of individual motivation, the incentive structure created by nonexcludability favors free-riding on the contributions of others (Hardin, 1968; Olson, 1965; Sweeney, 1973). Unless one or more highly motivated and resource-rich individuals are willing to contribute toward creating the good despite the unattractive early payoff function, the good will not be produced at all.

The second stage is distribution or maintenance of the good. This stage offers its own challenges, often described by the so-called "Tragedy of the Commons": A typical small town in England would have a "common" area in which all the citizens could graze their animals. The tragedy so referenced reflected the case of villagers overgrazing the common ground, permitting their cattle to foul the land, or otherwise making the common area relatively unfit for use by other members of the community. Such tragedies threaten the nonrivalry of the good.

Although production and distribution of public good benefits are intertwined, they have somewhat different theoretical traditions, particularly since production of the good initially is a precondition to facing any challenges to subsequent distribution or maintenance of benefits. Following the lead of communication researchers over the past decade (Thorn & Connolly, 1987; Fulk et al., 1996; Markus, 1987, 1990; Monge et al., 1998; Connolly & Thorn, 1990), we focus primarily on the production problem, although both production of the good and distribution of its benefits can be linked together in important ways (Flanagin, Monge, & Fulk, 1997).

The production function describes, at the collective level, the degree of production of a public good at any one point as a function of the total resources that have been contributed by members of the public. The production function for the good is a key factor in determining an individual's willingness to contribute to the collective. Marwell and Oliver (1993) present the following gain equation that applies at the individual level, in which the production function plays a key role:

$$g_i(R, r) = v_i [P(R)] - c_i(r_i)$$

This equation explains the gain that a member derives at a particular time as a function of the value of the public good to the individual at that time minus the costs expended by that individual to date. More specifically, 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 production of the good as a function of the total resources contributed, **R** (i.e., P(R) is the production function). The total resources contributed, **R**, is the sum of the individual resources contributed Σr_i. Individual costs c_i are a function of the resources that individual has contributed, r_i.

As the gain equation specifies, the value of the public good at any time is a function of the collective resources that have been contributed to its creation. The value term approaches zero when collective contributions are low. As the value term approaches zero so does individual gain, and individual motivation to contribute to the collective endeavor is low as well. Thus, the production level of a public good is a critical determinant of individual motivation to contribute. Production functions will differ across situations and types of public goods.

Oliver, Marwell, and Teixeira (1985) point out that the nature of the production function reflects specific social dynamics among the members of the public that influence the production process and outcomes. Two key types are accelerating and decelerating functions. Accelerating

functions exist when the greatest benefits accrue to late contributors. This is typical for connectivity in interactive communication systems, which offer little value to the early adopters, since not enough people have yet adopted for the system to offer many communication partners. Later adopters of an email system, for example, will find the connectivity in the system highly attractive because it already includes all or nearly all of the persons with whom they wish to communicate. Not surprisingly, when the social dynamics fit an accelerating function, the connective or communal good is difficult to produce. However, if a critical mass of contributions can be obtained, contributions tend to grow rapidly from that point forward until the good is fully realized (Markus, 1987).

By contrast, decelerating functions exist when the greatest benefits do indeed accrue to the earliest contributors. However, since benefits for later contributions decline as more people participate, the contributions eventually tend to drop off such that the good may not ever be fully realized.

Marwell and Oliver (1993) used simulated data to test their gain equation in which they could hold certain variables constant while testing for others. While such experimentation and manipulation is not possible in real organizational settings, it is possible to test models derived from simulation against reality to assess their external validity. The research reported below measured each element of the production function and tested their hypothesized set of interrelationships in a field setting. The research also expanded the basic function to include other factors typically considered to be important to motivations to share information. These components and their relationships are described next.

Resources. Individuals possess different communication and information resources that may be valuable to the collective. Less tangible resources include both tacit and explicit

expertise and knowledge (Boland, Tenkasi, & Te'eni, 1994; Nonaka, 1994). When these different knowledge domains are based on a division of labor regarding who holds (or should hold) which specific knowledge and expertise, the collective store is often referred to as a transactive memory system (Hollingshead, 1998). People also have different resources in the form of social capital—who they know or have access to. Other more fungible resource categories include financial, personnel, and property. Besides contributing resources, individuals also gather resources from the public good itself, especially in the case of information and communication goods. Information obtained could be viewed as a resource that is acquired by the individual, and also as a contribution to the extent that their acquisition of information potentially can benefit the collective as a whole. That is, if the group benefits from everyone being knowledgeable. Both resources contributed and resources obtained affect costs, although in different ways as described below.

Costs. Contribution of resources to the collective typically incurs costs to the contributor. Costs can be both physical (e.g. hardware, software) and social (e.g. learning how to use the system; Connolly & Thorn, 1990; Marwell & Oliver, 1993; Monge et al., 1998). Social costs include start-up costs that occur at the beginning of the implementation and then do not recur (e.g., time to learn the system and giving up established ways of doing things), as well as recurring costs that do not diminish over time (e.g., the time and effort it takes to continually contribute to the good). The key individual decision is whether to bear the costs of contributing resources to the collective both initially and on a continuing basis. The possibility of members returning to non-participation status because of recurring costs is a significant concern because an information good can be threatened even after it is established if enough individuals stop contributing. According to the gain equation, this decision will depend on weighing the value of

the collective good at any point in time against the costs of contributing to its creation or maintenance.

In addition, a number of factors might mitigate perceived costs. Although information provision can be expected to increase costs due to the efforts required by contributors, the amount of information obtained might actually reduce felt costs and, in turn, increased perceived gain. Furthermore, the acquisition of sufficient and valuable information can lead to further information provision, either due to perceived utility of the public good or in hopes of prompting reciprocal information sharing on the part of other members of the public (Connolly & Thorn, 1987). Such is the goal, for instance, of the subsidization of public goods provision efforts, particularly in the early stages. Based on the relationship between resources and costs in the provision of public goods, we propose the following hypotheses:

H1: The greater the individual's resource contributions, the greater will be the individual's costs associated with using the Intranet.

H2: The greater the individual's resource acquisition, the lower will be the individual's costs associated with using the Intranet.

H3: The greater the individual's resource acquisition, the greater will be the individual's resource contributions.

Value. The value of the good at any point in time is a function of the number of contributors and the quantity and quality of information and communication resources that comprise the good. That is, the value depends on the production function. For an accelerating function, the value is quite low initially, but rises rapidly when and if the contributions reach a critical mass. For a decelerating function, the value is relatively higher initially, but may be lower (relative to the accelerating function) toward the end of the production cycle when the

marginal benefits of contribution are so low as to discourage additional contributions. Other types of interdependence between contributors may also influence the production function. For example, when information is distributed, nonredundant, and each piece is critical to producing a good, the good has no value unless and until all members of the community have contributed. Such is the case, for example, with information held by the members of design teams in which individual outputs combine to form the end product. Overall, value can be viewed as a function of public goods provision, as specified in hypothesis 4:

H4: The greater the perceived production of connectivity and communality through an Intranet, the greater will be the individual's value for the Intranet's functionality.

Gain. Motivation to contribute depends on perceived gain. The gain accruing to an individual, according to the gain equation, is the perceived value of the good minus the perceived costs of contributing one's resources. Consequently, one's gain rises as the perceived value of the good rises, although this is tempered by the individual costs incurred. These relationships are specified in hypotheses 5 and 6:

H5: The greater the individual's value for Intranet functionality, the greater will be the individual's perceived gain.

H6: The lesser the individual's costs associated with using the Intranet, the greater will be the individual's perceived gain.

These 6 hypotheses comprise to the basic gain function as applied to Intranets. Figure 1 presents a graphic of the structural model of the individual gain function.

The Role of Trust in the Production of Communication and Information Public Goods

Although public goods conceptualizations highlight the individual calculus that community members apply in making contribution decisions, they may neglect important mitigating factors that can influence information contributions. In particular, Monge et al. (1998) emphasize the role that trust may play in motivating and sustaining individuals' contributions to organizational communication and information systems.

In this context, trust is confidence in the tools and dynamics of organizational communication and information sharing. Trust can include faith in the technical security of the system employed (Bok, 1989), confidence in others' competency and intentions in providing and using information (Monge et al., 1998), and the conviction that other community members can and will use the contributed information in appropriate ways (Cummings & Bromily, 1996; Lewis & Weigert, 1985). High levels of trust can lead to economic gains due to cooperative behaviors (Fukuyama, 1995; Handy, 1995) and to a decrease in surveillance costs and transaction costs (Baba, 1999; Schmidt & Posner, 1982). In addition, trust can reduce the cost of monitoring performance, thus eliminating the need for a control system (Bromily & Cummings, 1992).

Monge et al. (1998) argued that for interactive communication systems, potential contributors must be content that their contributions are safe from intrusion by unauthorized users outside of the community. A similar concern applies to organizational knowledge sharing systems. Individuals' knowledge and expertise are important sources of power, influence, and mastery within their work domains. Individuals are often reluctant to release portions of these information resources without assurances that their contributions are safe from outside tampering or theft (Bok, 1989).

Furthermore, potential contributors must also trust other community members to protect the confidentiality of information and the rights of its contributors if they are to feel comfortable in contributing their most important and sensitive information resources (Lewis & Weigert, 1985). In contrast to system security, where individuals place trust in the system, personal trust requires confidence in the motives and capabilities of other community members to use the contributed information in appropriate ways (Cummings & Bromily, 1996). Trust facilitates transactions needed for survival by reducing the uncertainty and risk (or complexity) of cooperation (Schmidt & Posner, 1982).

Moreover, the absence of trust may inhibit information sharing within or across group boundaries, block the pathway to cooperation, and increase the risk of implementation failure in new information technology deployment (Baba, 1999; Majchrzak, 1992; Sproull & Kiesler, 1993). Trust in system security, when violated, can have important negative consequences that radically increase the personal costs of information contribution. For instance, a lack of trust can increase individual risk, thus diminishing the likelihood of cooperation among individuals (Luhmann, 1988). Based on these considerations, hypotheses 7, 8, and 9 address the role that trust may play in the provision of communication and information public goods.

H7: The lesser the individual's trust in the Intranet system and its users, the lesser will be the individual's information provision.

H8: The lesser the individual's trust in the Intranet system and its users, the lesser will be the individual's information acquisition.

H9: The lesser the individual's trust in the Intranet system and its users, the greater will be the individual's costs.

Hypotheses considering the role of trust, when coupled with those based on the production function derived from public goods theory, form the model of Intranets as providing the functionality of public goods shown in Figure 2.

Method

Research Site

On-line survey data were collected from a random sample of employees in a financial services corporation. On-line Finance Corporation (OFC; a pseudonym) specializes in providing a broad array of financial services in both traditional modes and on-line formats. OFC is an international corporation with over 13,000 employees spread across 300 offices worldwide. They foster a culture that encourages the development and use of on-line services for both their employees and customers.

OFC has focused on developing a core competency with Intranet and related technologies. The pilot Intranet was launched early in 1997 with 220 people from the Corporate Administrative Division. Prior to this, individual home pages did exist with no cohesive or overarching organization. Evolution of the Intranet has now been encouraged in a top-down manner and divided into four phases.

The first phase consisted of replicating existing functions and providing a new medium for which to obtain information. For example, the company newsletter was offered through the Intranet. The second phase focused on exchanging documents electronically and changing workflow. Database access and connectivity is crucial for this phase. The third and fourth phases were still developing at the time of data collection. The next phase was meant to allow employees to complete human resource functions through the Intranet as a replacement for hard copies of forms. An example is web-based forms for hiring and terminating employment.

Event-driven, employee-empowered business services were also included. The final stage is meant to interlink the Intranet, Extranet and Internet to better service customers. Overall, the Intranet is intended to increase employee's independence and self-service and allow them to develop applications for themselves.

Research Design and Participants

A survey was administered to Intranet users through OFS' own Intranet in three parts over a period of four weeks. Participation in the survey was encouraged by management but not required. We randomly sampled 2,000 employees from the company's employee roster, excluding executive management. Only offices located in the United States were sampled. The response rate, including those who answered at least one section was 30%.

Part I of the survey focused on respondents' conceptions of the Intranet and on how they used the system. Part II focused on variables related to public goods, such as gain and costs. Finally, Part III focused on networks and communication across and between departments. Because of a technical problem with the applet used to collect the network data on-line, the network data are not useable. Participants were notified about each part of the survey with an email that contained a URL. These emails were sent out about every 2 weeks with a follow-up email a week later. The surveys were anonymous and an identifying ID that the participants chose connected responses to different parts. Because the responses are coordinated across the two separate parts of the survey, the number of respondents is then lower than for either part individually. For this model, only respondents that answered both Part I and Part II were included. Job levels ranged from senior management to supervisor, and a variety of staff functions were also included. The 431 respondents were from 12 different divisions.

Measures

Appendix A lists all of the measures. Gain, value, and level of the provision are measured on scales of 0 "Not at all" to 10 "Totally." The *level of the provision* of the good measures individual's perceptions of the extent that other employees provide and use information through the Intranet. *Value* is how valuable the individual perceives the level of provision described in the previous item. *Gain* is measured by asking the respondent how much worth they see in Intranet-based information sharing given the level of provision and their own time and effort in using the Intranet.

We developed a *costs* scale, with a Cronbach's alpha of .77, that measures recurring costs of time and effort. An example of an item is, "Locating specific information on the Intranet was too time consuming," with response categories from 1 to 5 on a "strongly disagree" to "strongly agree" scale.

Resources contributed measures the frequency with which individuals contribute information through the Intranet. *Resources acquired* measures the frequency with which an individual acquires information via the Intranet.

Trust was measured by four items from Cummings & Bromiley (1996; Chronbach's alpha = .70). Items were answered on a 1 to 5 scale from "strongly disagree" to "strongly agree." They measured trust in the system itself and trust in others who had access to the system.

Analysis

The model displayed in Figure 1 was analyzed using LISREL 8. Path analysis with LISREL allows the researcher to test all the structural coefficients simultaneously while traditional regression techniques estimate each equation separately (Joreskog & Sorbom, 1988).

LISREL 8 also provides several methods of parametric estimation including maximum likelihood (ML).

One unique feature of the LISREL is the ability to provide goodness of fit indices, which show how well the specified model accounted for the data. Although the chi-square statistic has been accepted as an index of model adequacy, it is sensitive to sample size. Thus, the chi-square statistic must be interpreted with caution in most applications (Bollen, 1989). Other common fit indices include root mean squared error of approximation (RMSEA), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), non-normed fit index (NNFI), and comparative fit index (CFI). Byrne (1998) noted that RMSEA value less than .05 indicates good fit. For GFI, AGFI, NFI and NNFI, values range from zero to 1.00, with higher values indicating superior fit.

Results

Basic model

The overall validity of the hypothesized model was estimated with a LISREL model using the multiple fit criteria. The covariance matrix is presented in Appendix B. Maximum likelihood estimation was used to fit the models. Overall goodness fit for the theoretical model was mediocre, with the root mean squared error of approximation (RMSEA) equal to 0.13. The adjusted goodness-to-fit ratio was not strong at.80. The results are reported in Table 1 and Figure 3.

INSERT TABLE 1 AND FIGURE 3 ABOUT HERE

The current study finds that the level of provision through the Intranet has a positive and significant relationship to an individual's value for the Intranet's functionality (.42, $p<.05$), supporting Hypothesis 1. The results also confirm hypothesis 5, which states that individual

value is significantly and positively related to perceived gain (.76, $p<.05$). The individual's recurring cost was negatively related to the individual's perceived gain (-.15, $p<.05$), as proposed in hypothesis 6. These findings are consistent with Marwell and Oliver's (1993) simulation results.

The results indicate no statistically significant relationship between an individual's information provided and their costs (.09, ns). This result is contrary to Hypothesis 1, a key feature of the application of public goods theory to information-based resources. Hypothesis 2 proposed that information obtained would be inversely related to cost, and this prediction was supported (-.20, $p<.05$). Hypothesis 3 of our conception of the gain functions proposed a positive relationship between information provision and information acquisition, which was also supported by these data (.70, $p<.05$).

With the exception of one link, the results are consistent with the propositions reflected in the gain function.

Expanded Model

Figure 4 displays the results for the expanded model. The addition of the trust variable did not materially affect the coefficients of the basic gain function described above. Our hypotheses proposed that trust in the system and other users would facilitate information sharing (both acquisition and provision; hypotheses 8 and 9 respectively.) Distrust was seen to increase the costs and risks of contribution (hypothesis 10). The results did not support the relationship of trust to information sharing (.08 and -.02, both ns). However, trust was directly and inversely related to cost as suggested by hypothesis 10 (-.16, $p<05$). Overall, the direct link to cost was supported, but the indirect links were not.

INSERT FIGURE 4 ABOUT HERE

Discussion

The purpose of this research was to gain a greater understanding of the collective action necessary to create a viable knowledge-sharing network through the Intranet within an organizational context. Intranets were conceived of as providing two key functions defined by Fulk et al. (1996). Connectivity is the ability of every actor to reach every other actor through the Intranet. Communality is the ability of the actors to share a joint data repository through the Intranet. These Intranet functionalities were conceptualized as meeting the two defining conditions of a public good. First, every actor can use Intranet resources, irrespective of whether the actor has contributed to the creation and maintenance of those resources (i.e., nonexcludability). Second, use of Intranet resources by any actor does not diminish the ability of other actors to use them (nonrivalry). As extended by our theoretical model, public goods theory suggests that the potential to accomplish collectively what cannot be accomplished individually should serve as a strong incentive for actors to participate in information sharing via the Intranet. The gain function as applied to Intranets posits that individuals make participation decisions by gauging the benefits they will receive from the collective as a whole minus their individual costs of participation in the collective. We proposed an extension to the gain function that incorporates individuals' trust in the system itself and the other members of the collective. Distrust was posited to increase costs and reduce the likelihood of contribution or acquisition, all else equal.

Our findings support the basic calculus in which the individual's subjective gain is assessed by discounting the value of the collective contributions by individual costs of contributing personal information resources. Value, however, showed a much more significant relationship to gain than did cost. Value not only significantly predicted gain, but also was itself

a function of the level of provision of the collective good, as specified in the gain equation. The level of provision, in this instance, is the level of use of the Intranet both in providing and acquiring information by all those who have access to it. If employees, as a collective, both contribute their information and obtain information, the level of provision is high. The more the Intranet is used in this way by the employees, the greater the individual's value of the Intranet.

Cost was posited to be a function of investments made by individuals to contribute and acquire information. As the frequency in which individuals provided information increased, their costs would also increase. Conversely, as the frequency in which individual's acquired information increased, their costs would decrease. There was a significant relationship between acquired information and costs but not a significant relationship between information provision and costs. This latter result may suggest a need to rethink the way in which public goods theory was extended to information sharing. For example, information quality as well as frequency should be considered. Also, the strong correlation between obtaining and providing information may have had a suppression effect. Finally, the overall pattern of responses to questions regarding information provision and interviews with company officials suggest that not all respondents were authorized to upload information to certain parts of the Intranet. Thus, low levels of information provision comprise a complex set of respondents some of whom may have been involuntarily excluded. The overall weaker relationships of costs to other variables in the model may also be a function of the measurement of costs. Costs were operationalized as investments of time and energy in using the Intranet and difficulties in accessing it. Other less tangible aspects of costs, such as threats to power bases that rest on control of key information, may also be acting on potential participants.

In the expanded model, we incorporated three hypotheses about trust. Our hypotheses stated that as trust in both the system and other colleagues increased, individuals would both provide and acquire more information. These hypotheses were not supported using our measures of amount of information sharing. Perhaps quality more than frequency of information sharing is affected by trust. Yet, there was a significant negative relationship between trust and costs, as specified in the third hypothesis. As trust decreases, costs increase. There is a greater risk factor involved in sharing resources if you do not trust the system and the people who use the system.

The implications for this research in regards to communication and information systems and knowledge sharing systems in organizations, especially new emerging forms of organizing, are significant. These systems become viable only through the collective action of those individuals involved. When information resources are widely distributed throughout the organization, wide participation is necessary. The likelihood of participation is a function of the perceived gain by those individuals in relation to the costs they incur in participating. Trust also seems to play a role, although more directly than the hypothesized indirect role through information sharing. As other relationships or influences on costs are further developed and researched, it is most important to realize that in the end, the knowledge sharing system must be worth it to the individual, or to enough individuals, to make it viable for all.

Limitations

One limitation of this study was the measures used. The cost measure focused on system access and time investment. Other dimensions of recurring cost should be identified and investigated. Also, the gain and value measures were only single items, and thus are of unknown reliability. A second limitation is that these data were gathered only at one point in time. Future research employing longitudinal designs will help to assess better the processual

nature of the production of public goods. Previous research that has looked at over-time processes in the production of other types of public goods is heavily based in simulation and laboratory experiments. This study advances the research agenda by adding important findings from field sites and from production of important collective action in a real organizational setting. Future research can advance this agenda by tracking processes themselves as they unfold.

Conclusion

We began this paper with the assertion that nowhere is the collective action challenge more evident than in creation and maintenance of the knowledge sharing systems that undergird new organizational forms. Recent research has shown that corporate Intranets are one of the main technology platforms for implementing knowledge management programs (http://www.knowledgebusiness.com/kmrlframe.htm). To the extent that this study and future research can help scholars to understand the forces that underlie the relative success or failure of such initiatives, they will also help toward understanding the complex issues surrounding new organizational forms.

References

Baba, M. L. (1999). Dangerous liaisons: Trust, distrust, and information technology in American work organizations. Human Organization, 58(3), 331-346.

Barry, B., & Hardin, R. (1982). (Eds.) Rational man and irrational society. Beverly Hills, CA: Sage.

Bok, S. (1989). Secrets: On concealment and revelation. New York: Vintage.

Boland, R., Tenkasi, R., & Te'eni, D. (1994). Designing information technology to support distributed organizational cognition. Organization Science, 5 (3), 456-475.

Bollen, K.A. (1989). Structural equations with latent variables. New York: Wiley.

Bromily, P., & Cummings, L. L. (1992). Transaction costs in organizations with trust (Working paper No. 28). Minneapolis, MN: Strategic Management Research Center. University of Minnesota.

Burris, B. H. (1993). Technocracy at work. Albany, NY: State Univ of New York Press.

Byrne, B. M. (1998). Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming. Mahwah, NJ: Lawrence Erlbaum Associates.

Connolly, T., & Thorn, B.K. (1990). Discretionary databases: Theory, data, and implications. In J. Fulk & C. Steinfeld (Eds.), Organizations and communication technology (pp. 219-233). Newbury Park, CA: Sage.

Cummings, L.L. & Bromiley, P. (1996). The organizational trust inventory (OTI). In R.M. Kramer & T. Tyler (Eds.), Trust in organizations: Frontiers of theory and research (pp. 302-330). Thousand Oaks, CA: Sage.

Davidow, W. H. & Malone, M. S. (1992). The virtual corporation. New York: Harper Business.

Flanagin, A. J., Monge, P. R., & Fulk, J. (1997, May). The effects of formative interorganizational relationships on subsequent interaction. Paper presented at the annual meeting of the International Communication Association, Montreal, Canada.

Fulk, J., & DeSanctis, G. (1999). Articulation of communication technology and organizational form. In G. DeSanctis & J. Fulk (Eds.), Shaping organizational form: Communication, connection and community (pp. 5-32). Newbury Park, CA: Sage.

Fulk, J., Flanagin, A., Kalman, M., Monge, P., & Ryan, T. (1996). Connective and communal public goods in interactive communication systems. Communication Theory, 61, 60-87.

Fukuyama, F. (1995). Trust: The Social Virtues and the Creation of Prosperity. New York: Free Press.

Handy, C. (1995). Trust and the Virtual Organization. Harvard Business Review, 73, 40-50.

Hardin, G. (1968). The tragedy of the commons. Science, 162, 1243-1248.

Head, J. G. (1972). Public goods: The polar case. In R. M. Bird & J. G. Head (Eds.), Modern fiscal issues: Essays in honour of Carl. S. Shoup (pp. 7-16). Toronto: University of Toronto Press.

Heckscher, C. (1994). Defining the post-bureaucratic type. In C. Heckscher & A. Donnellon, (Eds.), The post-bureaucratic organization: New perspectives on organizational change (pp.14-62), Thousand Oaks, CA: Sage.

Hedlund, G. (1986). The hypermodern MNC--A heterarchy? Human Resource Management, 25(1), 9-35.

Holland, J.H. (1998). Emergence: From chaos to order. Reading, MA: Perseus Book.

Hollingshead, A.B. (1998). Retrieval processes in transactive memory systems. Journal of Personality and Social Psychology, 74, 659-671.

Joreskog, K.G. & Sorbom, D. (1988). A guide to the program and applications. Chicago, IL: SPSS.

Lewis, J.D., & Weigert, A. (1985). Trust as a social reality. Social Forces, 63, 967-985.

Luhmann, N. (1988). Familiarity, Confidence, Trust. In D. Gambetta (Ed.), Trust: Making and Breaking Cooperative Relations (pp. 94-108). New York: Basil Blackwell.

Majchrzak, A. (1992). Management of Technological and Organizational Change. In G. Salvendy (Ed.), Handbook of Industrial Engineering (pp. 767-797). New York: John Wiley.

Malone, T. W. & Rockart, J. F. (1991). Computers, networks and the corporation, Scientific American, 265 (3), 92-99.

Markus, M. L. (1987). Toward a "critical mass" theory of interactive media. Communication Research, 14, 491-511.

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

Miles, R. E., & Snow, C.C. (1992). Causes of failure in network organizations. California Management Review, Summer, 53-72.

Mintzberg, H. (1983). Structure in fives: Designing effective organizations. Englewood Cliffs, NJ: Prentice-Hall.

Monge, P.R., & Contractor, N.S. (in press). Emergence of communication networks. In F. Jablin & L. Putnam (Eds.), New handbook of organizational communication . Newbury Park, CA: Sage.

Monge, P.R., & 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., Flanagin, A., Parnassa, C., & Rumsey, S. (1998). Production of collective action in alliance-based interorganizational communication and information systems. Organizational Science, 9, 411-433.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. Organization Science, 5, 14-37.

Oliver, P., Marwell, G., & Teixeira, R. (1985). A theory of critical mass I. Group heterogeneity, interdependence and the production of public goods. American Journal of Sociology, 91, 522-556.

Olson, M. (1965). The logic of collective action. Cambridge, MA: Harvard University Press.

Powell, W. W. (1990). Neither market nor hierarchy: Network forms of organization. In L.L. Cummings & B.M. Staw (Eds.), Research in organizational behavior, 12, 295-336.

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

Schmidt, W., & Posner, B. (1982). Mangerial Values and Expectations: The Silent Power in Personal and Organizational Life. New York: American Management Association.

Shmanske, S. (1991). Public Goods, Mixed Goods, and Monopolistic Competition. College Station, TX: Texas A&M University Press.

Sproull, L., & Keisler, S. (1993). Connections: New Ways of Working in the Networked Organization. Cambridge, Mass.: MIT Press.

Sweeney, J. W. (1973). An experimental investigation of the free-rider problem. Social Science Research, 2, 277-292.

Thorn, B.K., & Connolly, T. (1987). Discretionary data bases: A theory and some experimental findings. Communication Research, 14, 512-528.

Figure 1
Basic Gain Function

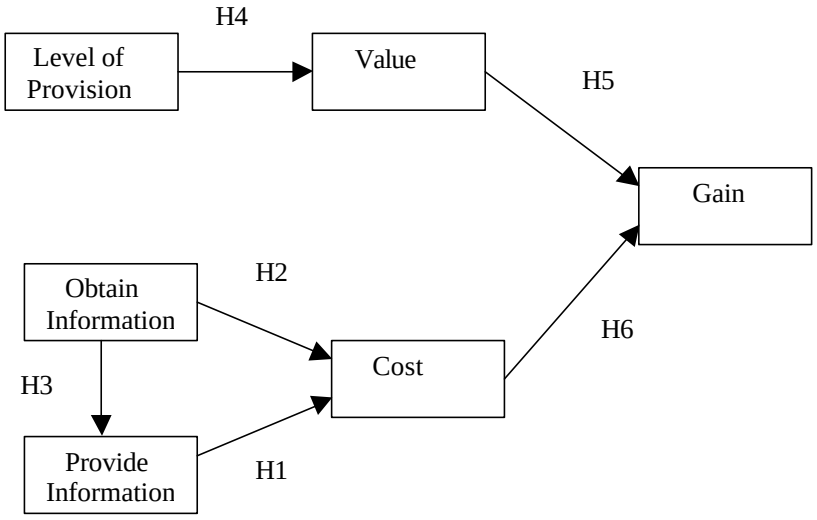

Figure 2
Expanded Model

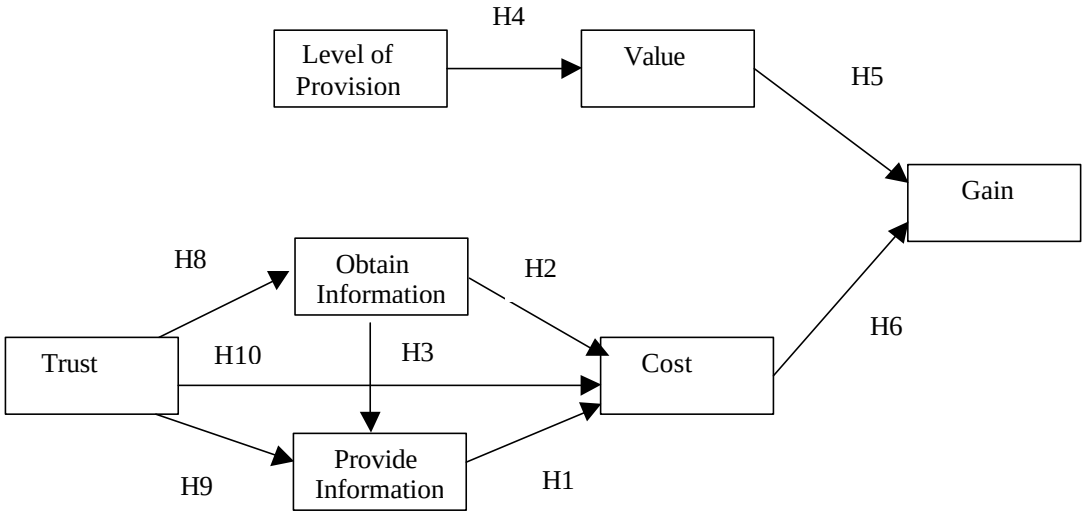

Figure 3
Results for Basic Model

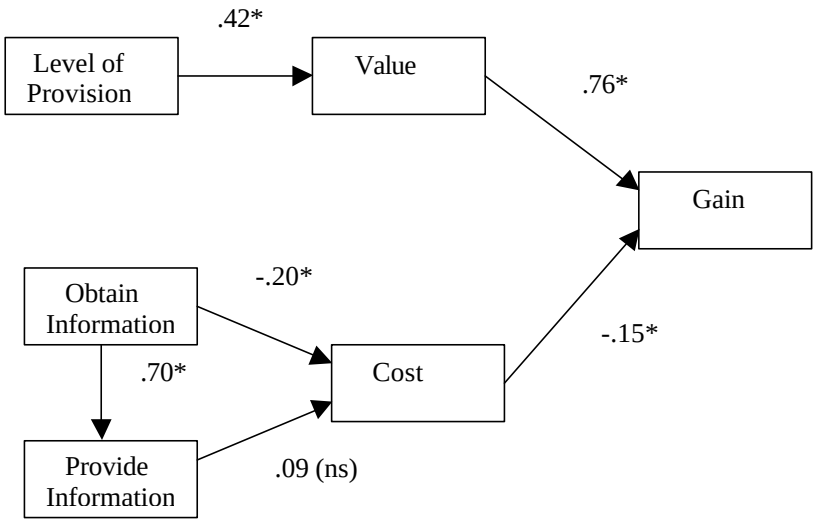

Figure 4
Results for Expanded Model

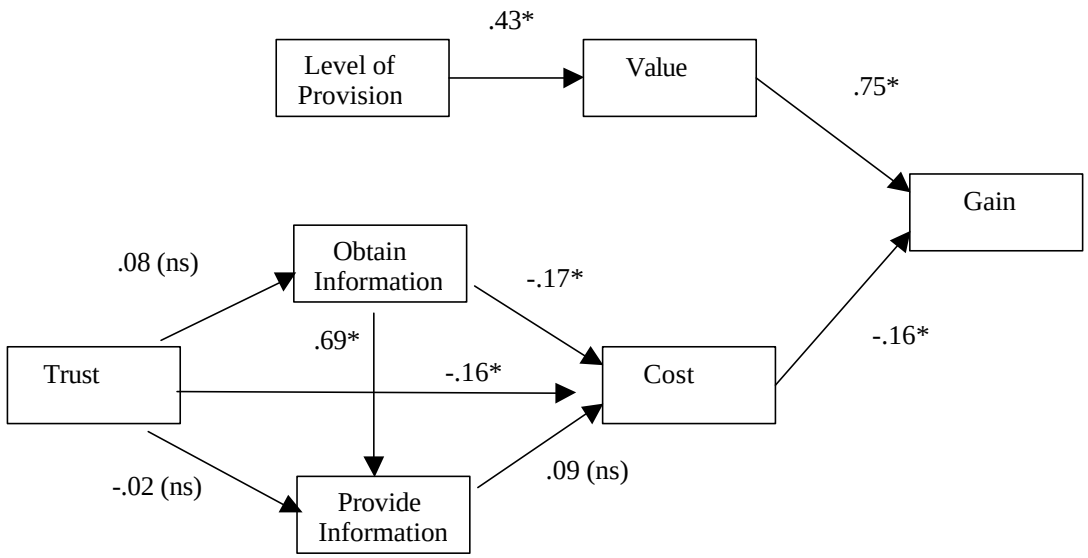

Table 1
Model Statistics

	Basic	**Expanded**
Sample Size	431	429
Degrees of Freedom	8	11
Minimum Fit Function Chi-Square	122.50	181.09
RMSEA	0.13	.19
GFI	.92	.91
AGFI	0.80	.76
NFI	0.88	.83
NNFI	0.78	.68
CFI	0.88	.83

APPENDIX A

Provision, Value and Gain:

Perceived Level of Public Good (Provision)
To what extent does everyone provide all their work-related information?

To what extent is that information used by everyone else?

Value
Given the way you have described how the Intranet is being used today, how valuable is this level of use to you now?

Perceived Gain
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?

Scale:
Select one number from 0 to 10 that describes how you see the Intranet being used today.

Not at all										Totally
0	1	2	3	4	5	6	7	8	9	10

Recurring Costs
I could not gain access to the Intranet when I wanted to because the system was very slow.

Using the Intranet was so time consuming that I wasn't able to complete other tasks.

Locating specific information on the Intranet was too time consuming.

Scale:

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Resources (Information) Contributed
During your last full day of work, how often did you use the Intranet to provide information?

Scale:

NA	Never	Seldom	Sometimes	Often	Very Often

Resources (Information) Acquired

During your last full day of work, how often did you use the Intranet to obtain information?

Scale:

NA	Never	Seldom	Sometimes	Often	Very Often

Trust

I trust all my colleagues to use information appropriately when it is made available to them on the Intranet.

I am worried about how the information will be used after I upload it onto the Intranet.

The Intranet is a threat to my privacy.

Competitors will not receive information published on the Intranet.

Scale:

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Appendix B
Covariance Matrix

	Value	*Obtain Information*	*Provide Information*	*Cost*	*Gain*	*Level of Provision*	*Trust*
Value	6.25						
Obtain Information	2.55	4.00					
Provide Information	2.19	2.76	5.29				
Cost	-1.50	-0.53	-0.06	5.76			
Gain	4.93	2.41	2.21	-2.04	7.51		
Level of Provision	7.31	3.05	3.13	-0.89	6.21	16.97	
Trust	1.10	0.42	0.16	-0.95	1.14	1.91	5.38