December 2004

Is Free Information Really Free? Information Supply into an IT-Based Organizational Memory System

David Firth
University of Montana

IS FREE INFORMATION REALLY FREE? INFORMATION SUPPLY INTO AN IT-BASED ORGANIZATIONAL MEMORY SYSTEM

David R. Firth
School of Business Administration
University of Montana
Missoula, MT U.S.A.
david.firth@business.umt.edu

Abstract

Information sharing is a critical issue facing businesses today. In the United States some 90 percent of large private sector and 40 percent of public sector enterprises are reported to have at least one initiative in place to assist in the sharing of information. In contrast, the realities of not sharing information are great with estimates of up to $12 billion wasted each year as employees duplicate one another's work. Information sharing is often facilitated by an IT-based organizational memory system, and this paper examines one such system at a large U.S.-based IT consulting firm. Our study examines what impacts information supply into the system. Using a wide-scale survey deployed to over 1,200 professionals with over a 30 percent response rate, we use structural equation modeling to show that information supply by an individual is a result of weighing up the personal costs and benefits of such supply. While the costs of information supply have been covered in depth in the literature, the benefits side of the equation has received little attention. This paper addresses that gap, and shows that the ability to influence is a critical component of the benefits the information supplier expects to receive to offset the costs of supplying information. We conclude by noting how this research may impact managers, suppliers and users of information sharing systems, and present ideas for future research.

Keywords: Information supply, influence, organizational memory systems, structural equation modeling

Introduction

And yet, Socrates, rhetoric should be used like any other competitive art, not against everybody—the rhetorician ought not to abuse his strength any more than a pugilist or pancratiast or other master of fence; because he has powers which are more than a match either for friend or enemy, he ought not therefore to strike, stab, or slay his friends (Plato's Gorgias)

The quote from Plato's Gorgias to Socrates suggests the direction our paper will take. Gorgias is talking about the art of rhetoric, and the power that such rhetoric has—"more than a match for friend or enemy." This paper will take the point of view that the supply of information is a form of rhetoric that can be used "like any other competitive art."

In the United States, some 90 percent of large private sector and 40 percent of public sector enterprises are reported to have at least one initiative in place to assist in the sharing of information (Caldwell 2001). In contrast, the realities of not sharing information are great. IDC, a research group that focuses on technology, estimates that the world's largest companies waste up to $12 billion each year as employees duplicate one another's work (Stewart 2002). Such problems afflict companies of all sizes: any time you have two employees performing a similar role there is the potential for either one of them to have encountered a thorny problem before the other. Sharing information on how to solve the problem is where time and money can be saved.

An information technology-based system that facilitates information sharing is sometimes called a knowledge management system (Alavi and Leidner 2001), but Markus (2001) notes that it is often called an organizational memory system. In this paper, we call the information technology-based system that facilitates information sharing an information technology-based organizational memory system (ITOMS).

It has been argued that the issue of sharing information using technology is most often considered in the literature as a technical challenge, whereas the bigger challenge may be to get employees to contribute information in the first place (Boisot and Griffiths 1999). The question of how organizational actors contribute information has received some attention in the literature. One early, and oft-cited experiment into how organizational actors contribute information looked at the impact a previously unhelpful coworkers' behavior had on information supply (Constant et al. 1994). We find it difficult to generalize this result, however, to the context of ITOMS. Much of the supply of information in an ITOMS occurs before the supplier is aware of who will use it. The influence of coworker's previous behavior seems therefore to be very limited. Nonetheless, the study by Constant et al. (1994) highlights that information supply is a behavior that is best examined at the individual level. Although there has been other influential work in the field of information supply (e.g., Constant et al. 1996), much of this focuses on contexts that differ from that of the ITOMS we wish to study (one exception is Connolly and Thorn 1991). We are, therefore, motivated to ask the following research question: What impacts an individual's supply of information into an ITOMS?

Theory

In examining the decision to supply information into a database, Connolly and Thorn (1991) use a rational choice model in which a potential contributor weighs the costs of contributing (such as the effort involved to write the document), with the benefits to be gained from using information already contributed to the database. It is suggested that problems of information supply occur because once contributed to the ITOMS the information becomes a "public good." The problem with a public good is that although everyone would be better off if the good is provided, they would be better off still if they weren't the one providing it. As a result, an optimal strategy is to "free ride," that is, use the information in the ITOMS without supplying any of it.

Research by Constant et al. (1996) examining "the kindness of strangers" shows that information providers gave useful advice to information seekers, despite having no personal connection with the seekers. The notion of why suppliers supplied is examined, although somewhat tangentially. The authors do this by asking information providers to allocate 100 points among eight reasons for contributing a response. The authors allowed for only four reasons associated with personal benefits of information sharing— (1) enjoy helping others, (2) enjoy solving problems, (3) earn respect, and (4) firm rewards sharing—and four reasons associated with organizational motivation—(1) good organizational citizen, (2) important firm problem, (3) part of my job to help, and (4) it is only fair to help). Among these reasons for supplying information, only "part of my job to help" was found to be significant. We suggest that the authors only looked at part of the picture of what motivates people to provide information. The theory we will elaborate below suggests a more powerful reason for the supply of information, as well as addressing the fact that costs are an important part of what must be considered.

Goodman and Darr (1998) suggest that the decision to contribute information into an ITOMS is affected both by the costs of contributing as well as motivating factors. The costs of contributing are thought to be three-fold: (1) formulating and delivering solutions takes time and effort, (2) a lack of potential payback, or reciprocity, in a distributed environment, and (3) actually learning to use the system takes time and effort. Of these, the time costs of contributing were found to be the most significant impediment to information supply. The motivating factors for contributing were only addressed briefly. It is suggested that the act of formulating a reply helps enforce ones own technical competency, and as a result enhances ones own self-esteem, an idea also captured by Constant et al. (1994). The authors also suggest that a shared value of cooperation and citizenship helps motivate people to share information, a notion considered by other authors in our review.

Wasko and Faraj (2000) examine information sharing in three electronic communities by treating the information in the community as a public good owned and maintained by the community. They find that as a result of this approach, information supply can be viewed as being motivated by moral obligation and community interest. Cabrera and Cabrera (2002) also use a public good approach to examining information exchange using ITOMS, and suggest that the public good dilemma can be corrected using interventions such as making it easier to contribute (lowering the costs of supply) and providing incentives to contributing, as well as improving the efficacy that a person perceives from supplying, and by making potential suppliers have a better sense of group and personal responsibility.
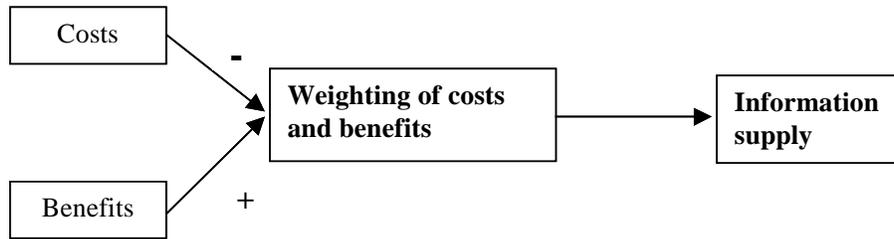
Figure 1. A Rudimentary Model of Information Supply

For our own model of information supply in ITOMS, we too use the notion of a public good. "A public good is defined by its nonexcludability: if any one group member consumes it, it cannot feasibly be withheld from other group members" (Olson 1965, p. 14). While this is important, more important is the concept of jointness of supply. A "good with *jointness of supply* costs the same no matter how many people 'enjoy' it" (Oliver and Marwell 1988, p. 2). That is, one person's use of the good does not diminish the level of the good for other users (Monge et al. 1998). The classic example of a public good is the town bridge. The bridge is a public good, since once built anyone can enjoy it. Up to a limit the bridge can be enjoyed without regard to who else is using it. Once too many people use it, though, the bridge becomes clogged and ineffective. We need a bigger bridge with more roadways, and that means more supply costs.

An information good, such as a digital document supplied into an ITOMS has pure jointness of supply. It matters not whether one person uses it or a thousand—the supply costs do not change. What this means, then, is "for any individual deciding whether to contribute to a collective good with pure jointness of supply, it is irrelevant how many others might share in the good…individuals will provide the good if their own benefit from the good outweighs its cost" (Oliver and Marwell 1988).

Oliver and Marwell's (1988) argument is critical to our own theory of information supply for several reasons. First, it makes the point that the issue of information supply needs to be examined at the individual actor level. Second, it suggests that information supply is a balance between the positive aspects of supply (the benefits), and the negative aspects of supply (the costs). We, therefore, propose a rudimentary model of information supply in Figure 1.

Figure 1 shows that an individual cognitively weighs the personal costs and personal benefits of information supply before making a decision on whether such supply takes place. When there is a positive weighting, information supply will take place. This model does not vary substantially from those previously presented in the literature, but what is important is that equal prominence is given in this model to the consideration of both costs and benefits. Much of the prior literature on information supply has given considerable consideration to the costs element of this model, and usually only a cursory mention to the benefits element. Our model, in contrast, suggests that each is important.

To get to the items that make up the costs and benefits constructs, we draw on Swanson (1992), who proposes that the costs of contributing can be addressed from an economic perspective, and the benefits can be addressed from a political perspective.

Costs

In an organizational context, time is perhaps the most important resource. It is the opportunity cost of time that is critical to the provision of information: the lower the opportunity cost, the more information will be supplied (Swanson 1992). Others who have studied information technology-supported systems for the sharing of information support this perspective (e.g., Goodman and Darr 1998).

Benefits

As we have already noted, the benefits of information supply are rarely considered in the organizational literature. When they are considered, they usually relate to matters of personal affect, noting that information supply gives a person the chance to self express, and hence makes them feel better (Constant et al. 1994). While this may have some impact, we suggest that there are

stronger factors influencing information supply. Swanson notes that the basic exchange in organizational communication is that of information for the user in return for influence for the supplier. That is, an actor supplies information so that he or she might exert influence over the user. The whole industry of advertising supports this notion; it is based on the premise that information can be supplied to influence a user's decision to make a purchase, cast a vote, or express an opinion.

It is this notion of being able to influence others through the supply of information that is so important. The traditional approach to considering information supply as a public good only considers the costs (Connolly and Thorn 1991), and therefore concludes that, as a result of the costs of contributing, the best way for everyone to proceed is to rely on the provision of public goods by others. Everyone should be a free rider, which implies that no one should contribute. By considering the benefits of contributing, particularly the influence that may be exerted by the supplier on the user, the idea that there are free riders actually may be a good thing. It is these free riders that may be the easiest to influence, as they believe that they are getting something for nothing. Indeed, this is likely not the case: "free information may not necessarily set its prospective user free" (Swanson 1992). In supplying a public good then, a supplier of information might consider that the benefits of influence outweigh the costs of making the information available, and decide to contribute.

The idea of influence has been explored extensively in the management literature. A classic study by Kipnis et al. (1980) showed that organizational actors exerted influence on others primarily so that they would do their jobs the way the influencer wanted, and so that the influencer could obtain personal benefits. Kipnis et al. were able to identify a number of ways in which influence could be exerted, but concluded that that the use of rationality was a key factor. An examination of the items used to tap into the notion of rationality shows that a written document is critical in exerting this type of influence.

Other Factors Influencing Information Supply

The rudimentary model of information supply described above and illustrated in Figure 1 suggests that an individual actor weighs the costs and benefits of supplying information before such information supply takes place. Prior research has suggested other factors that might influence information supply. The picture we have drawn has focused solely on the costs and benefits of a particular decision to supply information. However, it is appropriate to assume that individuals themselves have different organizational experiences that might affect their weighing up of whether to supply information, as well as different personal attributes. Gender and organizational level have been shown to impact information sharing, as has the actor's propensity to share (Jarvenpaa and Staples 2001). This suggests a modification to the rudimentary model of information supply, where gender, organizational level, and personal propensity to share are hypothesized to moderate the decision to supply information (see Figure 2).

Method

We use a case study approach in examining information supply. The case is circumscribed by membership in the IT consulting practice of a major U.S. accounting firm. There are over 1,500 professionals in this practice, spread across more thatn 45 physical locations in the United States. Upon joining the practice, each professional is given an authentication token, which combined with a user-name and password provides access to the ITOMS.
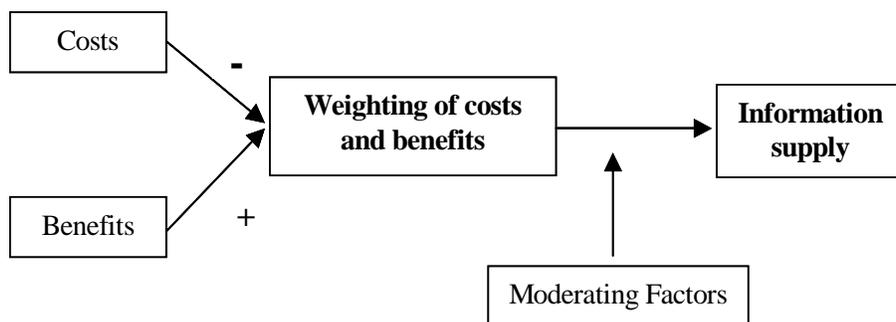

Figure 2. A Model of Information Supply in ITOMS

Our study of information supply examined documents. A survey was sent to all 1,268 users of the ITOMS (out of 1,500 professionals). Of the 1,268, there were 218 suppliers of documents of whom 122 responded (56 percent response rate), and 1,050 non-supplying users of the ITOMS of whom 273 responded (26 percent responses rate). A review of survey response/nonresponse bias revealed no issues. Document suppliers and non-suppliers were asked the same survey questions. Suppliers were asked to respond based upon a particular supplied document picked at random (if more than one had been supplied) by the authors. A link was provided to the document. Non-suppliers were provided instructions to randomly locate a document they had completed but not supplied, and responded relative to this document. Suppliers of documents were also asked to respond based on a document that they did not supply.

Constructs and Questions

The dependent variable, information supply, is dichotomous. Information supply either occurs or it does not. For the 122 respondents who had supplied a document, their answers to our survey questions provided the "information supplied" element of our dependent variable. The same 122 respondents also answered questions for a document that was not supplied. These responses were combined with the 268 received from non-suppliers of documents providing the "information not supplied" element of our dependent variable.

Prior literature and our theory suggest that the main cost impacting information supply is time (Goodman and Darr 1998; Swanson 1992). Two questions assessed the time costs of information supply (Q1 and Q2).[1] To measure influence, we extract specific items relating to the use of rationality to influence from scales developed for the purpose by Yukl et al. (1993). This suggests a series of four questions: the information under consideration (1) provides a logical way for others to do a task, (2) provides facts and information that align with my point of view, (3) demonstrates my competence in this area, and (4) will help others view matters in the same way I do (Kipnis et al. 1980)—Q3 through Q6.

In addition to these primary costs and benefits, we also wanted to capture variation in information supply arising from other cost and benefits. Perrow (1967) and Daft and Lengel (1986) suggest that when a problem is complex it will be difficult to convey to others. This complexity, though, makes documenting the solution more interesting, and provides a mental workout, challenging the cognitive abilities of the documenter. Still, when the issue gets too broad and the problems too diverse, documenting the solution to a problem can become a significant challenge. A very specific issue, idea, or problem is more easily addressed. We asked two questions to assess the cognitive workout that complex, yet focused, problems offer (Q7 and Q8). We also asked two questions relative to other potential benefits of information supply, addressed previously in the literature (Constant et al. 1994; Constant et al. 1996): the level of improved feelings of technical competency as a result of supplying information (Q11), and the enhancement of reputation that such supply brings (Q12).

Besides time, we expected that there would be other costs impacting information supply. We asked a question assessing how evaluation apprehension (the phenomenon whereby individuals withhold information for fear that others may not approve of it; Gallupe et al. 1992) had an impact (Q9). We also asked a question to see whether or not a document being part of a larger set of documents would be a cost of information supply (Q10).

Three moderating variables were examined. A person's level within the firm was obtained from organizational records. Gender was captured using a single survey item. Prior research has measured an actor's propensity to share using a vignette (Jarvenpaa and Staples 2001), which provides a means to lessen the confounding effect of perceptions of social desirability (Burstin et al. 1980). We used a vignette described by Constant et al. (1994) to determine a respondent's propensity to share. These items were administered at the end of the survey several sections from the information supply survey items to help reduce survey bias.

Structural Equation Modeling Analysis

Structural equation modeling (SEM) with latent variables is a particularly appropriate method to use to analyze this data as we are testing *a priori* theoretical assumptions against empirical data and are exploring latent constructs of costs (such as time) and benefits (such as influence) using several indications (Swanson and Dans 2000). SEM provides substantial flexibility in modeling relationships among multiple predictor variables measuring unobserved latent variables.

---

[1]Due to space limitations, we omit the actual questions.

Data were analyzed using EQS for Windows 5.7b (Bentler and Wu 1995), which is specifically designed to provide tools for SEM in the context of the Bentler-Weeks model (Bentler and Weeks 1980). Importantly, EQS also handles categorical variables, a requirement given our dependent variable, information supply, is dichotomous.

Measurement Model

For the measurement model, a factor analysis was conducted to confirm the validity of the scales. The results are provided in Table 1. Using the common standard for extracting factors of having to have eigenvalues greater than 1.0, four factors emerge. Factor 1 relates to the questions concerning the time costs of information supply. We label this latent construct *Time*. Factor 2 captures the questions concerning the influence benefits of information supply Q3 through Q6, but also includes questions 11 and 12. Given that our theory emphasizes the benefits of influence, Q3 through Q6 will be considered as one factor and labeled *Influence*, and Q11 and Q12 will be considered as another factor. Questions 11 and 12 relate to matters of personal affect (feeling good about oneself by solving problems, and feeling respected) and so seem to naturally belong together. We label this latent construct *Positive Affect*. Factor 3 captures questions relating to the complexity of a document and how specific the idea or problem is that the document addresses, and hence are both tied to attributes of the document to exercise the cognitive abilities of the respondent. This latent construct is labeled *Cognitive Workout*. Factor 4 captures Q9, concerning what others might think of a contribution, and Q10, which asks whether the document stands alone, and doesn't need further explanation. We label this latent construct *Other Costs*. The four factors extracted through factor analysis explain 63 percent of the total variance.

Internal consistency reliabilities (Cronbach coefficient alpha) for four of the five latent constructs (*Time*, *Influence*, *Cognitive Workout*, and *Other Costs*) were above the 0.5 level commonly used as an indication of the reliability of questions (e.g., Igbaria et al. 1994; Thompson et al. 1991). *Other Costs* was not, but this latent construct will be retained for the following analyses, and then considered for dropping during our structural equation modeling analysis.

In testing for multivariate normality, Mahalanobis distances were used and five respondents were identified as outliers and deleted (Ullman 2002). Given the possible presence of non-normal data, maximum likelihood and robust estimation was employed to estimate the measurement model. The independence model that tests the hypothesis that all variables are uncorrelated was easily

Table 1. Rotated Factor Matrix for Factor Analysis
(Method—Principal Components, Varimax Rotation, Eigenvalues greater than)

Item	Factor 1	Factor 2	Factor 3	Factor 4
Q1	**.816**	-.067	-.032	-.079
Q2	**.796**	.072	.015	.051
Q3	.055	**.545**	.190	-.232
Q4	-.107	**.756**	.127	-.211
Q5	.064	**.778**	.164	-.120
Q6	-.047	**.782**	.136	-.062
Q7	-.021	.245	**.823**	.008
Q8	.001	.100	**.868**	.026
Q9	-.094	.107	-.050	**.764**
Q10	.210	-.275	.122	**.676**
Q11	.093	**.810**	.076	.156
Q12	-.079	**.734**	-.029	.190

rejectable, $\chi^2(66, N = 512) = 1717.85$, p < 0.001. The hypothesized model[2] was tested next and support for it was found, $\chi^2(44, N = 512) = 115.108$, p < 0.001. The Satorra-Bentler Scaled χ^2 was 88.96. The Bentler-Bonnett normed fit index = 0.933, the Bentler-Bonnet non-normed fit index 0.935, the comparative fit index (CFI) = 0.935 and the robust CFI = 0.966, all indicate that the hypothesized model is a good fit for the data. The root mean square error of approximation (RMSEA) was 0.05 also indicating an excellent fit (Byrne 1994).

Post hoc model modifications were performed in an attempt to develop a better fitting, and possibly more parsimonious, measurement model. On the basis of the Lagrange multiplier test, a path was added from the *Positive Affect* latent variable to question 10. The test also suggested that two error variables were correlated, and this path was added. In addition, a Wald test showed that several paths were not significant and could be dropped from the model. These paths related to covariation between the factors. Because *post hoc* model modifications were performed, a correlation was calculated between the hypothesized and final measurement model estimates, r(18) = .88, p < 0.001 (Ullman 2002). This high correlation indicates that the relationship among the parameters hardly changed as a result of the model modifications.

The revised model represents a substantial improvement over the independence model as would be expected. With a $\chi^2(45, N = 512) = 108.11$, the revised model represents a significant improvement over the hypothesized model, $\chi^2_{diff}(1, N = 512) = 6.99$, p < 0.01. A CFI of 0.962, a robust CFI = 0.982, and a RMSEA of 0.05 indicate that this final model is a well-fitting, parsimonious measurement model for this data.

A review of the standardized solution for the final measurement model reveals that the correlated errors are small, suggesting that there is very limited redundant content across items (Byrne 1994). Further evidence of convergent validity is found by examining the individual parameters. All paths between measures and latent variables were significant. Such significance is good evidence of convergent validity (Byrne 1994).

Evidence of discriminant validity can be tested by comparing a model in which the covariances between factors are allowed to vary freely, and one in which they are not. The freely correlated model has a $\chi^2(45, N = 512) = 108.11$, a CFI of 0.962, and a robust CFI of 0.982. The constrained model has a $\chi^2(53, N = 512) = 381.92$, a CFI of 0.799, and a robust CFI of 0.794. The $\Delta\chi^2_{(constrained-free)} = 273.81$, df = 9, and is significant at p < 0.001. A significant difference in χ^2 supports evidence of discriminant validity (Akbar 1998; Byrne 1994; Teo et al. 2003). The $\Delta CFI_{(free - constrained)}$ is substantial (.188), providing additional support (Byrne 1994).

Structural Model

With an adequate measurement model, we now progress to testing the structural model. Our theory suggests that an individual will cognitively weight the costs and benefits of a particular information supply before such supply takes place (see Figure 1). We therefore expect to see significant regression coefficients for our structural paths from the latent variables depicted in the measurement model (*Time, Influence, Positive Affect, Cognitive Workout,* and *Other Costs*) to the information supply dependent variable.

In addition, we expect in particular that *Time* measures a cost, and *Influence* measures a benefit, and so we have *a priori* expectations of the valence of these regression coefficients. Our dichotomous dependent variable of information supply has a 0 when no supply occurs and a 1 when supply occurs. As a result, we expect that the path from the latent variable *Time* to the dependent variable will be negative: an increase in cost leads to a decrease in supply. We expect the path from the latent variable *Influence* to the supply dependent variable will be positive.

Our structural model was built based on the final measurement model discussed above. The Wald test for removing paths suggested that removing several of the covariances between factors would provide a significant improvement in both the fit and parsimoniousness of the model. This full structural model is shown in Figure 3. The explanatory power of the structural equation model can be evaluated by looking at the variance accounted for in the dependent variable, R^2 (Keil and Tan 2000). The model explains 79 percent of the variance in the supply of information. The independence model that tests the hypothesis that all variables are uncorrelated was easily rejectable, $\chi^2(78, N = 512) = 24141$, p < 0.001.

---

[2]The hypothesized measurement model and *post hoc* measurement model are not shown due to lack of space.
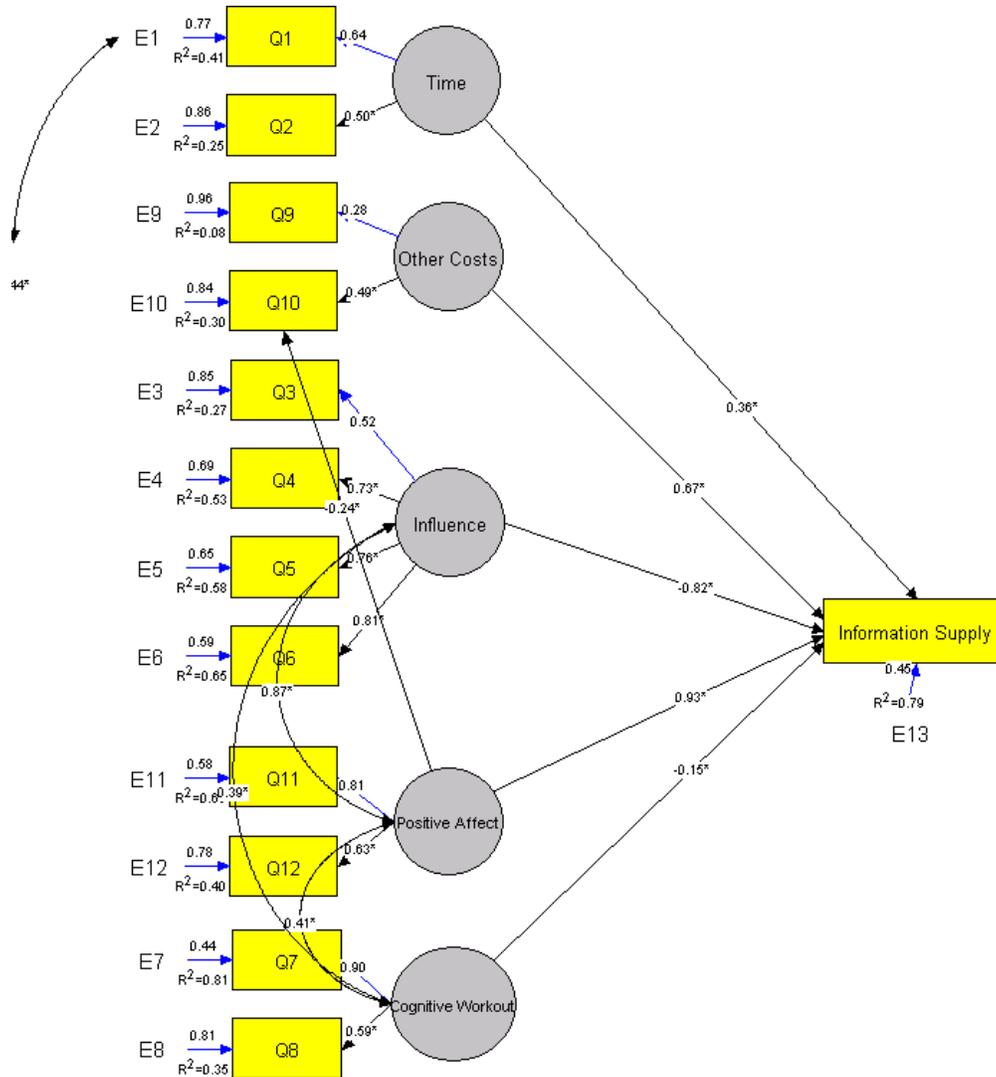
Figure 3. Structural Model of Information Supply

The hypothesized model was tested next and support for it was found, $\chi^2 56$, N = 512) = 331.298, p < 0.001. The comparative fit index (CFI) = 0.99 and the root mean square error of approximation (RMSEA) was 0.10, which together indicate an excellent fit of the model (Byrne 1994). We are not able to present robust estimates for these fit indices as the robust option cannot be applied when categorical variables are in use (our dependent variable is categorical) (Bentler and Wu 1995). It has been suggested, however, that estimation procedures such as maximum likelihood and generalize least squares are robust to fairly significant deviations from multivariate normality, especially if the number of observed variables is small (10 or 12 observed variables) as it is here.

Figure 3 shows that information supply can be predicted by the five latent constructs specified in the model. In particular, the regression path for *Time* is negative and significant, as expected. Likewise, the regression path for *Influence* is positive and significant. The costs associated with time decrease the likelihood that information supply will occur, whereas the benefits of being able to influence increase the likelihood that supply will occur.

Figure 3 also shows that our *Positive Affect*, *Cognitive Workout*, and *Other Costs* latent constructs significantly predict information supply. The results suggest that increased levels of *Positive Affect* lead to less supply, a puzzling result that we will address in the discussion section. The significant positive valence for *Cognitive Workout* suggests that the more complex and specific a document is, the more likely that document will be supplied. The *Other Costs* latent construct has a negative valence. Increased costs lead to less supply.

Table 2. Path Valences and Path Significances for the Three Moderating Variables

	Gender		Organizational Level		Propensity to Share	
	Males	Females	Staff	Mgt	Low Prop	High Prop
Time	– sig	– sig	– sig	– sig	– sig	– n.s.
Influence	+ sig	+ sig[*]	+ n.s.	+ n.s.	– n.s.	+ n.s.
Positive Affect	– sig	– n.s.	– sig	– sig	– n.s.	– n.s.
Cognitive Workout	+ sig	+ n.s.	+ n.s.	+ sig	+ sig	+ n.s.
Other Costs	– sig	– n.s.	– sig	– sig	– sig	– n.s.

n.s. = not significant   sig = p < 0.05   *sig p < 0.05 one-tailed[†]

[†]One-tailed tests are appropriate only for *Time* and *Influence* as we have strong *a priori* expectations of the valence of these paths.

The model of information supply expressed in Figure 2 suggests that there are moderating factors that will impact an individual's cognitive weighting of their personal costs and benefits. In the following analysis, we examine three moderating factors: the supplier's gender, their level within the organization, and their own general propensity to supply information.

We will examine the effects of these moderating factors independently, using the multigroup SEM technique. In this technique, the structural paths in the two groups (males and females, for example) are constrained to be the same and the model is run to test the invariance of these paths across the two groups (Bollen 1989). If univariate and multivariate LM $\chi 2$ tests show that the equality constraints set on the structural paths are tenable, then the two groups have the same structural model (Byrne 1994). Prior research in the IS field using cross-group analysis has constrained only one path at a time (e.g., Taylor and Todd 1995) due to limitations in the analysis package used (LISREL). EQS allows for paths to be constrained and tested multivariately.

Each of moderating variables needed to be split into two groups to allow comparison. Propensity to share was measured using a three-item scale (Cronbach's alpha 0.76). Each item of the scale was standardized, and then the three standardized items were combined to give a propensity score for each respondent. This propensity score was split in two at the median to give a low propensity to share group and a high propensity to share group.[3] Level within the organization can take one of five values, but this variable was split into staff and management groups, just as the firm does. Our gender variable has male and female as the two groups

Table 2 shows the results after constraining the structural paths from our latent variables to the information supply dependent variable, and examining our univariate and multivariate LM χ^2 tests.[4] In each moderating variable case we can conclude that there is a moderating effect on information supply.

Discussion

By integrating both individual costs and individual benefits into a theoretical model, this study has accounted for a substantial proportion of the variance in an individual's decision to supply information into an IT-based organizational memory system. Moreover, we have illustrated that factors such as gender and level within the organization may play a role in moderating this effect.

In previous research it has been shown time and again that personal costs impact an individual's decision to supply information into an ITOMS for others to use (e.g., Constant et al. 1996; Goodman and Darr 1998). Our findings support this. In particular, previous research has focused on the fact that the time to make a contribution, and having to clean a document up for contribution,

---

[3]Teo et al. (2003) uses this same method to test moderation using SEM.

[4]This is after ensuring that our baseline models have appropriate CFI and RMSEA statistics (Byrne 1994).

reduces information supply. Except in one subgroup, we found that increases in time costs significantly predict a reduction in the level of information supply. One contribution of this present study is that we considered moderating effects on the constructs that predict information supply. By examining propensity to share as a moderating variable, we are able to show that those with a *high* propensity to share anyway are alone in *not* considering the time costs of sharing.

Most importantly, these results show individuals do consider the ability to influence others through information supply. Building off theoretical work by Swanson (1992), and Oliver and Marwell (1988), and by using an established psychological influence scale (Kipnis et al. 1980), we are able to show that the ability to influence others is a significant factor in predicting increased information supply. This is not trivial. First and foremost it suggests that indeed, people do balance both costs and benefits before deciding whether to supply information or not. It also suggests that the free-rider problem pervasive in studies concerning information supply may not be so much of a problem. Free information comes at a price: the information being presented is from the perspective of the supplier and by consuming that information a user is potentially allowing him or herself to be influenced by the supplier. Seen this way, free-riders are not a problem at all—they are consumers of the supplier's influence. Indeed, the more free-riders there are to consume, presumably the broader the supplier's influence is exerted, *ceteris paribus*. Here we can only speculate at the actual impact of a supplier's influence. What we have learned in this study is that the ability to influence others is considered as a benefit to information supply. Future research should seek to examine whether the benefits of influence perceived by suppliers actually instantiates itself in consumers of information.[5]

In our overall model, the *Cognitive Workout* latent construct expresses itself as a benefit. Put otherwise, the more complex the issue, idea, or problem that a document addresses, the more likely a person is to supply it. Coupled with this, the more specific the issue, idea, or process a document is addressing, the more likely a person is to supply it. Together, these two items show that it is difficult yet well-defined problems that are more likely to be supplied. As might be expected, documents that address ill-defined problems are likely felt to have limited appeal to the broader community, and so do not get supplied. Similarly, documents that address less complex, simpler issues do not get supplied as people likely expect that they add little value to the community.

Looking at our moderated models, presented in Table 4, adds some depth to this insight.[6] While each subgroup in the moderated models has the same valence for the *Cognitive Workout* latent construct, only those for males, management, and low propensity to share are significant. This means that for females, staff, and those with a high propensity to share, the *Cognitive Workout* latent construct is not an important predictor of information supply. Put another way, staff, for instance, are less likely to be concerned about the complexity of a document up for supply. This might be because staff are more likely to work on less complex matters, and so just don't have complex documents available to them to supply. It might also be that staff members appreciate that less complex matters are worthy of sharing. With their less limited work experience, having documents that support the more mundane aspects of work and help them complete more simple tasks is likely to be of more value to them. As a result, complexity is less of a consideration. Our result may also echo the findings of Jarvenpaa and Staples (2001), who found that women attach more property rights to the organization than men, as do lower organizational levels. This implies that these groups are more likely to supply information irrespective of the cognitive workout benefits, as we find here.

That information supply enhances ones own self-esteem has been shown in the literature as a factor benefiting such supply (e.g., Constant et al. 1994; Constant et al. 1996; Goodman and Darr 1998), particularly in the software development community (Lakhani and Von Hippel 2000). In this present research, our *Positive Affect* latent construct comprises two questions designed to capture this concept. Our model, however, shows that *Positive Affect* is expressed as a cost, not a benefit. If a particular document made a respondent feel good about the way they solved problems, and helped them feel respected, then our results mean that this document was *less* likely to be supplied.

To explore this apparent anomaly, we look first at the two questions making up the *Positive Affect* construct and the way different respondents answered them. Table 3 shows the mean values for (1) respondents who have supplied a document and are answering the question for a document they have supplied, (2) respondents who have supplied a document and are answering the question for a document they have not supplied, and (3) respondents who have not supplied a document and are therefore answering the question for a document they have not supplied.

---

[5]Given the size of the advertising industry worldwide, we have some sense that it does. What is not clear is how non-advertising information such as proposal, reports, presentations, and the like actually influence users of information.

[6]See Teo et al. (2003), who also use base model path valences and path significances to show the effects of moderating variables.

**Table 3. Mean Value of Responses from the Different Types of Respondents on the
Two *Positive Affect* Latent Construct Questions**

Question addressed Respondent Type	This particular document makes me feel good about the way I solve problems	I enjoy earning respect and this document helps me feel respected
(1) Document suppliers responding on a document actually supplied	4.03	4.03
(2) Document suppliers responding on a document not supplied	4.51	4.03
(3) Respondents who have not supplied a document responding on a document not supplied	4.47	4.06

T-tests show that on the question "I enjoy earning respect and this document helps me feel respected" there are no significant differences between respondent types 1, 2, or 3. For the question "This particular document makes me feel good about the way I solve problems," when we look at document suppliers (respondent types 1 and 2) the mean responses are statistically different ($\alpha = 0.05$). When we look at how respondents answer this question for a document that they have not contributed (respondent types 2 and 3), the mean responses are *not* statistically different ($\alpha = 0.05$).

It seems, therefore, that our respondents consider supplied and non-supplied documents differently when it comes to whether or not that document makes them feel good about the way they solve problems. They feel less good about the way they solve problems when the document is supplied. It is possible this is because supplied documents have to be cleansed and tidied up before being submitted (one of our costs) which makes them more generic and less interesting. When we examined the *Cognitive Workout* factor, we saw that supplied documents are likely to be more specific to a problem or idea than those not supplied. It is possible that the need to be specific makes the document less valued in the eyes of the supplier. Left for future research is an exploration of why the differences we have found here actually arise.

The final latent construct in our model of information supply was *Other Costs*. This captures the concept of evaluation apprehension (the phenomenon whereby individuals withhold their questions for fear that others may not approve; Gallupe et al. 1992) as well as asking whether the document stands alone without further explanation. Table 4 shows the mean values for (1) respondents who have supplied a document, and are answering the question for a document they have supplied, (2) respondents who have supplied a document, and are answering the question for a document they have not supplied, and (3) respondents who have not supplied a document, and are therefore answering the question for a document they have not supplied.

**Table 4. Mean Value of Responses from the Different Types of Respondents
on the Two *Other Costs* Factor Questions**

Question addressed Respondent Type	I worried about what others might think of me when I contributed this particular document	This document stands alone, and doesn't need further explanation (reverse coded)
(1) Document suppliers responding on a document actually supplied	2.13	2.74
(2) Document suppliers responding on a document not supplied	2.55	3.31
(3) Respondents who have not supplied a document responding on a document not supplied	2.96	3.93

Table 4 shows that document suppliers (respondent types 1 and 2) feel greater evaluation apprehension (t-test, $\alpha = 0.05$) for a document they have not supplied as compared to one they have, as would be expected—it has not gone through the processes necessary to get it ready for others to read it. Document non-suppliers feel greater evaluation than suppliers (t-test, $\alpha = 0.05$). We can only speculate that this is part of the reason these respondents have not supplied, and suggest that this is an avenue for future research. A similar pattern emerges for the second question. The less a document stands on its own, the less likely it will be supplied.

Conclusion

This research has implications for users and designers of ITOMS. For users, the main story emerging is essential one of *caveat emptor*—the buyer must beware, or in our case, the user must beware. They must be aware of the possibility that suppliers are considering personal benefits of being able to influence others when they supply information. The majority of previous research in this field has considered that the lack of a way for a supplier to receive reciprocity for such supply is a problem. We have shown that suppliers actually believe that they *can* get something back from supplying information, even when the user is unknown.

For ITOMS designers, we believe that different designs may impact the information supply factors in different ways. For instance, Goodman and Darr (1998) examined an ITOMS that had specialists mediating the supply. We think that this impacts the *Time* construct directly. Indeed, Goodman and Darr describe that as part of the process of information supply these mediating specialists often asked questions of the suppliers to clarify issues. Clearly this increases the time costs of supply. Such a design also likely impacts the ability of a supplier to exert influence. With specialists sitting between the supplier and the user of information, they can filter out, tone down, or perhaps even enhance any influence attempts that the supplier had in mind. Okamura et al. (1995) report on essentially this occurring in a computer conferencing system.

This study has its limitations. A primary issue is that in examining documents not supplied, we looked only at a respondent's *intentions* to not supply. That these reflect factors impacting actual non-supply is not known. This study is also limited to one organization, and the ITOMS in use is very basic in its functionality. Our goal in this paper was not to consider specific features of the ITOMS, but rather to consider the factors impacting information supply through an ITOMS. The apparent richness of our model in its ability to account for a substantial proportion of the variance in information supply suggests that we have succeeded in identifying several of the factors in play. That other factors might also enter the model if the ITOMS is of a substantially different design or present in a different context can only be explored by conducting research on such ITOMS. Nonetheless, we believe that the model of information supply presented here and the techniques used to analyze our data are a valuable contribution. Prior studies have considered, sometimes only tangentially, all of the factors present in our study. This paper contributes in that it brings together all of these factors in one, relatively parsimonious, model of information supply.

Acknowledgement

References

Akbar, Z. "Does Trust Matter? Exploring the Effects of Interorganizational and Interpersonal Trust on Performance," *Organization Science* (9:2), 1998, pp. 141-160.

Alavi, M., and Leidner, D. E. "*Review*: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly* (25:1), 2001, pp. 107-136.

Bentler, P. , and Weeks, D. G. "Linear Structural Equations with Latent Variables," *Psychometrika* (45:3), 1980, pp. 289-308.

Bentler, P., and Wu, E. *EQS for Windows User's Guide*, Multivariate Software, Inc., Encino, CA, 1995.

Boisot, M., and Griffiths, D. "Possession Is Nine Tenths of the Law: Managing a Firm's Knowledge Base in a Regime of Weak Appropriability," *International Journal of Technology Management* (17:6), 1999, pp. 662-676.

Bollen, K. A. *Structural Equations with Latent Variables*, John Wiley, New York, 1989.

Burstin, K., Doughtie, E. B., and Raphaeli, A. "Contrastive Vignette Technique—An Indirect Methodology Designed to Address Reactive Social Attitude Measurement," *Journal of Applied Social Psychology* (10:2), 1980, pp. 147-165.

Byrne, B. M. *Structural Equation Modeling with EQS and EQS/Windows*, Sage Publications, Thousand Oaks, CA, 1994.

Cabrera, A., and Cabrera, E. F. "Knowledge-Sharing Dilemmas," *Organization Studies* (23:5), 2002, pp. 687-710.

Caldwell, F. "CEO Update: Measuring the Success of Enterprise Knowledge Management," Gartner Research and Advisory Services, Volume MRR-01012001-03, 2001.

Chin, W. "Issues and Opinion on Structural Equation Modeling," *MIS Quarterly* (22:1), 1998, pp. vii-xvi.

Connolly, T., and Thorn, B. K. "Discretionary Database: Theory, Data and Implications," in *Organizations and Communication Technology*, J. Fulk and C. Steinfield (Eds.), Sage Publications, Newbury Park, CA, 1991, pp. 219-233.

Constant, D., Keisler, S., and Sproull, L. "What's Mine Is Ours, or Is it? A Study of Attitudes about Information Sharing," *Information Systems Research* (5:4), 1994, pp. 400-421.

Constant, D., Sproull, L., and Keisler, S. "The Kindness of Strangers: The Usefulness of Electronic Weak Ties for Technical Advice," *Organization Science* (7:2), 1996, pp. 119-135.

Daft, R. L., and Lengel, R. H. "Organizational Information Requirements, Media Richness and Structural Design," *Organization Science* (7:2), 1986, pp. 554-571.

Gallupe, R. B., Dennis, A. R., Cooper, W. H., Valacich, J. S., Bastianutti, L. M., and Nunamaker Jr., J. F. "Electronic Brainstorming and Group Size," *Academy of Management Journal* (35:2), 1992, pp. 350-369.

Goodman, P. S., and Darr, E. D. "Computer-Aided Systems and Communities: Mechanisms for Organizational Learning in Distributed Environments," *MIS Quarterly* (22:4), 1998, pp. 1-23.

Igbaria, M., Parasuraman, S., and Barawy, M. K. "Work Experiences, Job Involvement and Quality of Work Life among Information Systems Personnel," *MIS Quarterly* (18:4), 1994, pp. 175-201.

Jarvenpaa, S. L., and Staples, D. S. "Exploring Perceptions of Organizational Ownership of Information and Expertise," *Journal of Management Information Systems* (18:1), 2001, pp. 151-183.

Keil, M., and Tan, B. C. Y. "A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects," *MIS Quarterly* (24:2), 2000, pp. 299-325.

Kipnis, D., Schmidt, S., and Wilkinson, I. "Intraorganizational Influence Tactics: Explorations in Getting One's Way," *Journal of Applied Psychology* (65:4), 1980, pp. 440-452.

Lakhani, K., and Von Hippel, E. "How Open Source Software Works: Free User to User Assistance," Working Paper #4117, Sloan School of Management, Massachusetts Institute of Technology, 2000.

Markus, M. L. "Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success," *Journal of Management Information Systems* (18:1), 2001, pp. 57-93.

Monge, P. R., Fulk, J., Kalman, M. E., Flanagin, A. J., Parnassa, C., and Rumsey, S. "Production of Collective Action in Alliance-Based Interorganizational Communication and Information Systems," *Organization Science* (9:3), 1998, pp. 411-433.

Okamura, K., Fujimoto, M., Orlikowski, W. J., and Yates, J. "Helping CSCW Applications Succeed: The Role of Mediators in the Context of Use," *Information Society* (11:3), 1995, pp. 157-172.

Oliver, P. E., and Marwell, G. "The Paradox of Group-Size in Collective Action—A Theory of the Critical Mass 2," *American Sociological Review* (53:1), 1988, pp. 1-8.

Olson, M. *The Logic of Collective Action*, Harvard University Press, Cambridge, MA, 1965.

Perrow, C. "A Framework for the Comparative Analysis of Organizations," *American Sociological Review* (32), 1967, pp. 194-208.

Stewart, T. A. "The Case Against Knowledge Management," *Business 2.0*, February 2000.

Swanson, E. B. "Information Accessibility Reconsidered," *Accounting, Management and Information Technology* (2:3), 1992, pp. 183-196.

Swanson, E. B., and Dans, E. "Systems Life Expectancy and the Maintenance Effort: Exploring Their Equilibriation," *MIS Quarterly* (24:2), 2000, pp. 277-297.

Taylor, S., and Todd, P. "Assessing IT Usage: The Role of Prior Experience," *MIS Quarterly* (19:4), 1995, pp. 561-570.

Teo, H. H., Wei, K. K., and Benbasat, I. "Predicting Intention to Adopt Interorganizational Linkages: An Institutional Perspective," *MIS Quarterly* (27:1), 2003, pp. 19-49.

Thompson, R. L., Higgins, C. A., and Howell, J. M. "Personal Computing: Toward a Conceptual Model of Utilization," *MIS Quarterly* (15:1), 1991, pp. 125-143.

Ullman, J. "Structural Equation Modeling," in *Handbook of Psychology, Research Methods in Psychology*, J. A. Schinka and W. F. Velicer (Ed.), John Wiley & Sons, New York, 2002.

Wasko, M., and Faraj, S. "'It Is What One Does': Why People Participate and Help Others in Electronic Communities of Practice," *Journal of Strategic Information Systems* (9), 2000, pp. 155-173.

Yukl, G., Falbe, C. M., and Youn, J. Y. "Patterns of Influence Behavior for Managers," *Group & Organization Management* (18:1), 1993, pp. 5-28.