Integrated Customer-Focused Knowledge Portals: Design Challenges and Empirical Approaches

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ABSTRACT

Knowledge Portals (KPs) are highly integrative Knowledge Management Systems (KMS) that promise to synthesize widely dispersed knowledge and to interconnect individuals by functioning as a 'one-stop knowledge shop'. Yet, in practice, KPs face major challenges, which are for the most part due to the intricacies of knowledge exchange being subjected to multi-faceted individual and social factors. At the same time, growing anecdotal evidence from case studies indicates KPs' enormous potential. This paper makes an effort to more distinctly conceptualize KPs and emphasize a KP's role to unify networking and repository KMS features. The paper develops three major challenges to successful KP deployment, namely(1) knowledge integration, (2) sufficient participation, and (3) favorable organizational culture and validates these as applicable to KP through a review of 42 empirical papers. The paper concludes with suggestions towards a set of design principles for KP.

INTRODUCTION

The knowledge-based view of the firm (Penrose, 1995) describes knowledge as a key resource for organizations, suggesting that organizations can be profitably viewed as knowledge systems (Alavi & Tiwana, 2002;Gelbuda & Soerensen, 2005;Tsoukas, 1996). As knowledge *per se* resides solely in the minds of individuals, an organization members' collective knowledge is highly distributed, often sub-optimally allocated, not readily available where it is needed, and only arduously translated into competitive advantage. The problem of dispersed knowledge

suggests the value of the process of knowledge integration, which denotes the combination and systemization of individuals' knowledge into valuable situation-adapted knowledge (Alavi & Tiwana, 2002). Better application of knowledge can lead to higher competitiveness, either by means of direct customer integration or of increasing customer focus through more purposeful knowledge reuse. However, achieving knowledge integration is a difficult task for organizations.

To address this problem, some organizations have developed Knowledge Portals (KPs) that attempt to provide a 'one-stop knowledge shop', that is, a single point of access to the knowledge available in an organization (or even beyond), reprocessed in such a way that it is useful and applicable for a knowledge-seeking user. Yet, knowledge is quite an intractable resource, and implementers of KPs struggle both to get individuals to contribute their knowledge and to provide knowledge seekers with useful reprocessed knowledge. Organizations have thus struggled to fully obtain value from KPs and frequently experienced disappointments with the modest outcomes that KP deployments yielded. The goal of this paper is to investigate the major design challenges that organizations face in their efforts to deploy KPs in the business context and to suggest ways to address these challenges.

We organize the remainder of this paper as follows. We first offer a conceptualization of KPs as combining features of knowledge repositories and of electronic networks and thus moving them away from a notion confining them to visualizing web pages. We next identify three main design challenges in the context of deploying KPs in the organizational context, namely (1) knowledge integration, (2) sufficient participation, and (3) a favorable organizational culture. These challenges are then validated and their applicability explored through a more systematic review of findings from a literature review of 42 empirical KP-related studies. Finally, we close with a discussion of the impact of the identified design challenges on principles of KP design and implementation.

The contributions of the paper are threefold: first, a definition and description of knowledge portals; second, identification of key challenges in KP implementation; and third, identification of possibly helpful implementation strategies. The definition of a KP can be helpful as a foundation for future research on this fast developing topic, while the identified challenges and strategies may be of use to managers seeking to implement KPs in their organizations.

BACKGROUND: AN INTRODUCTION TO KNOWLEDGE PORTALS

In this section, we develop a definition and description of a KP starting from basic definitions and the literature. Drawing on the literature, we define *knowledge* as a justified belief that potentially increases an entity's ability to take effective action (Alavi & Leidner, 2001). In this view, knowledge is possessed and exercised by persons (Fahey & Prusak, 1998) and is derived from flows of information mentally processed relative to existing beliefs and commitments (Nonaka, 1994). It is subjective (Durcikova & Gray, 2009;Okhuysen & Eisenhardt, 2002), dynamic (Desouza & Awazu, 2005; Gelbuda & Soerensen, 2005), not self-contained (Tsoukas, 1996), socially constructed (Alavi & Leidner, 2001; Griffith et al., 2003;Wasko&Faraj, 2000) and affective (Hwang & Kim, 2007;Malhotra, 2003;Malhotra&Galletta, 2005).

The definition of knowledge adopted implies a distinction between information and knowledge. Knowledge *per se* only exists in an individual's mind; it becomes information once it is communicated (Alavi & Leidner, 2001; Fahey & Prusak, 1998). *Knowledge artifacts* refer to physically-stored information such as documents, records, or videos (Davenport et al., 1998; Davenport & Prusak, 1998). *Knowledge management* refers to the processes of "identifying and leveraging the collective knowledge in an organization to help the organization compete" (Alavi & Leidner, 2001: 113), addressing knowledge creation, knowledge storage and retrieval,

knowledge transfer and knowledge application (Alavi & Leidner, 2001; Pentland, 1995). Knowledge management is complicated by the nature of knowledge and the need to address it indirectly through knowledge artifacts.

We define a *portal* as an information system designed to provide secure, customizable, personalizable, integrated access to dynamic information from a variety of sources, in a variety of source formats, wherever it is needed (Detlor, 2004; Smith, 2004). An important aspect of a portal is the repository of information to which it provides (ubiquitous) access. Its gateway character is commonly realized in the form of a web site (Smith 2004). In organizational contexts, portals are, hence, embedded in an organization's intranet, meaning that integration of Internet access and functionalities is a supplementary feature but not a necessity.

Finally, we define a *Knowledge Portal* (KP) as a portal that purposely supports and stimulates knowledge transfer, knowledge storage and retrieval, knowledge creation and knowledge application (i.e., the processes of knowledge management), thus addressing inefficiency and ineffectiveness in the use of organizational knowledge. Our definition of a KP differs from previous authors (e.g., Carlsson, 2003;Chau et al., 2006; Desouza & Awazu, 2005; Firestone & McElroy, 2003; Lee et al., 2009; Staab & Maedche, 2001; Tsui, 2004) who have each introduced rather specific concepts to describe this term. For instance, Detlor (2004), Firestone (2002), and Priebe and Pernul (2003) consider KPs to be the next level of portal sophistication, subsequent to information portals, often explicitly or implicitly referring to a hierarchical distinction of information and knowledge. In our view, the key to KPs is their focus on knowledge integration (Lee et al., 2009; Ryu et al.,2005). Knowledge integration is important because it is believed to lead to higher competitiveness (Alavi & Tiwana, 2002; Grant, 1996; Patnayakuni et al., 2006) by transforming specific knowledge into collectively valuable knowledge (Okhuysen & Eisenhardt,

2002). KPs thus specifically address organizational capabilities derived from organizational learning (Ryu et al., 2005).

Several types of KPs can be distinguished. One differentiator is the source of the knowledge provided, internal vs. external. Internal KPs are defined as processing only knowledge originating from members of the organization, regardless of the knowledge seekers. Consider, for example, customer self-service applications like online help services, frequently asked questions sites, and simple information provision about a company. These might be integrated into a portal as a service that external users can access, but if they are not open to external contribution, we classify this KP as internal, as the information is provided from internal sources.

External KPs involve knowledge flows from external sources towards the internal sphere (note that most of the time external KPs will also address internal knowledge flows). External KPs may directly integrate, for example, customers', suppliers', or business partners' knowledge. Such integration will fundamentally be required if knowledge demand implied by the organization's product or service does not directly correlate with the boundaries of the organization's knowledge (Grant, 1996). A special area of application where crucial user groups are particularly multi-faceted is customer-support knowledge, which can come from customers, competitors, public sources and partners, regularly leading to a cross-functional approach (Davenport & Klahr, 1998; McKemmish et al., 2009).

Due to more flexible technical solutions, a gradual inclusion of both knowledge flow directions is taking place in implementation (Terra & Gordon, 2003). However, a whole new world of issues arises for external KPs, including questions about appropriate standards (Kim et al., 2007; King et al., 2002), knowledge leakage from internal to external (Brown & Duguid, 2001), multi-lingual environments (Wingyan et al., 2004) and knowledge politics (Davenport & Klahr, 1998)

that arise for supply chain and other inter-organizational cooperative knowledge management and KMS. Because of this additional complexity, in this paper, we focus on issues involved only in implementing *internal KPs* processing knowledge originating from members of the organization for the purpose of *greater competitiveness* (in whatever form). The additional challenges of external KP is a topic for future research.

As a background to our discussion of problems in implementing KP, we now discuss typical components of a KP, dividing them into repository- and network-oriented functionality. Our definition thus goes beyond views of a portal as just web access to data. We cover in turn the repository access, knowledge organization system, search, applications and services, collaboration and communication tools, personalization and roles and the interface.

Repository Access. Integrating the access to an organization's repositories of information and knowledge artifacts is a key task for KPs (Collins 2003; Terra & Gordon 2003) in the context of knowledge integration. We refer to this functionality of KP as the repository focus, as the emphasis is on access to repositories of knowledge artifacts that convey knowledge in codified form. Types of repositories can be as simple as plain databases (Carlsson 2002) sophisticated KRs, meaning a repository that stores, indexes, and synthesizes knowledge artifacts (e.g., codified best practices), so as to promote knowledge reuse (Gray & Durcikova 2005).

Knowledge Organization Systems. Knowledge organization systems constitute the most essential component of a KP, as they address knowledge and information integration by proliferating and structuring meta-information for underlying repositories and networks (Collins 2003). Under this broad concept, one can subsume the more specific content management systems, which offer the possibility of classifying and (re-)codifying knowledge artifacts from various sources in an

integrative manner (Benbya et al. 2004). Other important sub-categories are document and project management systems, as well as knowledge maps (Lee et al. 2009).

Simple components of knowledge organization systems can be registers and categorizations (Collins 2003). Registers are lists or indexes of information, for instance, comprising glossaries, dictionaries, or authority files (Collins 2003) that facilitate a common understanding and language. Categorizations are relevant in particular for facilitation of the knowledge retrieval process, and are important no matter how powerful the search engine is (Garud & Kumaraswamy 2005). They comprise, for example, subject headings or content separation schemes (Collins 2003).

On a more complex structural level, KPs include taxonomies. First of all, like all portals, a KP regularly contains an organizational information taxonomy (Detlor 2004) (or 'business information directory', Dias 2001), representing a metadata catalog prompted by the different publishing units and ideally comprising all codified information existing in the organization (Dias 2001). In addition, a KP can integrate a variety of other taxonomies, such as simple thesauri or more complex ontologies. The latter, by giving information a semantic underlay (Collins 2003; Liming et al. 2007,), can enhance the search function (Horrocks 2008) and other functions of the system (Benbya et al. 2004). The purpose of taxonomic meta-information is to provide context and to indicate where knowledge or knowing individuals can be found (Alavi & Leidner 2001; Liming et al. 2007). Thus, organization systems contribute to navigation and coordination, thereby enhance knowledge retrieval, storage and transfer processes.

Search. For all KMS, search represents an essential part of the knowledge retrieval process. Basic categories are standard, concept-based and metadata search (Collins 2003). The integration of varying sources and evolving insights into search is a particularly important issue for KPs

(Terra & Gordon 2003). Search is intertwined with the KP interface, as it is mostly implemented as a static feature (Collins 2003), requiring adapted and contextualized display (Detlor 2004).

Applications and Services. A KP delivers integrated access to different software tools and a variety of services to facilitate knowledge work (Goodwin 1987). Exemplary feature categories are multi-repository support, process and web service applications (Collins 2003). Multi-repository support refers to an application that overlies a variety of other repositories thus providing an integrated point of access for the separate systems. One can consider the integration of applications and the integration of repositories as complementary parts of a holistic integration of existing IT (Carlsson 2002). The main issue is the visual integration of different interface structures without losing the applications' functionality or giving up on the KP's established logic of use.

Collaboration and Communication Tools. Up until now, we have focused on the repository-oriented functions of KP. However, as some types of knowledge are most readily transferred through direct interaction, KPs can offer media to connect people, mostly in the form of online collaboration (Benbya et al. 2004). We refer to this focus of a KP as the network focus, as it relates to the system's capability to enhance the communications network of participants. Work-group productivity tools and specialized transactional functions make an effort to foster and facilitate collaboration and communication by providing a convenient platform (Detlor 2004). Available tools are extremely versatile, among them email, shared document writing spaces, net meetings, video conferences, (Lee et al. 2009) etc. One notable example is semantic blogging, considered especially pertinent for more decentralized knowledge management (Cayzer 2004).

Personalization and Roles. By definition, portals offer customization and personalization, being important means to reach a higher degree of structure and usefulness of retrieved information

and distinguishing it from common web services (Benbya et al. 2004). To do so, user and role management, which recognizes and administrates user and access (Carlsson 2002), is required (Collins 2003). Roles can defined according to tasks (Patnayakuni et al. 2006), with the purpose to pre-determine knowledge flows towards user groups (Carlsson 2002) as specifically as possible. Role management can be considered the groundwork of ‘tailored’ personalization.

There are two possibilities for supplementary personalization. On the one hand, the KP will allow the user to organize knowledge flows (Collins 2003), providing them with means to avert an overflow of information and save browsing time (Terra & Gordon 2003). This is referred to as explicit personalization or (user) customization. Otherwise, the KP can personalize the web page itself, based on rules or user behavior (Benbya et al. 2004; Forsati & Meybodi 2010), that is, implicit personalization.

Interface. Finally, a KP’s interface is the point of visual contact with the user. It must offer direct manual access to relevant features. Explicit personalization, for example, must be provided for shown content, but also for the visual representation itself (Smith 2004). The interface’s key function is visual integration, having to be geared to the user experience in order to present all functionalities: for example, enabled by knowledge organization systems, it complements content pages by content relevant pages, thereby helping the user to interpret the main body (Collins 2003).

In summary then, a KP is portal (i.e., as an information system designed to provide secure, customizable, personalizable, integrated access to dynamic information from a variety of sources) that purposely supports and stimulates the processes of knowledge management (knowledge integration in particular) in order to improve the efficiency and effectiveness of the use of organizational knowledge. KP functionality includes repository-oriented functionality,

such as repository access, knowledge organization system, search, and applications and services, as well as network-oriented collaboration and communication tools, together with personalization and roles and a common interface.

MAJOR CHALLENGES FOR KNOWLEDGE PORTAL DESIGN

Having presented the concept and functionality of knowledge portals, we next discuss three main challenges for the successful deployment of internal KPs: (1) achieving knowledge integration, (2) encouraging sufficient participation, and (3) having a favorable organizational culture. While the challenge to enhance knowledge integration seems most distinctive of KPs, achieving sufficient participation and a favorable organizational culture must not be neglected as knowledge exchange and integration rely on individual and social factors.

Knowledge Integration

As a portal's primary purpose is to be a gateway to various underlying sources, KPs have to provide mechanisms to integrate extensive and dispersed knowledge in various facets and from various sources. Several authors (e.g., Chau et al., 2006; Davenport et al., 2008; Teo, 2005) used the term 'One-Stop Shop' to describe this purpose. However, the right balance between centralization (One-Stop Shop) and decentralization (dispersed knowledge) in knowledge management initiatives is difficult to achieve (Garud & Kumaraswamy, 2005). Knowledge integration and comprehensive knowledge supply involve not only pooling of knowledge, but also providing it in a coordinated and meaningful form (Lee et al., 2009).

A variety of factors can complicate knowledge integration. The diversity of the knowledge itself poses challenges.It is in the nature of systems that they are able to deal best with codified

knowledge (Desouza et al. 2008; Grant 1996), which derives from the contribution of explicit knowledge or of tacit knowledge that has been explicated. However, explication and codification of knowledge are complex processes (Davenport & Prusak 1998,). They are bound to cause codification costs and to yield knowledge losses (Alavi & Leidner 2001; Grant 1996; von Hippel 1994; Zack 1999), "divorc[ing] the codified knowledge from its context" (Garud & Kumaraswamy 2005: 29). The severity of codification rising with the degree of tacitness (Alavi & Tiwana 2002), it can generally be tough or impossible for individuals to communicate tacit knowledge (Alavi & Leidner 2001; Morris 2001; Zhang 2006) and it is hardly generalizable (van Baalen et al. 2005).

Whereas repository-focused KMS refer to asynchronous explicit KT (e.g., through KRs), network-related KMS focus on tacit knowledge. They provide individuals either with ample opportunity to codify their knowledge or with means for direct electronic communication or contact (Zack 1999).Such an approach can support a diversity of transfer mechanisms, among them the noted storytelling approach (Davenport & Prusak 1998; Morris & Oldroyd 2009) or other best practice sharing (Garud & Kumaraswamy 2005; Voelpel et al. 2005). Mostly, practical experience will be sequentially recorded and recommended (Morris 2001), but, as it is subjective and rooted in action, deriving finite insights can be intricate. This will be especially significant if participants are only loosely tied together and have rather specific (e.g., project-oriented) tasks, overlapping only in general terms (Alavi & Leidner 2001; van Baalen et al. 2005).

A second problem arises from the diversity of potential participants in a KP. For example, different mechanisms and incentives must be applied to integrate customers' knowledge (Patnayakuni et al., 2006), as customers' knowledge will be even more dispersed than organizational knowledge (Davenport & Klahr, 1998) (as noted, we are focusing this review on internal KP in part for this reason). Issues of missing structure, relevance, reliability and quality

might become even more pressing (McKemmish et al., 2009). KPs face the demanding task not only to collect customer knowledge, but also to reprocess it into a valuable condition (Davenport &Jarvenpaa, 2003; McKemmish et al., 2009). Furthermore, regulatory boundaries constrain full exploitation of all collected information (Davenport & Jarvenpaa, 2003). Timeliness aggravates the challenge. Finally, considering the issue of leakage, KPs need to balance the fact that knowledge that is easily available for customers is also available for competitors (Davenport &Jarvenpaa, 2003).

Sufficient Participation

A second key issue is that KPs need to induce sufficient participation to be successful. KPs are useful only as far as knowledge or information is contributed and absorbed by participants (Bock et al., 2006; Durcikova & Gray, 2009; He & Wei, 2009; Kankanhalli et al., 2005a; Kulkarni et al., 2006; Malhotra & Galletta, 2004; Zimmer et al., 2007). As information systems, KPs are subject to the usual range of information systems adoption factors, such as perceived usefulness or ease of use. However, KPs face several additional issues in encouraging participation. We will discuss two in particular: motivation for contribution and knowledge quality.

First, KPs must address the users' motivation to contribute knowledge to the system. Contributing to the system is bound to impose costs, which consist of time, effort, and expected follow-up requests (Kankanhalli et al., 2005a). A further factor is the possible loss of power when a contributor's personal knowledge base becomes less unique, leaving them less irreplaceable and perhaps less valuable after their contribution (Davenport & Prusak 1998; Kankanhalli et al. 2005a). This concern is critical especially in the codification of tacit knowledge, as, in this case, individuals disclose more personal knowledge and partly give up

their status (Morris 2001). As they partially avoid codification, network-related KMS should be less susceptible to this issue (Tiwana & Bush 2005).

For the organization to benefit, participants may need to be motivated to add their knowledge even if it is does not appear economically rational from their individual point of view (Kankanhalli et al., 2005a; Lin & Huang, 2008). The calculation is comparable to a public good dilemma, as sharing of knowledge will make it available to others, irrespective of a direct compensatory reciprocal contribution (Bock et al. 2005; Marks et al. 2008).

One motivation might arise out of reciprocity, denoting the expectation of being able to seek knowledge later on as compensation for an own contribution (He & Wei, 2009). Moreover, based on the conviction that people share knowledge for altruistic pro-social reasons (Wasko & Faraj, 2000), the joy of helping others while expecting nothing or very little concrete in return could be a solid motivator for users to contribute (Kankanhalli et al., 2005a). Finally, while the mere seeking of a social relationship is unlikely to be a participant's prior concern, the wish to belong to a community might matter (Alavi et al., 2005; Wasko & Faraj, 2000; Zimmer et al., 2007).

As regards the hierarchical level of goal attainment to which remuneration should be bound, the literature tends to argue in favor of incentives relating to team, unit, or organization goals as opposed to individual bonuses (Gupta & Govindarjan, 2000; O'Dell & Grayson, 1998; Quigley et al., 2007; van Alstyne, 2005). Generally, competition within a group appears to hamper knowledge sharing, whereas the combination of individual and group incentives might be more rational (Siemsen et al., 2007).

A second problem in encouraging KP use is knowledge quality. To keep knowledge quality on a high level, validation and maintenance processes are needed. Although it is the perceived

information quality that counts, that is “the extent to which an individual believes that a repository provides precise and accurate content that meets his or her knowledge needs” (Durcikova & Gray, 2009: 84), validation processes are frequently implemented without reference to participants’ beliefs, perceptions, and behaviors (Durcikova & Gray, 2009). On the one hand, participants might be less motivated if their contributions are reedited, rejected, or delayed (Alavi et al., 2005). On the other hand, KPs must possibly guarantee high degrees of objectiveness and reliability for other participants through stringent validation (Durcikova & Gray, 2009). Assuring usability and usefulness of KPs needs continuous efforts. However, knowledge management related approaches to continuance are still under-employed (He & Wei, 2009). Furthermore, KP may require constant maintenance to ensure the continued quality and relevance of the knowledge contained.

Favorable Organizational Culture

A final concern is that KPs need to be accompanied by a favorable socio-cultural environment. Organizational culture describes a holistic arrangement of structures (Bock et al., 2005), to which organization members refer when they act or seek to generate action from others (Bates & Amundson, 1995), including rules, practices, behaviors, values, preferences, and attitudes (Kulkarni et al., 2006), marked by varying degrees of visibility (Alavi et al., 2005; Leidner & Kayworth, 2006) and little direct alterability (Bock et al., 2005). Organizational values play a particularly important role in IS research (Leidner & Kayworth, 2006).

Organizational culture may impact the success of a KP by impacting individuals’ willingness to share data. For example, a culture may prompt knowledge hording: a competitive culture purportedly leads to individuals keeping their knowledge for themselves (Kulkarni et al. 2006; van Alstyne 2005). Contrariwise, a supportive culture may lead to a state of less self-interest, in

which the individual no longer considers the organization's knowledge as distinct from their own and even feels the moral obligation to share (Voelpel et al. 2005; Wasko & Faraj 2000), based on the internalization of shared values (Goodman & Darr 1998; Malhotra & Galletta 2005). Of course, organizations succeed in making their culture part of the individual's mindset to quite unequal extents (Gupta & Govindarajan 2000; Voelpel et al. 2005) and these efforts are subjected to external and overall economic factors as well (Goodman & Darr 1998; Voelpel et al. 2005). Beside internalization and identification, organizational culture can create strong social norms, which might significantly limit perceived costs of compliance to the system and reduce knowledge hoarding (Malhotra & Galletta 2005). Finally, as with other information systems, senior management support plays a pivotal role for successfully deploying KPs (Benbya et al., 2004; Davenport & Prusak, 1998).

EVIDENCE FROM THE LITERATURE

As stated above, the goal of this paper is to investigate the major design challenges that organizations face in their efforts to deploy KPs in the business context and to suggest ways to address these challenges. While there has been a fair amount of prior research on KPs, challenges and best practices for implementation are still emerging. We therefore examined the three challenges noted above through a systematic survey of published reports of KP and KP implementations.

Specifically, we present an extensive literature review and analysis of empirical KP studies. The review was conducted from July to November 2009. Using ABI/INFORMS and EBSCO via our university library, we first conducted keyword-based searches on the terms “knowledge portal”, “knowledge management system”, “knowledge network”, “knowledge and intranet”,

"knowledge integration", "knowledge repository", and "knowledge platform" for the years 1988 to 2008. We then selected those papers that presented empirical studies. In addition, we took advantage of our reading of the theoretical knowledge management literature to identify additional journal papers that presented empirical studies. Note that not all of the papers necessarily described themselves as about knowledge portals; a paper might describe a system that fit our definition of a KP (given above) while using different words (e.g., a KMS that offers a web interface). Following this approach, we ended up with 42 studies that provide a good sample of work on this topic. The 42 papers reviewed are presented in Tables 1-4 in the Appendix.

In a second step, we closely analyzed the 42 studies. We first grouped the papers into four categories by the nature of the system described. We found 11 studies that apply directly to KPs described as such (Appendix Table 1), six that describe repository aspects of what we classified as KPs (Appendix Table 2), twelve that discuss the networking aspects of KPs (Appendix Table 3), and another thirteen that are generally KMS-related and discuss both networking and repository aspects (Appendix Table 4).

We next coded each paper for the design challenges identified. The coding was done based on the categories of challenges identified above. All three rounds of coding were done by a master and a PhD student, supervised and double checked by the academic mentor (one of the authors). There were few disagreements about the coding; any disagreements were discussed and resolved. A summary of the papers and the codes are given in Table 1 below.

Table 1. Summary of Codes Applied to Papers Reviewed

Category	#	Methods	KI	SP	OC
1. Directly KP related	11	Case study (9), survey (2)	11 (100%)	10 (91%)	10 (91%)
2. Repository related	6	Survey (4), field study (1), lab study (1)	6 (100%)	5 (83%)	5 (83%)
3. Networking-related	12	Survey (9), field study (2), lab study (1)	7 (58%)	8 (67%)	8 (67%)
4. Generally KMS related	13	Survey (8), field study (2), case study (1), lab study (1), simulation (1)	5 (35%)	11 (69%)	10 (69%)
Total	42		29	34	33

KI = Knowledge Integration; SP = Sufficient Participation; OC = Organizational Culture

A first observation is that KPs appear to be a relatively new topic of study, as suggested by the large number of case studies in the first category. By contrast, surveys were the most common method applied in the other three topics. Broader and more generalizable empirical research in the form of field studies and surveys on KPs is called for. Second, the first two categories are notable for their inclusion of all three sets of concerns. In contrast, studies in the final two groups that include network-related KP (i.e., with a focus on communication) less often address concerns of knowledge integration. This difference in focus is consistent with our emphasis on KP as enabling knowledge integration.

TOWARDS KP DESIGN PRINCIPLES

In this final section, we discuss possible design principles to address the challenges noted above. Ryu et al. (2005) developed a theoretical model aimed at sensitizing scholars and practitioners

about necessary antecedents of knowledge transfer and knowledge integration in a KP[1]. The authors weigh the productivity of learning processes against environmental factors and thereby assess under which circumstances individuals would invest in knowledge transfer through a KP. This individual investment leads to optimal outcomes in particular if opportunity costs of learning are low, if the acquired knowledge is effective, if a person's initial knowledge base is elevated, if others' knowledge is copious, and if learning from others through communication (as opposed to imitation) is productive. Elevated opportunity costs will occur during economically successful times, implying that resources might be spent for greater effect elsewhere rather than for the KP-enabled knowledge transfer.

Their work is further complemented by Markus et al. (2002), who developed an IS design theory for a type of problems different from common decision-making, denoted as 'emergent knowledge processes'. These processes refer to highly combinative IS-enabled work patterns, marked by indeterminate 'deliberations', the need for integration of general, specific, and tacit knowledge, and high unpredictability of user groups and work contexts. The authors empirically validate that these kinds of work patterns implicate more complex process, user, and knowledge requirements and that KMS need to integrate repository and networking features. Obviously, this is exactly what a KP seeks for. Thus, it could possibly reconcile the disagreement among knowledge management scholars whether a "high-tech 'contentful' system […] or […] a low-tech communication type system" (Markus et al., 2002: 205) is needed for practical KM. What is more, these findings suggest that, if organizations do not deal with emergent knowledge processes, the integrative approach of a KP might be less appropriate already at the outset. In simplified terms, if an organization only requires straightforward top-down information

1 Ryu et al. conceive KPs as sophisticated "enterprise information portals", but it transpires that their portal concept is largely equivalent to the (slightly broader) conception of KPs in this work.

dissemination or if it is involved in purely creative ‘brain-storming’ work, it might only require either a repository KMS or a networking KMS, but not an integrative KP. Hence, KP design must not lapse into the promises of knowledge sharing and knowledge integration or adopt any of the proposed measures in an undifferentiated manner.

Eventually, KP design must be adapted to a ‘systems perspective’ (Garud & Kumaraswamy, 2005). Owing to the strong interlacements of comprehensive KPs with various actualities of an organization on all levels, KP design must attempt to grasp this distributed knowledge system as a whole. It ought to bear in mind the intractability of knowledge, just as well as its potential value when it is managed considerately and flexibly.

CONCLUSIONS

Based on an examination of empirical studies, we suggest that KPs can be powerful tools to support knowledge integration. However, KPs commonly face three major challenges when deployed; they need to address knowledge integration, induce participation and establish a favorable organizational culture. Many of the reviewed measures to KP design and deployment are marked by high resource intensity and outcome uncertainty. Overall, the reviewed studies reflect a common conundrum for organizations: either they also address tacit knowledge in a long-term focused, interaction-related, and laborious manner within collocated organizational settings, or they content themselves with more frugal explicit knowledge integration, which may still yield timely results and be adequate for extremely dispersed settings (Desouza et al., 2008). Similarly Garud and Kumaraswamy (2005: 26-27) point to “…a key paradox of knowledge management: that an organization’s knowledge system contains seeds of its own destruction. Leave it alone, and virtuous knowledge circles may never materialize. Intervene to couple

processes at and across different levels, and vicious circles are bound to emerge." To understand these processes, broader and more generalizable empirical research in the form of field studies and surveys on KPs is required.

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APPENDIX

Table 1. Empirical Studies of KPs

Author(s) (Year)	Field of Research	Method	Subjects and Location	Major Findings	KP Design Challenges
Braganza et al. (2009)[2]	Knowledge management through intranet-based system	Case study	Schlumberger (oilfield services operator) Internationally operating firm	- 30 attributes for knowledge transfer through intranet-based KMS could be found for Schlumberger. - Numerous benefits of the intranet-based could empirically be validated and the theory-practice gap be limited. - The intricacies of KMS implementation reaching beyond issues of technology could be depicted and illustrated. - The relevance of metric systems for knowledge management activities is underscored. - Knowledge integration is a matter of repositories and of people and it concerns all phases of the knowledge life cycle.	- Knowledge integration - Participation - Organizational culture
Chau et al. (2006)	Design of a scientific web portal	Case study	20 Nano science researchers, results from NanoPort implementation Internet portal	- In the design of a web KP, various technologies should be considered and integrated. - A layered structure provides best flexibility results for implementation, maintenance, and updating.	- Knowledge integration
Garud, Kumaraswamy (2005)	Mutually causal relations of knowledge processes	Case Study	InfoSys (software services operator) Internationally operating firm	- Knowledge management initiatives can have the opposite than intended outcome, as knowledge processes frequently are dynamic and mutually causal, such that they enforce each other. - A coherent KMS must trade off centralization and decentralization. - It is important to create unique taxonomies and 'knowledge hierarchies' in knowledge repositories. - Human capital must be explicitly accounted for. - Knowledge management in an organization is a holistic and highly dynamic endeavor, having to adapt quickly and flexibly. - Knowledge management will evoke vicious and virtuous processes due to diverse mutually causal processes.	- Knowledge integration - Participation - Organizational culture

2 Does not explicitly refer to KPs, but to web-based or intranet-based KMS.

Lee et al. (2009)	Relative importance of KP features for research and developme nt teams	Survey	142 members of research and development teams from research institutes Korean public organization	- A KP needs to be integrated with project processes. - Perceived relevance of KP features is contingent on team tasks, such that organizations should dispose of means to align team structures. - The need for collaborative and communication features increases with team size. - Team tasks on the commercialization level value coordination higher than collaboration and communication. - The need for connection and communication features is contingent on team member dispersion. - Team member dispersion has no effect on the need for collaboration and coordination. - The need for content, customization, and community features is not contingent on dispersion or team size.	- Knowledge integration - Participation - Organiza-tional culture
McKemmis h et al. (2009)	Consumer empowerm ent through KPs	Case study	Breast cancer knowledge online portal project	- Subjectivity and context of knowledge are the most pressing attributes a KP must account for. - User-sensitivity and personalization are particularly important features of a KP; they ought to be enabled by user information-needs analysis, knowledge-domain mapping, metadata modeling. - Quality elements should be included in resource discovery metadata schema.	- Knowledge integration - Participation - Organiza-tional culture
Schwabe, Salim (2002)	KP at Xerox Brazil	Case study	Xerox Brazil Brazilian subsidiary of internationall y operating firm	- In the design of a KP, object oriented hypermedia design represents an adequate method to address the dynamics of knowledge. - KP design for sound codification, reviewing, and access comprises information structuring, navigation structuring, and visualization. - A business game can be an adequate test and communication measure prior to KP implementation.	- Knowledge integration - Participation - Organiza-tional culture

Teo (2005)	Knowledge manage-ment and KPs at Singapore Housing and Developme nt Board	Case study	Singapore Housing and Development Board Singapore-based public organization	- Management must realize the value of knowledge sharing and codification. - In particular, management support and the encouragement of (informal) knowledge sharing are important. - Subsidiary organizational support factors are incentives, recognition, and reward. - Public organizations, tending to adhere to bureaucratic structures, can particularly benefit from management-supported KM-initiatives. - A phased approach to knowledge management and KPs is recommendable. - Knowledge domain experts are important for KM. - People and culture issues prevail over IT problems.	- Knowledge integration - Participation - Organiza-tional culture
Teo, Bing (2008)	Task-technology fit for KPs	Survey	154 consultants from consulting firms Chinese firms	- Tacitness of demanded knowledge hampers KP usage. - Task interdependence is not significantly related to KP usage. - KP usage is positively related to performance.	- Knowledge integration - Participation - Organiza tional culture
Van Baalen et al. (2005)	Role of KPs for networks of practice	Case study	Agro-logistics Platform Dutch public and private organizations, external internet users	A KP can impact knowledge sharing of loosely coupled network members. Fragmented awareness and urgency are necessary conditions for the emergence of a network of practice. A knowledge broker is an appropriate means to bridge structural holes in a NoP by decreasing cognitive distance. Tacit knowledge is difficultly or not at all shared in a KP-enabled network of practice. Knowledge sharing in a KP-enabled network of practice is not reliant on reciprocity. Knowledge sharing in a KP-enabled network of practice is capable to permeate different structural levels.	- Knowledge integration - Participation - Organiza-tional culture

Voelpel et al. (2005)[3]	Web-based knowledge management tool at Siemens	Case study	116 interviews with high-level knowledge management representatives from varying organization 35 interviews with and observation of Siemens representatives, company data Internationally operating firms	- KMS deployment can be separated in 5 phases; conception, rollout, momentum building, expansion, consolidation. - KMS deployment is subjected to favorable external conditions that free resources for investments without concrete Return on Assets. - KMS implementation must be carried out forcefully and accompanied by sufficient initial communication and marketing effort. - User need assessment ought to be extensive. - In extremely distributed contexts, KMS implementation must be accompanied by training and promotion measures. - Intrinsic motivation accounts strongly for participation. - Organizational and national cross-cultural barriers can be severe barriers to knowledge sharing and must be addressed explicitly. - Individual rewards fundamentally foster participation. - Reward systems that uniquely focus on knowledge contribution intensity will lead to cross-culturally unleveled effects and quality issues.	- Knowledge integration - Participation - Organizational culture
Zhang (2006)	Wonder's KP	Case study	Wonder, IS development firm Chinese firm	- Mere confrontation with different units' issues can enhance knowledge sharing-friendly organizational culture. - Tacit knowledge exchange is intricate and only occurs on an occasional basis when enabled only digitally through a KP. - Users' perceptions and usage strongly varies contingent on collaborative spirit. - As KP design requires great flexibility, in-house solutions are preferable if possible.	- Knowledge integration - Participation - Organizational culture

3 Does not explicitly refer to KPs, but to web-based or intranet-based KMS.

Table 2. Repository-Related Empirical Studies

Author(s) (Year)	Field of Research	Method	Subjects and Location	Major Findings	KP Design Challenges
Bock et al. (2006)	Norms and knowledge seeking	Survey	Only abstract available	- Social norms positively affect knowledge seeking behavior both directly and through deteriorating the negatively perceived future obligation. - Social norms might deteriorate perceived usefulness of knowledge repositories.	- Knowledge integration - Participation - Organizational culture
Desouza et al. (2006)	Explicit knowledge sourcing	Survey	175 employees of software engineering firm Internationally operating firm	- Simplicity is correlated to intention of explicit knowledge sourcing. - Perceived relative advantage determines explicit knowledge sourcing. - Risk aversion accounts for less explicit knowledge sourcing.	- Knowledge integration
Durcikova, Gray (2009)	Validation processes and knowledge contributing in knowledge repositories	Survey	118 customer service analysts U.S.-based firm	- Transparency of validation processes fosters knowledge contribution and perceived knowledge quality. - Validation duration has no effect on knowledge contribution but negatively influences perceived knowledge quality. - Restrictiveness of validation processes positively affects perceived knowledge quality but negatively affects knowledge contribution. - Perceived knowledge quality negatively affects knowledge contribution.	- Knowledge integration - Participation - Organizational culture
Kankanhalli et al. (2005a)	Antecedents of contributions to knowledge repositories	Field study (interviews, survey)	Interviews: senior executives from 17 organizations; survey: 150 knowledge management practitioners from 10 organizations Singapore-based public organizations	- Loss of knowledge power is not a significant detriment to knowledge contributions to know ledge repositories. - Perceived codification effort is limited by generalized trust. - Perceived codification effort is not contingent on pro-sharing norms and identification. - Organizational reward affects contribution positively directly and contingent on identification. - Image building is no motivator for contributions to knowledge repositories. - Under conditions of strong pro-sharing norms, the need for reciprocity is lessened. - Self-efficacy and enjoyment of helping others strongly counts as contribution catalyst.	- Knowledge integration - Participation - Organizational culture

Kankanhalli et al. (2005b)	Antecedents to seeking from knowledge repositories	Survey	160 knowledge management practitioners of 8 government-related organizations from 6 industries Singapore-based public organizations	- Perceived output quality of knowledge repositories is a predictor for knowledge seeking from knowledge repositories. - For low task tacitness, KR availability strongly determines knowledge seeking from it. - Under conditions of high task interdependence, incentive availability is a predictor of knowledge seeking from knowledge repositories.	- Knowledge integration - Participation - Organizational culture
Poston, Speier (2005)	Impacts of content ratings and validity on knowledge sourcing	Laboratory study	Experiment 1: 51 undergraduate students; experiments 2-4: 108 undergraduate students Midwestern U.S.-based university	- The degree to which content ratings reflect information quality determines information seeking, in turn influencing decision-making quality. - High quality anchoring occurs with high validity ratings, low quality anchoring with low validity ratings; some raters adjust away from anchors. - Decision-making quality is highest for anchoring on high validity and lowest for anchoring on low validity without adjustment. - While collaborative filtering accounts as acredibility filter, number of raters and rater expertise do not.	- Knowledge integration - Participation - Organizational culture

Table3. Networking-Related Empirical Studies

Author(s) (Year)	Field of Research	Method	Subjects and Location	Major Findings	KP Design Challenges
Chiu et al. (2006)	Social capital and social cognition in virtual communities	Survey	310 virtual community members of BlueShop Taiwanese virtual IT community	- Community-related outcome expectations determine knowledge sharing behavior in virtual communities, whereas personal-related ones do not. - Social ties, reciprocity, and identification increase knowledge sharing in virtual communities, whereas knowledge quality does not. - Trust and common languages do not have an impact on knowledge sharing behavior in virtual communities.	- Participation - Organizational culture
Cummings (2004)	External knowledge sharing of work groups and structural diversity	Field study (records, interviews, survey)	182 work groups of Fortune 500 telecommunications company Internationally operating firm	- Intra-group and external knowledge sharing positively affect group performance. - Influence of external knowledge sharing on performance is greater if groups are more structurally diverse.	- Knowledge integration
Hansen et al. (2005)	Inter-subset knowledge sharing	Survey	121 new product development teams from 27 subsidiaries of high-tech firm Internationally operating firm	- Density and frequency of intra-team relations negatively affects inter-subsidiary knowledge transfer. - Network range positively affects inter-subsidiary knowledge transfer. - Inter-subsidiary relation strength increases search costs but not knowledge transfer costs. - Perceived inter-subsidiary competition increases knowledge transfer costs. - Inter-subsidiary relation strength decreases knowledge transfer costs for tacit knowledge.	- Knowledge integration - Participation - Organizational culture
Levin, Cross (2004)	Dyadic knowledge transfer in social networks	Survey	127 employees, 3 firms from 3 industries U.S.-based, British, and Canadian firms	- Strong ties account for knowledge transfer but are mediated by trust. - Strong ties do not account for knowledge transfer of distinct knowledge type. - Under constant conditions of trust, weak ties account more strongly for knowledge transfer.	- Knowledge integration - Participation - Organizational culture
Lin, Lee (2006)	Socio-technical factors and knowledge sharing	Survey	154 senior executives from various backgrounds Taiwanese firms	- Managers having a positive perception of knowledge sharing are more likely to encourage it. - Pro-social organizational climate enhances knowledge sharing. - IT support has no significant effect on knowledge sharing.	- Participation - Organizational culture

Patnayakuni et al. (2007)	Integrative practices and knowledge integration across boundaries	Survey	Mid-level managers from IS departments in 110 randomly selected firms	- Knowledge integration across knowledge boundaries improves IS development performance. - Formal and informal organizational integrative practices enhance the integration of specialized knowledge within and across subunits. - The positive influence of formal and informal integrative practices on IS development performance is partially mediated by knowledge integration.	- Knowledge integration
Reagans, McEvily (2003)	Network cohesion and range and knowledge transfer	Survey	102 employees of research and development firm Midwestern U.S.-based firm	- Social cohesion facilitates knowledge transfer. - Network range facilitates knowledge transfer. - Tie strength is not predictive for the ease of transferring different types of knowledge. - Tacit knowledge is harder to transfer than explicit knowledge under conditions of constant tie strength.	- Knowledge integration - Participation - Organizational culture
Robert et al. (2008)	Social capital and knowledge integration in digitally enabled teams	Laboratory study	172 junior-level business school students in 46 teams U.S.-based universities	- Knowledge integration in teams is promotive to team performance. - Social capital has a strong influence on knowledge integration in teams. - Structural and cognitive capital play an increased role in digitally enabled teams.	- Knowledge integration
Sarker et al. (2005)	Antecedents of knowledge transfer in virtual teams	Survey	96IS development students from 12 teams U.S.-based and Norwegian universities	- Knowledge transfer in virtual teams is contingent on the contributor's credibility and their intensity of participation. - Knowledge transfer in virtual teams is not contingent on the contributor's capability.	- Knowledge integration
Tiwana, Bush (2005)	Continuance in expertise-sharing networks	Survey	122 members of 4 expertise-sharing networks Internet networks	- Postadoption irretrievable investments in expertise-sharing networks are constituted of relational capital and reputation. - Personalization has a negative effect on continuance intention. - Personalization has the strongest effect on continuance intention, followed by user satisfaction, relational capital, and reputation.	- Participation - Organizational culture
Wasko, Faraj (2005)	Impact of social capital on knowledge contribution in electronic networks of practice	Field study (usage data)	173 participants of electronic network of practice of legal professional association U.S.-based association	- Perceptual increase of professional reputation is a knowledge contribution antecedent. - There is weak evidence that people who enjoy helping others contribute more useful knowledge. - Intrinsic motivators only weakly influence knowledge contribution behavior. - Social capital influences contribution behavior, most significantly structural capital. - Relational capital has no effect on knowledge contribution behavior in networks of practice.	- Participation - Organizational culture

Zboralski (2009)	Antecedents of knowledge sharing in communities of practice	Survey	122 members of 36 communities of practice within multinational firm Internationally operating firm	- Community leaders and management support predict interaction quality. - Interaction is driven by personal profit, mainly derived from intrinsic motivators. - Individuals participate if it helps their current projects, networking, and career progress. - Passing on knowledge and knowledge sharing as such are not objectives of members of communities of practice. - Individual motivation does not predict interaction quality.	- Participation - Organizational culture

Table 4. General KMS-Related Empirical Studies

Author(s) (Year)	Field of Research	Method	Subjects and Location	Major Findings	KP Design Challenges
Alavi et al. (2005)	Influence of organizational culture on KMS usage and deployment	Case study	High-tech firm Internationally operating firm	- Local values will lead to unleveled usage of standardized KMS. - Diverse features of KMS will be used according to embedded cultural values. - Cultural differences will evoke differences between individual and organizational outcome of KMS usage. - In the presence of multiple cultures within one firm, bottom-up and top-down processes are likely to occur simultaneously.	- Knowledge integration - Participation - Organizational culture
Benbya (2006)	Antecedents of KMS effectiveness	Field study (firm records, interviews, survey)	10 interviews with knowledge managers from 10 knowledge-intensive firms, survey forwarded to subject matter experts (number not specified) Silicon Valley, U.S.-based firms	- Trust does not account as KMS usage or quality factor. - Senior management support fuels KMS usage both directly and contingent on identification. - Socialization fuels the interrelation of management support and identification. - Socialization has no effect on KMS usage. - KMS integration is a strong predictor for KMS usage and quality, yet it is a major challenge. - KMS accessibility is a strong predictor of KMS usage and quality, even more so on condition of KMS integration. - Knowledge quality leads to usage and perceived benefits.	- Participation - Organizational culture
Bock et al. (2005)	Antecedents of knowledge sharing	Survey	154 knowledge and information managers from 30 public organizations in 16 industries Korean public organizations	- Extrinsic rewards are counter-productive to knowledge sharing intention. - Reciprocity is decisive for knowledge sharing. - Subjective norms have positive impact on knowledge sharing intention and attitude. - Fairness, innovativeness, and affiliation as aspects of organizational climate account for subjective norms and positive knowledge sharing intention. - Knowledge sharing ought not be forced or mandated.	- Participation - Organizational culture

He, Wei (2009)	Antecedents of continuous knowledge contributing and seeking	Field study (survey, KMS usage data)	161 knowledge contributors, 201 knowledge seekers from 3 units of IT company Internationally operating	- Habit strongly moderates both KMS usage intention and factual usage. - Organizational conditions tend to affect knowledge contributing more strongly than knowledge seeking (in particular, management support). - Social relationships play a role not only for knowledge contribution but also for knowledge seeking. - Knowledge growth does not account as a motivator for knowledge seeking behavior (in a corporate setting). - Reciprocity does not account as a contribution antecedent.	- Knowledge integration - Participation - Organizational culture
Hwang, Kim (2007)	Internalization and identification in knowledge sharing	Survey	411 undergraduate students Northern U.S.-based university	- Internalization and identification strongly account for electronic knowledge sharing. - Collectivistic culture is fully mediated by internalization and identification.	- Participation - Organizational culture
Janz, Prasarnphanich (2009)	Autonomy of teams in cooperative learning and knowledge integration	Survey	206 IS development workers from 38 teams and 13 productand service-related Fortune 500 companies U.S.-based and Canadian firms	- Autonomy of teams accounts for higher levels of cooperative learning. - Cooperative learning can be divided in three subcategories (group process, promotive interaction, and positive interdependence), having different results on fundamental goals of work satisfaction and performance. - Positive interdependence accounts for satisfaction, group process for work performance.	- Knowledge integration
Kulkarni et al. (2006)	KMS success model	Survey	111 midlevel managers enrolled in MBA program at large urban university U.S.-based university	- KMS quality and knowledge content quality are determinants for KMS usage. - Enhanced supervisors, coworkers, leadership, and incentive enhance KMS usage both directly and indirectly (directly for incentive and leadership). - Overall user satisfaction with KMS (itself determined by KMS and content quality) positively affects KMS usage. - Perceived usefulness of knowledge sharing enhances KMS user satisfaction.	- Knowledge integration - Participation - Organizational culture
Lin, Huang (2008)	Social cognitive / task technology fit for KMS	Survey	192 IS employees from various hierarchical backgrounds and industries Taiwanese firms	- Task interdependence is positive related to KMS usage. - Task tacitness is negatively correlated to task-technology fit. - Personal outcome expectations are positively correlated to KMS usage. - KMS self-efficacy strongly accounts both for KMS usage and outcome expectations.	- Participation - Organizational culture

Malhotra, Galletta (2005)	Influence of user commitment on volitional IS adoption and usage	Survey	179 respondents, participants of collaborative IS in healthcare organization Midwestern U.S.-based firm	- A model of volitional IS usage behavior comprising internalization, identification, and compliance (i.e., user commitment) as influence factors beside system quality can explain participation decisions. - User commitment influence usage intention directly during usage phase and indirectly via user attitude during adoption phase; internalization and identification have positive effects, compliance a negative one. - Perceived ease of use accounts indirectly for system adoption decision via the user's attitude - Perceived usefulness predicts system adoption and usage intention and is continuously enhanced by identification and internalization.	- Participation - Organizational culture
Marks et al. (2008)	Managerial prompting	Laboratory study	76 undergraduate students from 2 universities U.S.-based universities	- Repeated managerial prompting leads to an increase in knowledge sharing.	- Participation - Organizational culture
Patnayakuni et al. (2006)	Knowledge integration and process formalization in IS development	Survey	Representatives from 60 organizations being clients of operating software vendor firm	- Collaboration integrating tacit knowledge positively impacts systems development performance. - Explicit knowledge integration across different phases of the systems development process positively impacts performance. - Formalization of processes (establishing routines and discipline) accounts for performance gains. - Effects of collaborative exchange are positively/of explicit knowledge integration are negatively moderated by the formalization.	- Knowledge integration
Quigley et al. (2007)	Motivational factors for dyadic knowledge sharing	Computer-based simulation	Undergraduate students, 120 participants U.S.-based Mid-Atlantic university	- Knowledge sharing can be better determined if norms and incentives are conceived interactively. - Isolated incentives cannot account for knowledge sharing; group incentives are more adequate than individual incentives; combination of incentives with norms has strongest impact on knowledge sharing. - Knowledge sharing accounts for personal goal-setting and thus performance.	- Participation - Organizational culture
Siemsen et al. (2007)	Incentives and knowledge sharing	Survey	280 respondents from 4 organizations (private and public) U.S.-based organizations	- Optimal incentive-setting is contingent on given linkages between workers. - In case of knowledge linkages, individual and group incentives are not antithetic but complementary for optimal outcome.	- Participation