

## Developing a conceptual model for knowledge sharing

Irit Alony  
Assoc Prof Greg Whymark

School of Management and Information Systems  
Central Queensland University  
Rockhampton, Queensland.  
Email: [i.alony@cqu.edu.au](mailto:i.alony@cqu.edu.au)

School of Management and Information Systems  
Central Queensland University  
Rockhampton, Queensland.  
Email: [g.whymark@cqu.edu.au](mailto:g.whymark@cqu.edu.au)

### Abstract

*Knowledge sharing in an organization is a complex process with many factors influencing the activity. This paper reviews research on the topic and identifies many of the variables (or factors) identified by previous authors. We also identify where such factors have been measured empirically or investigated using qualitative techniques. Some shortcomings are identified and a possible avenue of research suggested that will provide further insight into what drives knowledge sharing in a modern organization. The paper focuses on describing the underlying conceptual framework for studying the problem using the individual knowledge worker and the knowledge sharing activity as the unit of analysis.*

### Keywords

Knowledge sharing, knowledge workers, collaborative technology

## 1 INTRODUCTION

Knowledge sharing in organizations is of great interest to researcher and practitioner alike. Both report that knowledge sharing improves organizational performance.(Lesser & Storck 2001), promoting competitive advantage (Argote & Ingram 2000), organizational learning (Argote 1999), innovation (Powell et al. 1996) and even survival (Baum & Ingram 1998). To argue that premise is outside the scope of this paper, but even if not universal, many managers ask how their organization can promote knowledge sharing amongst their knowledge workers. In this paper, we bring together factors reported to affect knowledge sharing, the nature of their effect, and the ways they were measured. We also examine the way knowledge sharing has been measured. Past research is reviewed in the next section, and it is apparent that both the type of research and the results are disparate and sometimes contradictory. This has implications for practitioners seeking to promote knowledge sharing in their organization.

A lot of the research has focused on empirical evidence (Burt 2004; Cross & Cummings 2004; Cummings 2004; Hansen 1999; Hansen 2002; Levin & Cross 2004; Owen-Smith & Powell 2004; Reagans & McEvily 2003) ,among others). Exploratory qualitative research has been reported (Ardichvili et al. 2003; Cummings 2004; Dyer & Nobeoka 2000; Stenmark 2000), among others) in an attempt to identify and describe factors affecting knowledge sharing. In this paper, we describe factors previously identified that may impact on the question: how does knowledge sharing happen?

There is no single succinct model upon which to base the research (Bock & Kim 2002; Bogenrieder & Nooteboom 2004; Levin & Cross 2004). Many factors involved are complex and interactive.

Another issue is the multidimensionality of many of the variables identified. Empirical studies focus on a small subset of variables, often only three or four (for example,(Levin & Cross 2004). This makes it difficult to examine for the expected interaction between influences, and to examine the role of perception of the knowledge sharers.

Since the problem is possibly too complex for a single model, further research is needed, especially on the perception of the knowledge worker and how that perception affects knowledge transfer within the network. How can the question be progressed further?

The first step is to identify a suitable research model, and the purpose of this paper is to describe that model. The application of the model is only briefly described due to the constrictions on space in a single conference paper. The model is not comprehensive, but is designed as a basis for a social constructivist analysis of the single knowledge worker's view of knowledge sharing.

The following section describes the various factors previously identified to affect knowledge sharing, and the methods used to measure them. We then present a complete model based on these factors, and discuss the perspective provided by activity theory.

## 2 RESEARCH INTO KNOWLEDGE SHARING

As knowledge sharing has been identified as the basis for competitive advantage and organizational learning (Argote & Ingram 2000), there is no wonder why many studies have tried to map the key factors affecting the process. Both qualitative and quantitative studies have attempted to describe factors affecting knowledge sharing, and quantify their affect. In this paper we provide an overview of the methods of research and findings of these studies.

### 2.1 Position of individuals in the network

The position of individuals involved in knowledge sharing has been found to affect knowledge flow and availability. One dimension of the individual's position is "betweenness centrality" – the number of ties one has, connecting otherwise disconnected individuals. This factor positively impacts the effectiveness of knowledge sharing. Burt (2004) found individuals bridging across "structural holes" and who discuss ideas with their contacts are more likely to derive useful solutions for the organization.

Betweenness centrality was found to positively affect individual's performance according to Cross and Cummings (2004). Two types of betweenness centrality were examined: on the information network and on the awareness network. Both were found to positively affect individual performance: the individual's betweenness centrality on the *information* network provides better access to useful information, whereas the individual's betweenness centrality on the *awareness* network improves the individual's opportunity to learn who has relevant knowledge. Brauner and Becker (2006) labelled the latter "meta-knowledge" – knowledge about the knowledge of others.

In their research of knowledge spillovers in the Boston biotechnology community, Owen-Smith and Powell (2004) found betweenness centrality to have two potential courses of action: a positive one, acting as "cupids [to] pass information on to the distantly positioned networks alters", or, as the members of this network are often more competitors rather than co-operators, a negative one, where "powerfully positioned middlemen extract value by interrupting or distorting information" (Owen-Smith & Powell 2004, p. 16). This study also shows betweenness centrality contributes to member's innovation.

"Closeness Centrality" is another indication of a member's position in a network: "how *close* an actor is to all the other actors" (Wasserman & Faust 1994, p.183). Short path lengths to other members are more likely to deliver non-distorted and relevant information, and indeed, Hansen (2002) found closeness-centrality to positively affect the amount of knowledge obtained by the member, and on project completion time.

A number of researchers have used network analysis data to generate a value for a member's betweenness and closeness centrality. To map the network's structure, Cross and Cummings (2004), Burt (2004) and Hansen (2002) used surveys to obtain information on relations between members, based on a method described by Marsden (1990). Due to the formal nature of the relations in their model, Owen-Smith and Powell (2004) relied on a database of formal network connections in Boston biotechnology firms.

Research to date makes it clear that a centrally-positioned individual has a better performance due to information flow and availability. However, the measurement on these concepts has proved difficult. Different researchers have used different surrogates. In an attempt to measure information flow and availability empirically, there has been no evidence to indicate one surrogate would be more suitable than others. These factors are fundamental to knowledge sharing, and further research is wanted.

### 2.2 Network properties

The properties of a network, across which knowledge is shared, has been found to have an affect on the sharing process.

One such property is network cohesion – the number of strong ties around a strong tie. Reagans and McEvily (2003) explain the effect of network cohesion is by reputation – the existence of more third-party ties around a *person* promotes sharing information regarding the person and their willingness to assist in the process of

knowledge transfer. This study also found a positive effect the range of the network has on ease of knowledge transfer.

Cummings (2004) found the diversity of network members to positively affect knowledge sharing. Four kinds of diversity were studied: Demographic diversity (as in, age, sex and years in the company), geographic diversity (member's location), functional diversity (assignment to work groups) and reporting managers (managers the members report to). All factors were found to have an affect on effective knowledge sharing, however a saturation level was observed as well. The affect diminished as the number of factors increased. Diversity data was collected via surveys and HR records.

This research shows a cohesive and diverse network provides better knowledge sharing support.

### 2.3 Properties of the knowledge shared

Other than the properties of the knowledge-exchanging parties, the object exchanged also has an effect on the knowledge sharing activity. The level to which knowledge is "codified" or "explicit" makes a difference to how easy it is to transfer knowledge. The terms "codified" and "explicit" are used interchangeably in the research literature.

Reagans and McEvily (2003) Related codifiability directly with the ability to encode the knowledge. To value how 'codifiable' knowledge is, Reagans and McEvily (2003) surveyed the participants about the perceived ease of codification and the existence of such codified knowledge in the company, using 7-point Likert scale questions. The terms "codified" and "explicit" are used interchangeably by other researchers (Alavi 2001; Gertler 2003; Nonaka 1994).

Hansen (1999, p. 100) found that transferring "highly codified and stand-alone" knowledge over weak ties promotes project completion, and that the transfer of "non-codified" knowledge is more effective over direct ties (Hansen 2002). The results of Reagans and McEvily (2003, p. 261) are similar. They found "strong ties facilitate the transfer of tacit knowledge more than...codified knowledge". Hansen's studies relate to knowledge that is already codified, whereas Reagans and McEvily look at how easy it would be to codify it, or make it explicit. Hansen used a survey instrument to determine the extent to which knowledge is already codified.

Rather than measuring how explicit knowledge is (and therefore easy to transfer), is it better to look at how *transferable* knowledge is? In an exploratory study, Stenmark (2000) investigated the use of a tool enabling the tracking web-based resources used by knowledge workers. This tool created an implicit profile of the worker and was found to assist in sharing that tacit knowledge across the organization. This tacit knowledge was not difficult to share, since it was tangible and transferable. There was no need to externalize it to make it transferable. It is this concept of transferable knowledge rather than codifiable knowledge that requires further research.

### 2.4 Tie properties

Knowledge sharing can occur over dyadic relationships. The ties over which knowledge is exchanged have been found to impact on the activity of knowledge sharing.

**Tie strength:** Reagans and McEvily (2003) found that both tacit and explicit knowledge are easier to transfer over strong ties. Hansen (1999), however, found tacit knowledge is easier to transfer over strong ties, but weak ties are more efficient when it comes to explicit knowledge sharing. The explanation suggested by Hansen is that weak ties require less maintenance. Hansen (1999; 2002), as well as Reagans and McEvily (2003), measured tie strength by asking respondents about relationship-closeness and frequency of communication with each contact. Reagans and McEvily also asked if the relationship is described as "friendship" or "advice source", to control for the content of the ties.

**Tie range:** tie range is defined as ties spanning beyond unit / organizational boundaries and is another factor positively affecting knowledge sharing (Cross & Cummings 2004). These ties are potentially a source of non-redundant information (Cross & Cummings 2004; Hansen 1999; Hansen 2002; Reagans & McEvily 2003). Tie range data is typically measured using network analysis data, as discussed in the previous section.

**Common knowledge:** Reagans and McEvily (2003) found a positive relationship between the level of common knowledge and ease of transfer. The level of common knowledge was estimated based on the assumption that individuals from similar background (race, sex, level of education, tenure) and area of expertise would have "common experiences, resulting in shared knowledge" (Reagans & McEvily 2003, p. 250). Data regarding individual characteristics was obtained from the HR department. Tenure was measured as time the individual has been employed by the firm, and area of expertise was provided by participants and reviewed by the executive in charge. This paper provided little justification for the use of background information as a surrogate for these variables.

A possible explanation for the support common knowledge provides to knowledge transfer is given by Nooteboom (1999). He suggests that the level of common knowledge, 'Cognitive proximity', improves communicability, and enables better understanding.

Van Daal et al (1998) suggest a way to measure the knowledge gap between individuals, using a matrix of areas of expertise and self-perceived level of expertise.

Cummings' results (described above) are somewhat contradictory to those of Reagans and McEvily (2003). Cummings (2004) shows diversity promotes effective knowledge sharing. Reagans and McEvily (2003) show the importance of common experience. There is no explanation for this apparent contradiction, but it is probably a result of the shortcomings of the survey research approach. A possible explanation is, different people commonly have different meaning for the same term (for example, the term 'goal' can mean different things to different people, even if they share the same work place). When people are aware of the possibility of such a difference in meanings, they address it. It is therefore possible that they perceive the communication in these cases as more difficult, but it turns out to be more effective. Further insight is needed into the mechanism through which diversity affect knowledge sharing.

## 2.5 Organizational properties

Since each organization has its own culture, processes, objectives and goals, it can be expected that the nature of knowledge sharing will thus be different and will depend on organizational characteristics.

Organizational incentives to share knowledge have been found to affect motivation. Bock and Kim (2002) found financial incentives to induce a negative attitude towards knowledge sharing. Dyer and Nobeoka (2000) showed non-financial incentives improve knowledge sharing across organizational boundaries. Additional research is required in this area.

## 2.6 The issue of trust

Trust is manifested in many forms when knowledge sharing is studied.

Ardichvili et al (2003) have conducted an exploratory research, to identify what impedes personal motivation to share knowledge over an online forum. They used semi-structured interviews, and corroborated their findings with log-files, documentation, and participants' approval of their interpretations. The study identified trust as an important factor. A description of two kinds of trust in this research complies with the definitions of both kinds of trust measured by Levin and Cross (2004): benevolence-based trust and competence based trust. Benevolence-based trust means "trust that the other members will not misuse the posted information". Competence-based trust means "trust it [the network] to be a source of reliable and objective information" (Ardichvili et al. 2003, p. 72).

Levin and Cross (2004) operationalized the concept of knowledge transfer by using the term *receipt of useful knowledge*. This term denotes the perceived receipt of knowledge (or information) that has a positive effect on the receivers work. They describe trust as a multidimensional characteristic and examine its effect on weak ties in enhancing knowledge sharing. In their discussion of the elements of trust they cite McAllister (1995) as having demonstrated "empirically the importance of two types of trust". These were affect-based and cognition-based trust. However, they used a subset of these two dimensions in their empirical study, citing Mayer (1995). They suggest that benevolence (or institution based, according to Ardichvili et al), has a large affective component and that the second one, competence (or knowledge based, according to Ardichvili et al) has a large cognitive component, and then proceed to use these two as an operationalization of the affective and cognitive domains. Their study, using a large survey based data collection, showed that both benevolence and competence-based trust have a positive influence on knowledge transfer. It also showed that trust is "a critical mechanism underlying the knowledge benefits of strong ties" (Levin & Cross 2004, p. 1486). The measurement of trust was based on the work of Johnson et al and McAllister (1995), both of whom measured trust using a survey instrument.

In their qualitative study of inter-company knowledge sharing, Dyer and Nobeoka (2000) described the prevention of 'free-riders' as an important step to motivate participants to share knowledge. This can be viewed as a manifested form of benevolence based trust. The prevention was enabled due to the formal nature of the network studied: the participants had to officially commit to sharing relevant knowledge. The study did not suggest a surrogate or a way to measure the "free-riding" factor.

To measure the affect these factors have on knowledge sharing, one needs to measure knowledge sharing itself. Knowledge sharing is not a simple variable to operationalize, and different methods of this operationalization are described in the following section.

## 2.7 Measuring knowledge sharing

The different ways of operationalizing knowledge sharing can be divided into the following categories: based on amount, events, receipt of useful knowledge, and result-based assumption. These categories are described in the following sections.

### 2.7.1 Amount

Hansen (1999; 2002) examined the amount of knowledge acquired by the unit studied. The amount was estimated by the unit managers. Cummings (2004) also used the estimate of members regarding frequency and kind of knowledge shared. Burt (2004) examined how many people were involved in discussing the idea, thus having an indication to the number of interactions a person had regarding their knowledge. Some researchers used documentation as evidence to estimate the amount of knowledge shared. Ardichvili et al (2003) studied knowledge sharing over an online forum, and thus viewed log files and documentation. Stenmark (2000) studied knowledge sharing over an online tool as well, and used log files documentation to support results gathered in interviews and questionnaires.

Another way to estimate the amount of knowledge shared is by viewing how much of one's 'broadcasted' knowledge has been used. Spencer (2003) studied the role of knowledge sharing among companies in the flat panel industry. She viewed the quantity of knowledge companies were 'broadcasting', to indicate quantity, and the number of times their work has been cited, as an indication of the relevance of the knowledge they shared.

### 2.7.2 Events

Another way to observe the occurrence of knowledge sharing is by recording events in which knowledge sharing is likely to happen.

In their study of Toyota's suppliers network, Dyer and Nobeoka (2000) described events of knowledge sharing, such as knowledge sharing committees, visits to other suppliers, transference of staff members to other suppliers, and the presence of consultants from one company (Toyota) in another (supplier company). The declared purpose of these events (facilitated or conducted by Toyota) was to promote knowledge sharing among the supplier companies.

'Stories' of knowledge shared were also described by Cummings (2004) in a series of case-studies. The stories depict the kind of knowledge shared and used, and the benefits resulting from that sharing.

Unlike the events described by Dyer and Nobeoka, the effect of the knowledge sharing described by Cummings is known, but at the same time, these events can only be reported in hindsight. The events reported by Dyer and Nobeoka can be recorded in real time, but it is difficult to tell how much knowledge was actually shared, and how much of it is useful.

### 2.7.3 Receipt of useful knowledge:

While it is important to measure knowledge sharing per-se, it is *useful* knowledge sharing that is of interest to practitioners.

Levin and Cross (2004) surveyed for the perceived receipt of useful knowledge, to indicate 'to what extent the knowledge received from each person hurt or helped key aspects of the project's outcome' (Levin & Cross 2004, p. 1482). It is difficult, however, to examine if the knowledge was in fact useful – this variable only gages if the knowledge *seemed* useful to the receiver. As described above, whether knowledge sharing is useful can usually only be told in hindsight.

### 2.7.4 Result-based assumption

Another perception is not to measure the affect a factor had on knowledge sharing, but rather the affect on results that are assumed to be affected by knowledge sharing.

For example, Cross & Cummings (2004) examined how the position of the individual in a network affects that individual's performance, arguing that "properties of both ties and networks can increase the quality and relevance of information an individual receives and concurrently improve the performance of those engaged in knowledge-intensive work" (Cross & Cummings 2004, p. 4)

The concept of *receipt of useful knowledge* is particularly interesting, since it gives insight into the effective portion of knowledge sharing, rather than the potential for one. Amount and events based measurements indicate potential for useful knowledge sharing. Results can be partially attributed to knowledge sharing, but there is no way of telling to which extent, if at all.

## 2.8 Role of technology

It is difficult to imagine a modern knowledge sharing network that does not involve technology. Emails and shared files are basic tools available to every working community. Some researchers rely, at least partially, on evidence generated by technology to learn about knowledge sharing. It is mostly used to corroborate statements given in interviews or surveys (Hansen 1999; Hansen 2002; Owen-Smith & Powell 2004; Stenmark 2000).

Technology as a tool used in knowledge sharing is clearly stated by Ardichvili et al(2003), as sharing was done over an online forum. This study found trust to have a major affect on knowledge sharing. Participants who had prior acquaintance with online members of the community felt more comfortable using the forum as a knowledge source. This shows a limitation of the online forum as a tool for knowledge sharing. Trust among the network members is not as easy to create.

Trust can also be related to technology itself. Stenmark (2000) reported a study where knowledge sharing was facilitated by online agents. Some unexpected results provided by the tool were regarded by the participants as 'interesting', whereas other results were negatively referred to as 'strange' or even as 'a bug'. Some users were adapting to the tool in order to get results they were satisfied with, which shows they were willing to make an effort. However, the population studied in this research was experienced IT employees, who are likely to be favourably inclined to technological tools.

Unlike these studies, the individual's level of IT usage was not found to have a significant moderating affect on knowledge sharing behaviour in a study of a public organization in Korea (Bock & Kim 2002).

A good example of technology not improving, and even hurting knowledge sharing is described in a case study by Kautz (2005). In this case study, a document handling system was setup to support text-based project data. The knowledge stored in that system was often incomplete, as not all relevant documents were on the system. Searching documents was inconvenient and difficult, sometimes resulting in failure to find the relevant documents.

Many researchers studied the affect of sharing knowledge across physical or organizational boundaries (Burt 2004; Cross & Cummings 2004; Cummings 2004; Dyer & Nobeoka 2000; Hansen 1999; Hansen 2002; Owen-Smith & Powell 2004), but technology was not addressed as a factor affecting knowledge sharing in these studies.

Technology will usually have a role in this kind of knowledge sharing, but we observe a paucity of research into the role of technology in knowledge sharing networks.

## 2.9 Studying the factors

Studies of this subject have been both qualitative and quantitative. The qualitative studies have explored and described numerous factors affecting knowledge sharing, but have not quantified the variables or the affect they have on knowledge sharing. Quantitative studies attempt to measure both the level of the factor studied, and the level of its affect, but often involve only a small number of factors.

As the process of knowledge sharing is complex and involves many variables, it is difficult to estimate the contribution of a quantitative study in this field. Basic characteristics – the culture of the sharing entity, the sharing members, the medium used for sharing, the type of knowledge shared – can have a significant affect on a quantitative result. For example, what is true for knowledge sharing in a high-tech American based online forum can be completely different for knowledge sharing between Japanese companies. Statistical evidence provides reassurance of statistical significance, but does not inform us as to how the variables studied interact with the complex array of other factors involved in knowledge sharing networks. These aspects require more research.

## 3 THE FACTORS AFFECTING KNOWLEDGE SHARING

The previous section described a number of factors found to have an impact. Unfortunately, not all the research was definitive and included factors that researchers considered important, but did not measure or study. In this section each factor is listed together with a comment on its complexity, previously used instruments to measure it, and its relationship to other factors. Guiding this analysis is the need for applying the model to the study of the perceived significance of the factors to the individual member of a knowledge network.

### 3.1 Individual properties

- Position in a network – evident from network analysis
- “Betweenness centrality” of a member – evident from network analysis
- Closeness centrality of a member – evident from network analysis

### 3.2 Network properties

- Network cohesion (how many strong ties are there, around a strong tie) - measuring results from network analysis
- Demographic diversity - Age sex, and years in the company. Measured via survey, HR data
- Geographic diversity - Geographic location of members. Measured by survey, HR data
- Functional diversity - assignment in the work group (marketing, quality, etc). Measured by survey Survey, HR data
- Reporting managers - Managers reported to by the network members. Measured by survey survey, HR data

### 3.3 Tie properties

- Tie strength - measured using questionnaires emotional closeness and frequency of communication with each contact: is the relationship described as “friendship” or “advice source”?
- Tie range - ties spanning beyond the unit / organization. Measuring results from network analysis
- Common knowledge – Based on similar background – race, sex, education level, tenure, and on the area of expertise. Data can be collected regarding duration and field of previous experience. Alternatively, a ‘knowledge matrix’ of areas of expertise and self-perceived level of expertise can provide knowledge gap information.

### 3.4 Knowledge shared properties

- Knowledge codifiability - how easily can the knowledge transferred be codified. Measured using a set of 5 questions with a 7-point Likert scale.

### 3.5 Organizational properties

- Financial incentive - A financial bonus for sharing knowledge. Measured by survey instrument
- Incentive to share knowledge - Not a financial incentive, but an organizational one. Not measured, but observed, in form of benefits available to those who share
- Preventing “free-riding” of participants. Measured by looking for organizational rules or norms preventing “free-riding” of participants. One such norm could be an explicit agreement to share knowledge.
- Perception of knowledge ownership - Perception of the knowledge as ‘public goods’ rather than private
- Trust - Trust among members has been reported in two forms and measured via a survey instrument. The two forms are benevolence based trust, and competence-based trust. These forms are an operationalization of two broader dimensions, affective and cognitive based trust.

### 3.6 Evidence of knowledge sharing

- Receipt of useful knowledge – this is the perception of the knowledge receiver as to both what was received and the value of that knowledge to their work.
- Amount of knowledge shared – extending receipt of useful knowledge to gain the individuals knowledge workers perception of how much and how often.
- Events –events reported that are likely to support knowledge sharing, or evidence of events in which knowledge sharing is likely to take place. Such events include meetings (face-to-face or virtual), phone calls, visits or other organizationally instigated socializing events.

- Result-based assumption –organizational results that can be attributed to knowledge sharing, such as individual performance differences, appearing in correlation with the likelihood of knowledge sharing.

## 4 THE NEXT STEP

Most of the factors listed above could influence virtually every knowledge network. The question we raise here is which of these factors feature in the perception of the individual knowledge worker?

To examine that question we propose that a qualitative review of the knowledge workers perception of knowledge sharing in their organization will lead to the identification of active factors evidenced by the surfacing of concurrent activities, the central activity being that of the knowledge sharing amongst community members. This extends the research of learning as a cultural and historical activity and uses the concepts from that research to investigate the process of learning through knowledge sharing. Hawkins (2006) provides guidelines and useful techniques to use in the analysis of qualitative data using activity theory.

## 5 CONCLUSION

This paper describes a broad approach to the investigation of knowledge sharing amongst knowledge workers. The potential variables are described, but we also suggest that the list is not yet complete. We need more research to identify all the active variables and propose a qualitative, constructivist approach to address this.

Previous research will provide a foundation, and the measurements used will form the basis of the proposed data gathering, however by the nature of empirical research it can be limiting.

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