

ICT Perceptions and Meanings: Implications for Knowledge Transfer

Anne P. Massey
Indiana University
amassey@indiana.edu

Taylor M. Wells
Indiana University
tmwells@indiana.edu

Abstract

Driven by global competition and economic pressures, organizations are increasingly interested in transferring and leveraging local expertise at the global level. While many of the challenges of knowledge transfer (KT) have been discussed in the literature (e.g., incentives, cognitive limitations), the challenge of KT in distributed, or “virtual”, settings and the role of information and communication technologies (ICTs) have received limited attention. While any given ICT may be described in terms of one’s perceptual awareness of its capabilities (e.g., richness, interactivity), it may also be described relative to the meanings an individual attaches to it, i.e., the idea of it or its purpose, rather than capability. We propose that understanding both perceptions and meanings, particularly as new ICTs are introduced, is critical to understanding selection and use by KT participants, and ultimately outcomes. In this paper, we conceptually explore the implications of meanings and perceptions on KT in virtual settings.

1. Introduction

Driven by global competition and economic pressures, organizations are increasingly interested in transferring and leveraging local expertise at the global level [6, 29, 34]. Effective organizations require that distributed knowledge be coordinated and communicated – transferred from one individual to another and from one site to another. As such, increasing attention is being paid to knowledge transfer (KT), the process through which one unit (e.g., individual, group) is affected by the experience of another [2]. KT manifests itself through changes in the knowledge or performance of the recipient(s). For example, organizations are extending the boundaries of new product development teams from traditional co-located settings to virtual settings (c.f., [40, 49]). By doing so, a previously linear work process is being replaced by parallel work, with information and communication technologies (ICTs), or electronic media, playing a central role in interaction [19, 29].

Today, for example, one can easily imagine virtual new product development teams consisting of marketers in Europe, software developers from India, design engineers in the US, manufacturing liaisons in China, and a myriad of other relevant knowledge resources in other locations.

While many of the challenges of KT have been discussed in the literature (e.g., incentives, cognitive limitations) [37, 63], the challenge of KT in distributed settings and the role of ICTs have received limited attention. By enhancing opportunities for coordination and communication, ICTs have the potential to facilitate KT across distributed units [30] – thus increasing the speed of KT, while reducing costs [29]. Dispersed knowledge workers place increased demands on an organization’s existing communication and collaboration systems, and in some cases they compel further investment in ICTs specially dedicated to supporting virtual work. A recent industry report by Gartner Group [21], for example, indicates that the growing demand for ICTs will drive the collaboration software market to nearly \$1.1 billion by 2008.

ICTs include *synchronous* media, e.g., telephone, audio/videoconferencing, shared applications (e.g., via NetMeeting®), and instant messaging ([IM], e.g., Lotus Sametime®), and *asynchronous* media, e.g., email, voicemail, threaded discussion forums, calendaring systems, and shared document repositories. While first-generation Internet/Web-based tools have garnered the most interest by practitioners and academics, we are witnessing the introduction of second-generation means of collaboration, including blogs, wikis, folksonomies, social networking sites, 3D virtual worlds (e.g., Second Life), and even podcasts. Existing and emerging means of collaboration pose significant opportunities and challenges.

As the need to transfer knowledge across boundaries (culture, time, space, and organizations) increases, we need to gain a deeper understanding of why virtual knowledge workers select from the seemingly ever increasing plethora of ICTs available to them. Without this understanding, organizations may continue to support and/or invest in ICTs that do not effectively support KT. In the context of virtual KT,

we propose that understanding perceptions *and* meanings of ICTs is critical to understanding selection and use by KT participants, and ultimately outcomes. For example, while email or IM may be described in terms of – and selected based on perceptions of – their capabilities (e.g., richness, social presence) relative to communication tasks, each of these media also likely reflect specific meanings that KT partners attach to them. The purpose of this paper is to conceptually explore these concepts and offer implications for KT.

In the following sections, we first discuss KT and then review alternative perspectives on ICTs. We then discuss theoretical perspectives on perceptions and meanings, and illustrate the construction of both via a discussion of an ICT introduced a century ago – the telephone. We conclude our paper by discussing KT implications and future research directions.

2. Knowledge transfer in virtual settings

KT can occur among entities spanning multiple levels, i.e., individuals, groups, and organizations [2, 33]. Arguably, one of the most important aspects of collaborative work is the transfer of knowledge from one set of individuals to another [53].

KT is the process through which one unit is affected by the experience of another unit [2]. KT occurs by moving a knowledge reservoir from senders to receivers with transfer manifested through changes in understanding of the recipients. In order for knowledge to be useful for others, senders must express it in such a manner as to be interpretable by the intended receivers [1]. Receivers must “decode” the symbols that constitute a message and interpret the meaning of the sender. For communication to be successful, both senders and receivers must mutually agree that the message has been understood [11]. Feedback plays an important role in communicating to the senders that the receivers have understood the message [16].

Argote and Ingram [2] suggest that ascertaining how knowledge understanding changes as a function of experience (e.g., with a KT partner) is an important undertaking. With the increase in globalization, KT increasingly occurs among entities that are not necessarily co-located, but separated by geographic distances [53, 65]. The contexts within which senders and receivers encode and interpret information are likely to differ significantly when their geographic locations are distant, increasing the likelihood of misinterpretation [12].

To date, researchers have attempted to investigate KT at individual [22], group [62], and organizational levels [52, 74], although with few exceptions, such investigations have been limited to co-located organizational members [58]. Szulanski suggests that

“knowledge transfers are often laborious, time consuming, and difficult” [63:10] and argues that it is important to examine the *process* of KT to produce more favorable KT outcomes, defined as the effects of another’s experience upon an individual [47]. Given these difficulties, it is reasonable to expect that KT may become more problematic in virtual situations where participants communicate via technology. Thus, we focus our paper at the individual level of KT in the context of virtual, ICT-enabled, work.

Communication and social cognition theories suggest that individuals must find or develop a shared interpretive context, or shared meanings, for interaction and communication to take place and continue [5, 9, 45, 53, 68, 70]. Generally, these theories focus on the knowledge content being transferred where KT participants must find or develop some degree of congruence in “thought worlds” [20] such that communication can take place. For example, individuals involved in distributed KT often represent different functional areas or cultural backgrounds, which are likely to have different values and preferences. Clearly, it is important to examine how participants’ knowledge and understanding about the topic content evolve over time. At the same time, however, when ICTs are the central enablers (or inhibitors) of the KT process, we must also pay attention to changes in understanding as a function of ICT perceptions and meanings, i.e., which participants bring and/or develop through experience.

Social science research suggests that mental models evolve and are founded on a complex entangling of cognition, culture, and language [51, 61]. This would be true for both the mental model associated with the KT content/topic, as well as the mental model(s) associated with the available ICTs. For example, cross-functional communication may be hampered by differences in functional “language” or “culture”. In fact, multiple dimensions of culture may be at play in the KT process if participants are dispersed (e.g., national or organizational culture in addition to functional culture). While ICTs can enable KT, past research suggests that, in actual use, the capabilities of ICTs can be subjectively perceived differently by individuals [32]. This may be particularly true in virtual settings wherein participants have little (if any) history of working together using various ICTs, and may be separated not only geographically, but also culturally. For example, Massey et al. [46] found that different national cultures perceive ICTs differently in terms of capabilities relative to communication tasks. Furthermore, different individuals may attach alternative meanings to various ICTs [35, 54]. In the next section, we review two broad theoretical perspectives regarding ICT selection and use.

3. Theoretical perspectives: ICTs

3.1 ICT capabilities perspectives

Media capacity theories describe ICTs in terms of capabilities such as richness, social presence, and interactivity [4, 17, 73]. These capabilities do not define any specific communication technologies or features, but rather they express the ideals to be achieved by the communication system [4]. As prescriptive theories, media capacity theories suggest that proper "matching" of ICT capabilities and tasks will lead to increased KT effectiveness [14, 57].

A review of the literature reveals that richness, social presence, and interactivity are highly developed, well-studied constructs that are significantly interrelated and entangled [27, 67, 73]. Richness is described as a blend of four factors: (1) the immediacy of feedback, (2) the use of multiple cues (verbal and non-verbal), (3) language variety, and (4) the ability to personalize messages [14]. A rich ICT would have high levels of each factor and a lean ICT would have low levels of each. This hierarchy of richness describes the capability of an ICT to convey cues and facilitate shared knowledge understanding in a timely manner.

Social presence describes the degree to which the ICT allows the KT participants to feel psychologically close or present [27, 59]. The use of multiple, nonverbal communication channels and cues, as well as continuous feedback convey social presence. Furthermore, high social presence enables the conveyance of social influence and other symbolic content and social context cues, while those low in social presence filter out those cues. Richness and social presence are highly related [67].

Finally, both richness and social presence are highly similar to interactivity discussed in the sociology literature (c.f., [73]). This literature identifies several key characteristics of interactive communication that differentiate ICTs, e.g., the simultaneity and continuity of communication, the ability to interrupt or preempt, and the patterns of turn taking.

While media capacity theories allow for prescriptive theorizing about the fit between capabilities and tasks, when used to describe how individuals select ICTs, empirical results have been inconsistent. When tested on telephone and written communication, as examples, these theories have generally been supported (e.g., [57]). However, inconsistent empirical findings have been found with electronic mail and voice mail (e.g., [7, 25, 42]).

Fundamentally, theories that deal with ICT capabilities (e.g., richness), offer individual-level rational choice explanations of behavior. In practice, every individual will subjectively perceive these

capabilities based on his/her personal awareness of and experience with the ICT.

3.2 ICT social dynamic perspectives

In contrast to media capacity theories, social dynamic perspectives emphasize the collective character of ICT use, suggesting that KT participants will develop individual and shared beliefs about what an ICT is good for in the process of using it [3, 28, 42]. These perspectives, rather than focusing explicitly or solely on *capabilities*, begin to turn our attention to *purpose*, or the "meaning" of the ICT.

Social dynamic perspectives include structuration theory [18], social influence theory [26], social information processing theory [66], and TIP (time, interaction, and performance) theory [50]. Structuration theory [18] suggests that communication and ICT use "shape" each other as participants' selectively appropriate features in the context of evolving social structures. Social influence theory [28] attempts to identify social psychological processes that can be used to explain behaviors toward ICTs. Social information processing theory [66] asserts that some social information must be processed in order to develop interpersonal relations. However, it is not the amount of information processed in a single communication exchange that is important; rather, it is the accrual and processing of information over a series of exchanges that is important to relational development. TIP theory [50] emphasizes the temporal processes in group interaction and argues that groups and the technologies that support them cannot be disentangled from the surrounding social and organizational systems.

All of these perspectives emphasize the dynamic aspects of communication and meaning construction within the larger context of social and organizational structures. Interestingly, channel expansion theory (CET) [10] may also be considered a social dynamic perspective. Yet, unlike the above theories, Carlson and Zmud [10] focus on perception construction as a dynamic, experiential-based process. Specifically, they proposed and demonstrated (with email) that perceptions of richness can evolve as individuals acquire experiences with others, the organizational context and task, and the ICT itself.

In summary, media capacity and social dynamic theories offer alternative perspectives on ICT selection and use – respectively centering on capabilities and meanings. In the next section, we explore perspectives that bridge perceptions and meanings. Overall, we posit that KT participants will bring to the KT process previously formed, and likely intertwined perceptions and meanings.

4. Theoretical perspectives: Perceptions and meanings

Several researchers have noted that knowledge workers must make sense of and interpret their environment according to preexisting knowledge structures (c.f., [36, 54, 56]. For example, Weick [69, 71] describes sense-making as the process wherein knowledge workers interpret and give meaning to some environmental uncertainty – in our context, the selection and use of an ICT in the KT process.

Building upon sense-making, Orlikowski and Gash [54] describe how individuals hold frames of reference about events and objects within organizations and then give them meaning. Technology frames reflect the result of the interpretive process wherein users construct meanings around technology – in their study, a Lotus Notes® implementation. While clearly Lotus Notes® can be perceived in terms of capabilities (e.g., interactivity), Orlikowski and Gash found that users attached broader, or arguably higher level, meanings to the technology. As examples, frame domains that emerged included the nature of the technology, why it was introduced (i.e., the strategic drivers), and how the technology would alter work. Moreover, meanings differed significantly across stakeholder groups, e.g., managers, IT/IS, users.

Personal Construct Theory (PCT) [36] similarly constitutes an interpretive theory of human behavior. PCT suggests that individuals are constantly engaged in interpreting and reinterpreting their environment, building mental maps in order to make sense of it [8, 31, 43, 44]). For example, Reger et al. [56] draw upon PCT to explain why certain change initiatives fail. In PCT, individuals build a set of bipolar constructs as they have experiences [24]. These constructs represent the meanings created from individual interaction with the environment. Kelly [36] argues that not only are personal constructs created through interaction, but that an individual is free to choose the constructs attached to events and objects.

Based on the various theoretical perspectives discussed previously, for ICTs, we conclude that meaning reflects the idea conveyed by the ICT; perception reflects an awareness of the capabilities of the ICT. The two are related in that the ICT is “perceived” in terms of whatever “meaning” that a person applies to it [36, 39]. In turn, meanings can be altered through capability-based experience although changing sticky individual meanings is difficult process [36]. This recognized relationship may help bridge the perspectives of media capacity theories and social dynamic theories.

In the following section, to illustrate the processes of perception and meaning construction, we explore

the introduction of the telephone. Clearly, today, in most parts of the world, the telephone is commonplace, with its capabilities and varied purposes understood. However, when first introduced, sellers of the new technology had to persuade individuals to use it. In the late 1800s and first half of the 20th century, the Bell System not only had to demonstrate the telephone’s capabilities (relative to other means of communication) but also had to invent business and personal purposes *and* convince people that there were purposes, emphasizing the phrase “educating the public” [23:63].

5. The construction of meanings and perceptions: An illustrative example

In exploring the construction of perceptions and meanings as related to the telephone, it is important to recognize that the ability to travel and communicate across space fundamentally changed between 1850 and 1950: from horsepower to railroads and automobiles; from telegraphs to telephones [23:21]. At the turn of the last century, the telephone was largely a technical wonder. Since potential adopters’ had no prior knowledge of or experience with the telephone, early advertisements (ads)¹ often focused on describing the technical underpinnings of the telephone (see Figure 1). Over the next *several decades*, the Bell System (AT&T) sought to redefine the innovation from a technical wonder to a useful tool. In doing so, they sought to develop both perceptions of capabilities – relative to other existing communication options -- and meanings, i.e., creating the “idea” of the telephone by finding purposes. While the end goals are similar, on a relative basis, the pace of introduction and integration of today’s ICTs into everyday work and life is, seems astounding.

Figure 1. Ad emphasizing technical details



¹ Illustrations included may be found at: <http://shop.vendio.com/vintageads4u/category/4034/>

Early efforts, such as the 1910 one shown in Figure 2, also focused on developing perceptions of the telephone's capabilities. While not explicitly using the terminology of media capacity theories, this ad read: "By it [the telephone] the human voice – the truest experience of personality, ability, and character – is carried from place to place instantly and accurately ... all other means of communication are cold and colorless in comparison" (e.g., richness).

Figure 2. 1910 Ad emphasizing capabilities



While these efforts facilitated awareness, persuading people to use the telephone required not only describing and demonstrating capabilities, but also devising purposes (i.e., meanings) for the telephone. Vendors targeted businessmen first and most often, claiming the telephone would increase efficiency, save time, and even impress customers, such as the ad shown in Figure 3.

Figure 3. 1909 Ad emphasizing business purpose



The ad shown in Figure 4 provides an illustration of simultaneously facilitating the construction of

perceptions and meanings. This ad emphasized business purposes, but also capability of social presence, i.e., "As if across a desk".

Figure 4. Constructing capabilities and purposes



Interestingly, while the telephone reflected various business meaning (e.g., efficiency, connectedness, success, a way to impress customers, etc.), it held little meaning for the general public as it was regarded as an instrument for practical, business purposes. Thus, additional efforts emerged from the 1920s to 1940s to help construct "non-business" meanings for the general public. Figure 5 (emphasizing safety) provides an illustration of these efforts.

Figure 5. The telephone means safety



Increasingly, over several decades, the telephone took on more and more meanings – business innovativeness and competitiveness, sociability, family, safety, status symbol, success, etc. – driving adoption and use patterns in different ways for different users [23].

Examples of interesting, more recent ICT introductions include email, which largely derived early meanings from business purposes, and instant messaging (IM), where meanings evolved largely from the consumer/teen market. Interestingly, a survey conducted by the Pew Internet & American Life Project (2005)² revealed that US Internet users aged 12-17 prefer using instant messaging (IM) over email. Focus groups revealed the meanings that teens attached to email – email is something you use to talk to “old people”, institutions, or to send complex instructions to large groups. Conversely, IM means casual conversation, friends, and family. Clearly, these meanings influence selection and use by teens. It is only relatively recently that IM has emerged in the workplace for work-related purposes. Here, evidence suggests that the meaning of IM has expanded beyond purposes associated with informal interactions with friends and family to reflect business purposes, e.g., quick questions and clarifications, coordinating meetings [15], thus driving recent growth in business penetration³.

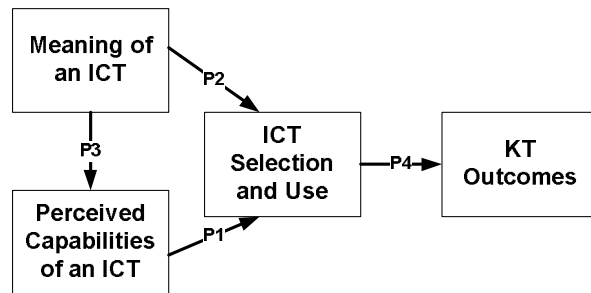
Arguably, and relative to other means of communication, the telephone, email, and IM can all be described in terms of their capabilities (e.g., social presence). But, as discussed, the meanings attached to each also likely play significant roles relative to subsequent behavior. Our discussion here is consistent with the strong and growing interest in understanding what technology means to individuals, and how these meanings influence needs and perceptual evaluations (e.g., ICT capabilities), ultimately leading to selection and use [3, 18, 48, 54, 64].

In the following section, we explore the implications of meanings and perceptions for KT, offering a research model and associated propositions.

6. KT Implications

In a virtual team setting, KT can be complicated by a variety of factors (e.g., geographical/temporal dispersion, organizational/cultural differences), particularly when ICTs are used as the primary means of communication. Based on prior research and our earlier discussions, we posit that ICT meanings not only influence selection and use, but also shape perceptions of capabilities. Moreover, we posit that (in)congruencies of either or both among KT participants may lead to selection and use patterns that have differential effects on KT outcomes. Figure 6 visually illustrates these relationships.

Figure 6. ICTs and KT Outcomes



Consistent with past research, we expect that perceptions of ICT capabilities (i.e., richness, social presence, interactivity) will influence selection and use in the KT process (c.f., [10, 13, 42, 47, 66, 73]). Stated formally:

P1: *Perceived ICT capabilities drive selection and use in the KT process.*

In addition, we note the limitations of perceptions to fully explain ICT selection and use [42]. Thus, based on past research, we also argue that the ICT meanings also influence selection and use. Importantly, we also posit that meanings serve as the foundation from which ICTs are evaluated and perceptions constructed. Thus, stated formally:

P2: *ICT meanings drive selection and use for the KT process.*

P3: *ICT meanings affect perceptions of ICT capabilities.*

Massey and Montoya-Weiss [47] proposed a relationship between perceptions of media utility and knowledge conversion outcomes. Drawing upon channel expansion theory and testing this proposed relationship, recent empirical research by Hasty et al. [32] showed that, during the KT process, participants evolve to congruent perceptions of the richness of various ICTs (i.e., IM, shared whiteboards, and IP voice). Moreover, results provided evidence that congruence in perceptions did, in fact, influence KT success – defined as a change in recipients’ knowledge. However, while congruence had a positive effect on KT success for two of the three ICTs in the study, congruence in IM perceptions had a negative effect. While their study focused solely on perceptions, we posit that the meanings participants attached to the various ICTs, particularly IM, likely played a role. As described earlier, IM may mean different things to different users. While they may come to shared perceptions of capabilities, they may not have possessed shared meanings as related to the ICT’s

² www.pewinternet.org/

³ www.primenewswire.com/newsroom/news.html?d=89532

purpose. Prior research in psychology has shown that an incongruence in meaning can negatively affect performance [60]. Understanding this may assist in explaining results that deviated from expectations. Thus, we posit that in the KT process, (in)congruence in meanings, as interpretations of ICT purpose, and perceptions, as evaluations of capabilities, will influence KT outcomes. Stated formally:

P4: *(In)congruence of ICT meanings and perceptions will affect KT outcomes through ICT use.*

While our model focuses on the relationship between ICTs and KT outcomes, we recognize that KT outcomes are not solely driven by ICTs; rather, they are enablers of the process. An array of other factors (e.g., content, knowledge type, experience, culture, incentives etc.) will also influence outcomes. Additionally, the dynamism of individual meanings and perceptions suggest feedback loops and reciprocal relationships that should be examined in future research. Given the increasing reliance on ICTs, particularly for dispersed KT, research is needed to further understand why and how ICTs are used in the KT process. In the next section, we discuss an agenda for future research.

7. Research directions

Our discussion of meanings and perceptions, leading to our research model and propositions related to KT raise many research questions. Multiple studies are needed to understand these complex phenomena. Our model can be examined using positivist and interpretivist research approaches [38].

A positivist approach would begin by substituting specific empirical indicators into the propositions to form testable hypotheses. Hypotheses could be tested in single or multiple snapshot views [41]. For example, Proposition 3 (P3) states that ICT meanings affect perceived ICT capabilities in the KC process. To specify a testable hypothesis, for example, the specific dimension of perceived capability that is of interest would need to be specified (e.g., social presence). Moreover, methods such as the repertory grid technique (see [24]) may be used to uncover various meanings attached to various ICTs. Selection and use can be measured objectively observed

Similarly, the point of Proposition 4 (P4) is that KT outcomes – manifested itself through changes in the knowledge or performance of the recipient(s) – will be influenced by congruence of meanings and perceptions. Here, subsets of P4 related to the links between congruence and KT outcomes could be

articulated as hypotheses. A study could involve the use of one ICT (e.g., email) and explore various configurations of congruence, i.e., ranging from full congruence to full incongruence, with various combinations in between. The study would include assessments of email meaning, measures of perceived capabilities, and measures of KT outcomes. For example, a sample hypothesis might include: “Congruence in meanings [of email] and perceptions of capabilities will positively influence KT outcomes”. Such studies will also lend insight into the relative influence of meanings and perceptions on ICT selection and use.

Whereas a positivist approach begins with theory and constructs, an interpretivist approach provides understanding of the complexities of the KT phenomena by examining the process theory tenets of our proposed research model [72], i.e., the social dynamic aspects of meaning and perception construction. Interpretivist data collection could entail longitudinal case studies so data collection and analysis can occur simultaneously. Analysis within and between cases could look for common patterns, events, and sequences of events that advance understanding regarding our model [38, 55].

Interpretive studies, coupled with positivist efforts, may also reveal the relative strength of meanings and perceptions over time. For example, as discussed earlier, much early effort was put forth to facilitate the construction of telephone meanings. Overtime, when an ICT becomes more “commonplace”, do meanings matter as much as perceptions of capabilities as related to communication tasks? Addressing this question in future research may lend valuable insights to organizations considering investments in emerging forms of communication, e.g., wikis, blogs, social networking, etc.

8. Conclusion

Management and deployment of knowledge-based resources are complex, strategic decisions. Although the benefits of knowledge transfer (KT) have been documented in many settings, much research remains to understand the factors that support or impede transfer. By enabling new ways of distributing work, technological advances have given rise to new organization forms, including distributed knowledge work [6, 34]. While many of the challenges of knowledge transfer (KT) have been acknowledged, the challenge of KT in distributed settings has received limited attention. Transferring knowledge among human entities that largely communicate electronically presents new challenges and avenues for research.

In this paper, we first explored alternative perspectives (i.e., media capacity theories, social dynamic theories) on information and communication technologies (ICTs) that may respectively help explain selection and use. However, our objective was to bridge these perspectives by conceptually examining meanings and perceptions, and their interrelationship. Our efforts were based on the premise that meanings reflect an interpretation of the purpose or idea of an ICT, while perceptions reflect an evaluation of its capabilities (i.e., richness, social presence, interactivity). Recognizing that today's organizations and knowledge workers are faced with a seemingly endless array of existing and emerging ICTs, for illustrative purposes, we also examined how meanings and perceptions were originally constructed around the telephone – today, a rather common and traditional ICT tool. Finally, we offered a research model and set of propositions that provide a foundation for future research.

In conclusion, since organizations must commit to a particular ICT infrastructure, a deeper understanding of the underlying reasons why ICTs are selected and used and how KT outcomes are influenced is essential. Without this understanding, investments may fall well short of desired returns.

9. References

- [1] M. Alavi and D. E. Leidner, "Knowledge management and knowledge management systems: Conceptual foundations and research issues," *MIS Quarterly*, vol. 25, p. 107, Mar 2001.
- [2] L. Argote and P. Ingram, "Knowledge transfer: A basis for competitive advantage in firms," *Organizational Behavior and Human Decision Processes*, vol. 82, pp. 150-169, 2000.
- [3] S. Barley, "Technology as an occasion for structuring: Evidence from observations of CT scanners and the social ordering of radiology departments," *Administrative Science Quarterly*, vol. 31, pp. 78-108, 1986.
- [4] R. J. Boland Jr., R. V. Tenkasi, and D. Te'eni, "Designing information technology to support distributed cognition," *Organization Science*, vol. 5, pp. 456-475, Aug 1994.
- [5] R. J. Boland Jr. and R. V. Tenkasi, "Perspective making and perspective taking in communities of knowing," *Organization Science*, vol. 6, pp. 350-372, Jul-Aug 1995.
- [6] M. Boudreau, K. D. Loch, D. Robey, and D. Straub, "Going global: Using information technology to advance the competitiveness of the virtual transnational organization," *The Academy of Management Executive*, vol. 12, p. 120, Nov 1998.
- [7] K. Burke and L. Chidambaram, "How much bandwidth is enough? A longitudinal examination of media characteristics and group outcomes," *MIS Quarterly*, vol. 23, pp. 557-580, 1999.
- [8] I. Burkitt, *Social selves: Theories of the social formation of personality*. London: Sage, 1991.
- [9] K. Carley, "Knowledge acquisition as a social phenomenon," *Instructional Science*, vol. 14, pp. 381-438, May 1986.
- [10] J. R. Carlson and R. W. Zmud, "Channel expansion theory and the experiential nature of media richness perceptions," *The Academy of Management Journal*, vol. 42, pp. 153-170, 1999.
- [11] H. H. Clark and D. Wilkes-Gibbs, "Referring as a collaborative process," *Cognition*, vol. 22, pp. 1-39, 1986.
- [12] C. D. Cramton, "The mutual knowledge problem and its consequences for dispersed collaboration," *Organization Science*, vol. 12, pp. 346-371, May-Jun 2001.
- [13] R. L. Daft and R. H. Lengel, "Information richness: a new approach to managerial information processing and organizational design " in *Research in Organizational Behavior*, B. Staw and L. Cummings, Eds. Greenwich, CT: JAI Press, 1984, pp. 191-233.
- [14] R. L. Daft, R. H. Lengel, and L. K. Trevino, "Message equivocality, media selection, and manager performance: Implications for information systems," *MIS Quarterly*, vol. 11, pp. 355-366, 1987.
- [15] H. de Vos, H. Hofte, and H. de Poot, "IM [@work]: adoption of instant messaging in a knowledge worker organisation," in *Proceedings of the 37th Hawaii International Conference on System Sciences*, 2004.
- [16] A. R. Dennis and S. T. Kinney, "Testing media richness theory in the new media: The effects of cues, feedback, and task equivocality," *Information Systems Research*, vol. 9, pp. 256-274, 1998.
- [17] A. R. Dennis and J. S. Valacich, "Rethinking media richness: Towards a theory of media synchronicity," in *32nd Hawaii International Conference on System Sciences*, 1999.
- [18] G. DeSanctis and M. S. Poole, "Capturing the complexity in advanced technology use: Adaptive structuration theory," *Organization Science*, vol. 5, pp. 121-147, 1994.
- [19] G. DeSanctis and P. Monge, "Introduction to the special issue: Communication processes for virtual organizations," *Organization Science*, vol. 10, pp. 693-703, Nov-Dec 1999.
- [20] D. Dougherty, "Interpretive barriers to successful product innovation in large firms," *Organization Science*, vol. 3, pp. 179-202, 1992.

- [21] T. Eid, "Forecast: Web Conferencing and Team Collaboration Software, Worldwide, 2005-2009 " Gartner Group G00128272, 2005.
- [22] L. Empson, "Fear of exploitation and fear of contamination: Impediments to knowledge transfer in mergers between professional service firms," *Human Relations*, vol. 54, p. 839, Jul 2001.
- [23] C. S. Fisher, *America Calling: A Social History of the Telephone to 1940*. Berkeley, CA: University of California Press, 1992.
- [24] F. Fransella, R. Bell, and D. Bannister, *A Manual for the Repertory Grid Technique*, 2nd ed. West Sussex: John Wiley & Sons, 2004.
- [25] J. Fulk and D. Ryu, "Perceiving electronic mail systems: A partial test of social information processing model of communication media in organizations," in *Annual Meeting of the International Communication Association* Dublin, Ireland, 1990.
- [26] J. Fulk, J. Schmitz, and C. W. Steinfield, "A social influence model of technology use," in *Organizations and Communication*, J. Fulk and C. W. Steinfield, Eds. Newbury Park, NJ: Sage Publications, 1990, pp. 117-140.
- [27] J. Fulk and B. Boyd, "Emerging theories of communication in organizations," *Journal of Management*, vol. 17, pp. 921-950, 1991.
- [28] J. Fulk, "Social construction of communication technology," *The Academy of Management Journal*, vol. 36, pp. 921-950, 1993.
- [29] J. Fulk and G. DeSanctis, "Electronic communication and changing organizational forms," *Organization Science*, vol. 6, pp. 337-349, 1995.
- [30] P. S. Goodman and E. D. Darr, "Exchanging best practices through computer-aided systems," *Academy of Management Executive*, vol. 10, pp. 7-18, May 1996.
- [31] J. Hassard, "FOCUS as a phenomenological technique for job analysis: Its use in multiple paradigm research (MPR)," *International Journal of Man-Machine Studies*, vol. 27, pp. 413-433, 1987.
- [32] B. K. Hasty, A. P. Massey, and S. A. Brown, "Role-based experiences, media perceptions, and knowledge transfer success in virtual dyads," *Group Decision and Negotiation*, vol. 15, pp. 367-387, 2006.
- [33] A. C. Inkpen and A. Dinur, "Knowledge management processes and international joint ventures," *Organization Science*, vol. 9, pp. 454-468, Jul-Aug 1998.
- [34] S. L. Jarvenpaa and D. E. Leidner, "Communication and trust in global virtual teams," *Journal of Computer Mediated Communication*, vol. 13, pp. 1-30, Jun 1998.
- [35] H. Karsten, "Converging paths to notes: In search of computer-based information systems in a networked company," *Information Technology & People*, vol. 8, pp. 7-34, Jan 1995.
- [36] G. A. Kelly, *The Psychology of Personal Constructs* vol. 1. New York: Norton, 1955.
- [37] D.-G. Ko, L. J. Kirsch, and W. R. King, "Antecedents of knowledge transfer from consultants to clients in enterprise system implementations," *MIS Quarterly*, vol. 29, pp. 59-85, Mar 2005.
- [38] A. S. Lee, "Integrating positivist and interpretive approaches to organizational research," *Organization Science*, vol. 2, pp. 342-365, Nov 1991.
- [39] N. Mackay, "Psychotherapy and the idea of meaning," *Theory & Psychology*, vol. 13, pp. 359-386, 2003.
- [40] A. Malhotra and A. Majchrzak, "Enabling knowledge creation in far-flung teams: Best practices for IT support and knowledge sharing," *Journal of Knowledge Management*, vol. 8, pp. 75-88, 2004.
- [41] M. L. Markus and D. Robey, "Information technology and organizational change: Causal structure in theory and research," *Management Science*, vol. 34, pp. 583-598, 1988.
- [42] M. L. Markus, "Electronic mail as the medium of managerial choice," *Organization Science*, vol. 5, pp. 502-527, 1994.
- [43] D. Marsden and D. Littler, "Exploring consumer product construct systems with the repertory grid technique," *Qualitative Market Research: An International Journal*, vol. 3, pp. 127-144, 2000.
- [44] D. Marsden and D. Littler, "Repertory grid technique: An interpretive research framework," *European Journal of Marketing*, vol. 34, pp. 816-834, 2000.
- [45] A. P. Massey and W. A. Wallace, "Understanding and facilitating group problem structuring and formulation: Mental representations, interaction, and representation aids " *Decision Support Systems*, vol. 17, pp. 253-274, Aug 1996.
- [46] A. P. Massey, M. M. Montoya-Weiss, C. Hung, and V. Ramesh, "Global virtual teams: Cultural perceptions of task-technology fit," *Communications of the ACM*, vol. 44, pp. 83-84, 2001.
- [47] A. P. Massey and M. M. Montoya-Weiss, "Unraveling the temporal fabric of knowledge conversion: A model of media selection and use," *MIS Quarterly*, vol. 30, pp. 99-114, 2006.
- [48] A. P. Massey, V. Khatri, and M. M. Montoya-Weiss, "Usability of online services: The role of technology readiness and context," *Decision Sciences*, vol. 32, pp. 277-308, 2007.

- [49] E. F. McDonough, K. B. Kahn, and G. Barczak, "An investigation of the use of global, virtual, and collocated new product development teams," *Journal of Product Innovation Management*, vol. 18, pp. 110-120, 2001.
- [50] J. E. McGrath, "Time, interaction, and performance (TIP): A theory of groups," *Small Group Research*, vol. 22, pp. 147-174, 1991.
- [51] G. H. Mead, *Mind, self, and society from the standpoint of a social behaviorist* Chicago: University of Chicago Press, 1962.
- [52] D. C. Mowery, J. E. Oxley, and B. S. Silverman, "Strategic alliances and interfirm knowledge transfer," *Strategic Management Journal*, vol. 17, pp. 77-91, 1996.
- [53] I. Nonaka, "A dynamic theory of organizational knowledge creation," *Organization Science*, vol. 5, pp. 14-37, Feb 1994.
- [54] W. J. Orlikowski and D. C. Gash, "Technological frames: Making sense of information technology in organizations," *ACM Transactions on Information Systems*, vol. 12, pp. 174-207, 1994.
- [55] G. Paré and J. J. Elam, "Using case study research to build theories of IT implementation," in *Information Systems and Qualitative Research*, A. S. Lee, J. Liebunau, and J. L. DeGross, Eds. London: Chapman & Hall, 1997, pp. 70-100.
- [56] R. K. Reger, L. T. Gustafson, S. M. Demarie, and J. V. Mullane, "Reframing the organization: Why implementing total quality is easier said than done," *The Academy of Management Review*, vol. 19, pp. 565-584, 1994.
- [57] G. S. Russ, R. L. Daft, and R. H. Lengel, "Media selection and managerial characteristics in organizational communications," *Management Communication Quarterly*, vol. 4, pp. 151-175, 1990.
- [58] S. Sarker, S. Sarker, D. Nicholson, and K. D. Joshi, "Knowledge transfer in virtual systems development teams: An exploratory study of four key enablers," *IEEE Transactions on Professional Communication*, vol. 48, pp. 201-218, 2005.
- [59] J. A. Short, F. Williams, and B. Christie, *The Social Psychology of Telecommunications*. New York, NY: Wiley, 1976.
- [60] J. R. Stroop, "Studies of interference in serial verbal reactions," *Journal of Experimental Psychology*, vol. 18, pp. 643-662, 1935.
- [61] S. Stryker, *Symbolic Interactionism: A Social Structural Version*. Menlo Park, CA: Benjamin Cummings, 1980.
- [62] G. Szulanski, "Exploring internal stickiness: Impediments to the transfer of best practices within the firm," *Strategic Management Journal*, vol. 17, pp. 27-43, Winter 1996.
- [63] G. Szulanski, "The process of knowledge transfer: A diachronic analysis of stickiness," *Organizational Behavior and Human Decision Processes*, vol. 82, pp. 9-27, 2000.
- [64] F. B. Tan and M. G. Hunter, "The repertory grid technique: A method for the study of cognition in information systems," *MIS Quarterly*, vol. 26, pp. 39-57, 2002.
- [65] D. R. Vogel, M. van Genuchten, D. Lou, S. Verveen, M. van Eekhout, and A. Adams, "Exploratory research on the role of national and professional cultures in a distributed learning project," *IEEE Transactions on Professional Communication*, vol. 44, pp. 114-125, 2001.
- [66] J. Walther, "Interpersonal effects in computer-mediated interaction," *Communication Research*, vol. 19, pp. 52-90, 1992.
- [67] J. Webster and L. K. Trevino, "Rational and social theories as complementary explanations of communication media choices: Two policy-capturing studies," *Academy of Management Journal*, vol. 38, pp. 1544-1572, 1995.
- [68] K. E. Weick and M. G. Bougon, "Organizations as cognitive maps: Charting ways to success and failure," in *The Thinking Organization*, H. Sims Jr. and D. Gioia, Eds. San Francisco, CA: Jossey-Bass, 1986.
- [69] K. E. Weick, "Enacted sensemaking in crisis situations," *Journal of Management Studies*, vol. 25, pp. 305-317, 1988.
- [70] K. E. Weick, "Cognitive processes in organizations," in *Information and Cognition in Organizations*, L. Cummings and B. Staw, Eds. Greenwich, CT: JAI Press, 1990.
- [71] K. E. Weick, *Sensemaking in Organizations*. Thousand Oaks, CA: Sage, 1995.
- [72] B. C. Wheeler, "NEBIC: A dynamic capabilities theory for assessing net-enablement," *Information Systems Research*, vol. 13, pp. 125-146, 2002.
- [73] Zack, "Interactivity and communication mode choice in ongoing management groups," *Information Systems Research*, vol. 4, pp. 207-239, 1993.
- [74] U. Zander and B. Kogut, "Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test," *Organization Science*, vol. 6, pp. 76-92, 1995.