KNOWLEDGE PORTALS: COMPONENTS, FUNCTIONALITIES, AND DEPLOYMENT CHALLENGES

Completed Research Paper

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Abstract

Knowledge Portals (KPs) are highly integrative Knowledge Management Systems (KMSs) that promise to synthesize widely dispersed knowledge and to interconnect individuals in order to provide a 'one-stop knowledge shop'. Yet, KPs face major challenges in practice, as the intricacies of knowledge exchange are subject to varied individual and social factors. At the same time, growing anecdotal evidence from case studies indicates KPs' enormous potential. In this paper, we take some initial steps towards a theory for KPs that more distinctly conceptualizes KPs and emphasizes a KP's role to unify networking and repository KMS features. We describe three major challenges to successful KP deployment: (1) sufficient contribution, (2) favorable organizational culture, and (3) knowledge integration—and validate these as applicable to KPs through a review of 42 empirical papers.

Keywords: Knowledge Portal, Knowledge Management System, Deployment Challenges

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 and Tiwana 2002; Gelbuda and Soerensen 2005; Tsoukas 1996). However, as knowledge *per se* resides solely in the minds of individuals, the collective knowledge of an organization's members is highly distributed, often sub-optimally allocated and not readily available where it is needed, and thus 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 to make it available as valuable situation-adapted knowledge (Alavi and Tiwana 2002), leading to higher competitiveness, e.g., by increasing customer focus through more purposeful knowledge reuse (Markus 2001). However, achieving knowledge integration is a difficult task for organizations. Accordingly, knowledge management has become an active area for information systems (IS) researchers.

To address the problem of knowledge integration, some organizations have developed Knowledge Portals (KPs). KPs are a type of Knowledge Management System (KMS) that strive 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. As a motivation for such a system, consider that a large company many have hundreds or even thousands of separate KMSs, not to mention thousands of knowledgeable employees potentially available to share their experiences. It can be a challenge to find a relevant system or person, much less to find relevant knowledge and to integrate diverse sources. Yet, knowledge is quite an intractable resource, and implementers of all sorts of KMSs struggle both to get individuals to contribute their knowledge and to provide knowledge seekers with useful reprocessed knowledge. Organizations have thus faced difficulty to fully obtain value from KPs and frequently experienced disappointments with the modest outcomes that KP deployments have yielded. But without a clear definition of KPs and a better theory about their expected effects on knowledge integration, IS researchers have little advice to offer.

The goal of this paper is to take some initial steps towards a theory that more distinctly conceptualizes KPs. We organize the remainder of this paper as follows. First, we define and conceptualize KPs as combining features of knowledge repositories and of electronic networks and thus move them away from a notion confining them to visualizing web pages. We identify three main challenges in the context of deploying KPs in the organizational context, namely (1) sufficient contribution, (2) a favorable organizational culture, and (3) knowledge integration, offering a set of hypotheses about the successful deployment of KPs. For the purposes of our theorizing, the outcome variable of concern is knowledge reuse; that is, a successful KP is one that is used and that actually provides useful knowledge to users. These challenges are then validated and their applicability explored through a review of findings from a literature review of 42 empirical KP-related studies.

Definition of a Knowledge Portal

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

In this definition, knowledge *per se* only exists in an individual's mind (Alavi and Leidner 2001; Fahey and Prusak 1998). *Knowledge artifacts* refer to physically stored information such as documents, records, or videos in a system (Davenport et al. 1998; Davenport and Prusak 1998) from which knowledge might be derived. *Knowledge management* refers to the processes of "identifying and leveraging the collective knowledge in an organization to help the organization compete" (Alavi and Leidner 2001: 113, after von Krogh 1998) addressing knowledge creation, knowledge storage and retrieval, knowledge transfer and

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

Knowledge Management Systems (KMSs) are systems that manage or provide access to knowledge artifacts. Knowledge can come from various sources, internal and external to the organization. Some KMSs process only knowledge originating from members of the organization, regardless of the knowledge seekers; examples are customer self-service applications like online help services, frequently asked questions sites, and simple information provision about a company. These might provide a service that external users can access, but as they are not open to external contribution of knowledge artifacts, we classify these as internal, as the information is provided from internal sources.

KMSs may also involve knowledge flows from external sources towards the internal sphere, 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 and 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 and Gordon 2003). However, a whole new world of issues arises for external KMSs, including questions about appropriate standards (Kim et al. 2007; King et al. 2002), knowledge leakage from internal to external (Brown and Duguid 2001), multi-lingual environments (Wingyan et al. 2004), and knowledge politics (Davenport and Klahr 1998).

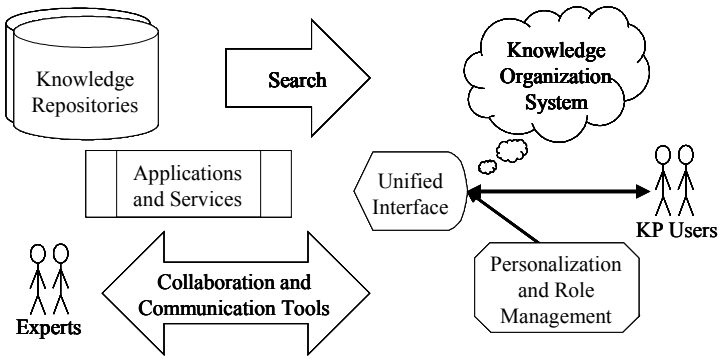
We define a *portal* as a system designed to provide secure, customizable, personalizable, and integrated access to dynamic information from a variety of sources, in a variety of source formats, wherever it is needed (Detlor 2004; Smith 2004). One important aspect of a portal is the repository of information to which it provides (ubiquitous) access. In addition, a portal includes personalization and role management and a common interface that integrates the diverse functionality. 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.

We then define a *Knowledge Portal* (KP) as a type of portal that purposely supports and stimulates knowledge transfer, knowledge storage and retrieval, knowledge creation, knowledge integration, and knowledge application (i.e., the processes of knowledge management) by providing access to relevant knowledge artifacts. Repository-oriented components and functionalities of a KP include a knowledge organization system, repository access, search, and applications and services. In addition to the repository-oriented functionality of KPs, such a portal must also offer network-oriented components and functionalities. Some types of knowledge are most readily transferred through direct interaction between a knowledge seeker and another knowledgeable individual. To that end, a KP also provides functionalities to identify and connect users based on their expertise, such as collaboration and communication tools. We discuss each of these components and functionalities in more detail in the following section.

Our definition of a KP differs from those made by previous authors (e.g., Carlsson 2003; Chau et al. 2006; Desouza and Awazu 2005; Firestone and McElroy 2003; Lee et al. 2009; Staab and 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 contrast, in our view, the key to KPs is their focus on knowledge integration (Lee et al. 2009; Ryu et al. 2005), the so called one-stop shop (e.g., Chau et al. 2006; Davenport et al. 2008; Teo 2005). Knowledge integration is important because it is believed to lead to higher competitiveness (Alavi and Tiwana 2002; Grant 1996; Patnayakuni et al. 2006) by transforming specific knowledge into collectively valuable knowledge (Okhuysen and Eisenhardt 2002) and to address organizational capabilities derived from organizational learning (Ryu et al. 2005). However, such a KP is successful only to the extent that it affects knowledge reuse, that is, people use it and find useful knowledge, thus motivating our theorizing.

Components and Functionalities of a Knowledge Portal

To make our definition of a KP more concrete as a basis for our discussion of problems in deploying KPs, we now discuss typical KP components and the repository- and network-oriented functionalities they provide. Such a definition is necessary to ensure awareness and consistent usage of KP terms among researchers. (We apply the description in this way in the following section.) Our definition goes beyond views of a portal as just web access to knowledge artifacts. We cover in turn the knowledge organization system, knowledge repositories/repository access, search, applications and services, collaboration and communication tools, personalization and role management, and the interface, as shown in Figure 1.



Boxes indicate the major components of a KP. Broad arrows indicate directions of knowledge flow, labeled with the system functionality that supports that flow.

Figure 1. Components and Functionalities of a Knowledge Portal

Knowledge Organization Systems. Knowledge organization systems constitute the most essential component of KPs, as they address knowledge and information integration by structuring meta-information for the underlying repositories and networks (Collins 2003). Under this broad concept, we 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 and Kumaraswamy 2005). They comprise, for example, subject headings or content separation schemes (Collins 2003). On a more complex structural level, knowledge organization systems 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 can enhance the search function (Horrocks 2008) and other functionality of the system (Benbya et al. 2004) by giving information a semantic underlay (Collins 2003; Liming et al. 2007). The purpose of taxonomic meta-information is to provide context and to indicate where knowledge or knowing individuals can be found (Alavi and Leidner 2001; Liming et al. 2007). Thus, organization systems contribute to navigation and coordination, thereby enhance knowledge retrieval, storage and transfer processes.

Knowledge Repositories/Repository Access. Integrating access to knowledge repositories is a key functionality for KPs (Collins 2003; Terra and Gordon 2003) in the context of knowledge integration. We

refer to this functionality of KPs as the repository focus, as the emphasis is on access to repositories of knowledge artifacts that convey knowledge in codified form. Repositories can be as simple as plain databases (Carlsson 2002) or more sophisticated, meaning repositories that store, index, and synthesize knowledge artifacts (e.g., codified best practices), so as to promote knowledge reuse (Gray and Durcikova 2005; Markus 2001). As we noted above, a large organization may have hundreds or even thousands of such repositories, making it valuable to provide more streamlined access.

Search. Search represents an essential functionality for the knowledge retrieval process, making a search engine a necessary component of a KP. 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 and Gordon 2003). The search engine is intertwined with the KP interface; 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), such as 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. In addition to the repository-oriented functionality discussed above, KPs offer collaboration and communication tools to connect people (Benbya et al. 2004), thus enabling direct transfer of knowledge. This network focus relates to the system's capability to enhance the communications network of participants. Workgroup productivity tools and specialized transactional functionality make an effort to foster and facilitate collaboration and communication by providing a convenient platform (Detlor 2004). Available tools are versatile, among them email, shared document writing spaces, net meetings, and video conferences (Lee et al. 2009). One notable example is semantic blogging, considered especially pertinent for more decentralized knowledge management (Cayzer 2004).

Personalization and Role Management. 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 users and access (Carlsson 2002), is required (Collins 2003). Roles can be 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. KPs may allow the users to organize knowledge flows (Collins 2003) providing them with means to avoid an overload of information and save browsing time (Terra and Gordon 2003). This functionality is referred to as explicit personalization or (user) customization. Alternatively, KPs can personalize the web page based on rules or user behavior (Benbya et al. 2004; Forsati and Meybodi 2010), which is called implicit personalization.

Unified Interface. Finally, a KP's interface is the point of visual contact with the user. It must offer direct and unified access to relevant features. Explicit personalization, for example, must be provided for displayed content, but also for the visual representation itself (Smith 2004). The key function of the unified interface 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).

Challenges for KP Deployment

Having presented KP components and functionalities, we now discuss three main challenges for the successful deployment of KPs. By successful we mean that the system achieves knowledge reuse, i.e., users use the system and find useful knowledge. There is a substantial literature on technology adoption that is potentially relevant to the question of successful KP deployment. For example, factors such as perceived

usefulness or top management support are undoubtedly as relevant for KPs as for other systems. The resulting challenge is to identify factors that are specific to KPs, either novel factors or particular influences on generic factors. We consider factors related to the system, the individual user, the organizational context of use and the knowledge itself.

Drawing on the KMS and KP literature discussed above, we identify three key challenges: (1) encouraging sufficient contribution, (2) having a favorable organizational culture, and (3) achieving knowledge integration. We present factors related to each of these challenges as a series of hypotheses with the intent to guide future research and system development.

Sufficient Contribution

A first key issue is that KPs, like all KMSs, are useful only as far as knowledge or information is contributed by participants (Bock et al. 2006; Durcikova and Gray 2009; He and Wei 2009; Kankanhalli et al. 2005a; Kulkarni et al. 2006; Malhotra and Galletta 2004; Zimmer et al. 2007). Contributing to a system is bound to impose costs, e.g., time, effort, and expected follow-up requests (Kankanhalli et al. 2005a). A factor unique to KMSs is the possible loss of power when contributors' personal knowledge base becomes less unique, leaving them less irreplaceable and perhaps less valuable after their contribution (Davenport and Prusak 1998; Kankanhalli et al. 2005a). We therefore propose:

H1: The more users consider knowledge to be personally valuable, the less likely they are to contribute it to a KP.

Given the costs of contributing, both actual and perceived, participants need motivations to add their knowledge to a repository, as it may not appear economically rational from their individual point of view, i.e., the individual costs may seem to outweigh the actual or potential benefits (Kankanhalli et al. 2005a; Lin and Huang 2008). The calculation is comparable to a public goods 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).

Considering benefits from contributing, we expect motivation for contribution to arise first out of reciprocity, denoting the expectation of being able to seek knowledge later on as compensation for an own contribution (He and Wei 2009). We therefore propose:

H2: The more a user uses a KP personally, the more likely the user is to contribute to the KP.

Users may also be motivated by benefits derived by other users. It has been observed in many settings (e.g., Wikipedia) that people share knowledge for altruistic pro-social reasons (Wasko and Faraj 2000). The joy of helping others while expecting nothing or very little concrete in return can be a motivator for users to contribute (Kankanhalli et al. 2005a). While such factors may also be at play in an organizational context, we expect it to be more motivating if the contributor has some connection to the users. While the mere seeking of a social relationship is unlikely to be a participant's prior concern, the feeling of belonging to that community might matter (Alavi et al. 2005; Wasko and Faraj 2000; Zimmer et al. 2007). Therefore, we propose:

H3: The more a user feels part of the group using the KP, the more like the user is to contribute to the KP.

Favorable Organizational Culture

A second deployment challenge is that KPs, like all systems, 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 and 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 and Kayworth 2006) and little direct alterability (Bock et al. 2005). We consider also material aspects of culture, such as reward systems.

Organizational culture may impact the success of any KMS, and a KP in particular, by impacting individuals' willingness to share data, or to use a system to seek knowledge. For example, a culture may

prompt knowledge hoarding: a competitive culture 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 and Faraj 2000), based on the internalization of shared values (Goodman and Darr 1998; Malhotra and Galletta 2005). We therefore propose:

H4: The more competitive the organizational culture, the less likely a user is to contribute to a KP.

Of course, organizations succeed in making their culture part of the individual's mindset to quite varying extents (Gupta and Govindarajan 2000; Voelpel et al. 2005); these efforts are subjected to external and overall economic factors as well (Goodman and 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 and Galletta 2005). Finally, as with other information systems, senior management support plays a pivotal role for successfully deploying KPs (Benbya et al. 2004; Davenport and Prusak 1998). Therefore, we propose:

H5: The stronger the social norms for contribution or use created by the organizational culture, the more likely a user is to use a KP.

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 and Govindarajan 2000; O'Dell and 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 make knowledge sharing seem more rational (Siemsen et al. 2007). We propose:

H6: Users will be more likely to contribute to a KP if there are group-level performance rewards than if there are individual-level performance rewards.

Knowledge Integration

A KP's primary purpose is to be a gateway to various underlying sources of knowledge—multiple repositories, applications or other users. Several authors (e.g., Chau et al. 2006; Davenport et al. 2008; Teo 2005) used the term 'one-stop shop' to describe this purpose. Previous research has identified the difficulty in achieving the right balance between centralization and decentralization (dispersed knowledge) in knowledge management initiatives (Garud and Kumaraswamy 2005). However, to be useful as a comprehensive knowledge supply requires not only pooling of knowledge, but also providing it in a coordinated and meaningful form (Lee et al. 2009). KPs have to provide mechanisms to integrate extensive and dispersed knowledge in various facets and from diverse sources.

A variety of factors complicate knowledge integration. The diversity of the knowledge itself poses challenges. It is in the nature of systems that they are best able to handle 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 and Prusak 1998) that are bound to cause costs and to yield knowledge losses (Alavi and Leidner 2001; Grant 1996; von Hippel 1994; Zack 1999) from "divorc[ing] the codified knowledge from its context" (Garud and Kumaraswamy 2005: 29). The difficulty of codification rises with the degree of tacitness of the knowledge (Alavi and Tiwana 2002); hence it is difficult for individuals to communicate tacit knowledge (Alavi and Leidner 2001; Morris 2001; Zhang 2006)—particularly in a generalizable way (van Baalen et al. 2005). This difficulty poses a particular problem for integrating knowledge for a KP. Therefore, we propose:

H7: The more diverse and tacit the knowledge, the less successful the KP will be in providing knowledge integration.

A second difficulty 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 and Klahr 1998). Issues of missing structure, relevance, reliability and quality might become even more pressing (McKemmish et al. 2009). Furthermore, regulatory boundaries may constrain full exploitation of

all collected information (Davenport and Jarvenpaa 2003). Differing needs for timeliness aggravate the challenge of integrating diverse knowledge. 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 and Jarvenpaa 2003). Diversity also hampers knowledge transfer in network-related KPs. Practical experience will be sequentially recorded and recommended (Morris 2001), but as such experience is subjective and rooted in action, deriving specific insights can be difficult. This problem will be especially significant if participants are only loosely tied together and have differing tasks that overlap only in general terms (Alavi and Leidner 2001; van Baalen et al. 2005). We therefore propose:

H8: The more diverse the needs of users of a KP, the less successful the KP will be in providing knowledge integration.

A further problem in knowledge integration is encouraging work on validation and maintenance in order to keep knowledge quality at a high level. 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 and Gray 2009: 84), validation processes are frequently implemented without reference to participants' beliefs, perceptions, and behaviors (Durcikova and Gray 2009). KPs must provide assurances of high degrees of objectiveness and reliability of knowledge for other participants through stringent validation (Durcikova and Gray 2009). Assuring quality, usability, relevance and usefulness of the knowledge provided by KPs needs continuous efforts. However, knowledge-management-related approaches to continuance are still underemployed (He and Wei 2009). We therefore propose:

H9a: Stronger knowledge validation efforts will increase perceived knowledge quality (i.e., increase perceived usefulness) and so better enable knowledge integration.

However, knowledge validation efforts will likely have a cost to contributors, making contributions more difficult and less rewarding (even if more valuable). Participants might be less motivated to contribute if they know that their contributions are likely to be reedited, rejected, or delayed (Alavi et al. 2005). We therefore propose:

H9b: Stronger knowledge validation efforts will increase the perceived difficulty of contributing (i.e., reduce ease of use) and so decrease contributions.

Our proposed hypotheses are summarized in Figure 2.

Evidence from the Literature

While there has been a fair amount of prior research on KPs, deployment challenges and best practices for implementation are still emerging. We therefore examined the relevance of the three broad challenges described above through a systematic survey of published reports of KPs and KP implementations. We chose this approach as it provides a holistic impression of the state of academic knowledge about KPs, which should reflect the broad state of practice, while a single empirical study would be limited to the particular KP implementations studied.

Specifically, we present a 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 mid-2009. 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 relevant journal papers that presented empirical studies. Not all of the papers necessarily described themselves as being about KPs in so many words; a paper might describe a system that fits 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 (see Appendix).

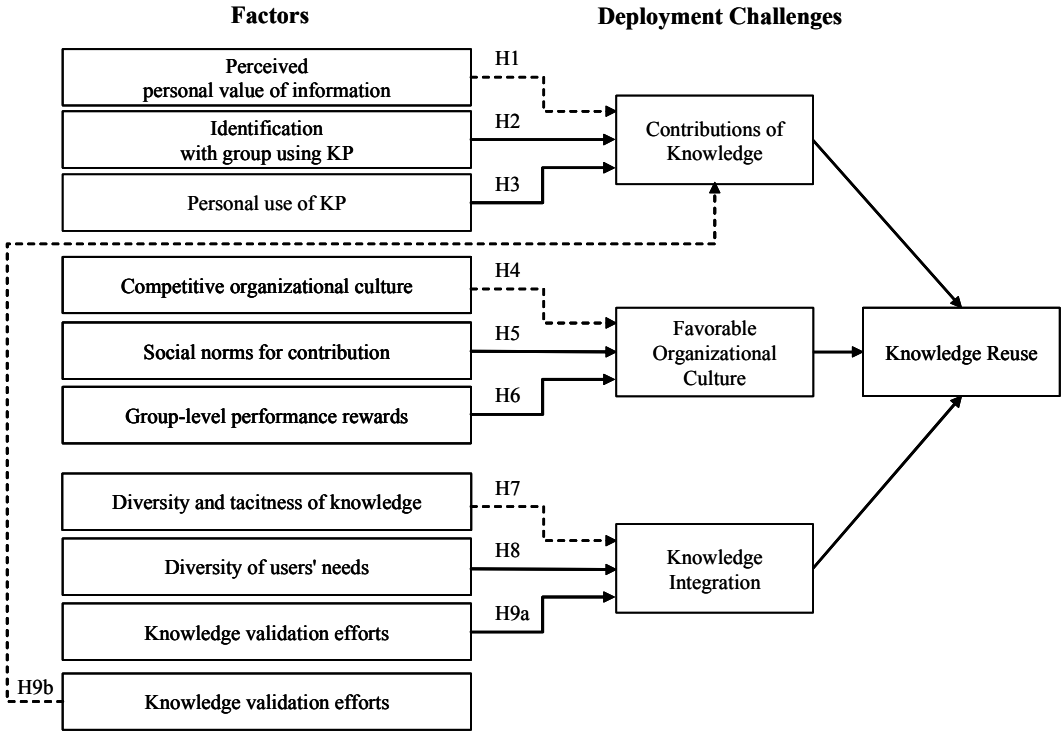


Figure 2. Summary of Hypothesized Relationships

In a second step, we analyzed the 42 studies. We first grouped the papers into four categories by the nature of the system described. The grouping was done by one of the authors and a master and a PhD student based on the described characteristics of the system and their match to the description of KP components given in the previous section. Eleven studies apply directly to KPs, six focus on repository aspects of systems that we classified as KPs, twelve discuss the networking aspects of KPs, and another thirteen are generally KMS-related, nevertheless matching the KP definition presented above. For example, Teo and Bing (2008) was coded as being directly KP-related, as the system described matched the definition developed in the previous section.

As a third step, we coded each paper as to whether it discussed approaches to the three deployment challenges discussed above. The coding was done by comparing the problems identified in the paper to the definition of the 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 is given in Table 1. The rows of the table represent the type of the system; the columns show the deployment challenges addressed, as well as the research methods used. Note that each paper was coded as addressing only a single type of system, but might address multiple deployment challenges. For example, Teo and Bing (2008) was coded as addressing all three challenges.

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 of studies, that is, the papers that explicitly addressed KP. By contrast, surveys were the most common method applied in the other three groups of papers.

Table 1. Summary of Codes as Applied to Papers Reviewed					
Category	**#**	**Methods**	**SC**	**OC**	**KI**
1. Directly KP related	11	Case study (9), survey (2)	10 (91%)	10 (91%)	11 (100%)
2. Focus on repository aspects	6	Survey (4), field study (1), lab study (1)	5 (83%)	5 (83%)	6 (100%)
3. Focus on network aspects	12	Survey (9), field study (2), lab study (1)	8 (67%)	8 (67%)	7 (58%)
4. Generally KMS related	13	Survey (8), field study (2), case study (1), lab study (1), simulation (1)	11 (69%)	10 (69%)	5 (35%)
Total	42		34	33	29
SC = Sufficient Contribution; OC = Organizational Culture; KI = Knowledge Integration					

Second, the empirical studies addressing KP specifically and repository aspects of KMSs are notable for their general inclusion of all three sets of concerns. In contrast, studies in the final two groups with a focus on communication less often address concerns of knowledge integration (addressed only in seven of twelve and five of thirteen papers in these groups). This difference is consistent with our emphasis on KPs as enabling knowledge integration.

The work reviewed provides first support for the hypotheses developed above. For example, 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 at those times, resources might be spent for greater effect elsewhere rather than for the KP-enabled knowledge transfer.

Ryu et al.'s 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. Markus et al. (2002) empirically validate that these kinds of work patterns implicate more complex process, user, and knowledge requirements and that KMSs need to integrate repository and networking features. Obviously, this is what a KP seeks. 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 knowledge management. 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 dissemination or if it is involved in purely creative 'brain-storming' work, it might not require an integrative KP. Hence, KP implementation must not lapse into the promises of knowledge sharing and knowledge integration or adopt any of the proposed measures in an undifferentiated manner.

Overall, the reviewed studies reflect a common conundrum for organizations: either they 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

1 Ryu et al. (2005) conceive KPs as sophisticated 'enterprise information portals', but their portal concept is largely equivalent to the (slightly broader) conception of KPs in this work.

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."

In summary, our study illuminates issues regarding KP deployment and principles and empirical approaches in the literature. Whereas the data points may not be sufficient to generalize any findings, they contributed to the development of propositions for further empirical testing and the development of theories that explain the deployment of KPs (see also Markus 2001).

Suggestions for Further Research

Based on the literature, we suggest that managers should seek to incentivize and reward contributions to KPs, while addressing concerns about loss of personal advantage from possessing unique knowledge. In other words, we conceptualize that KPs can be powerful tools if they properly induce sufficient contribution, work in a favorable organizational culture, and support knowledge integration and we propose the complimentary research hypotheses.

Of course, further research is needed to validate the hypotheses presented above. To do so will require operationalizing the factors noted above as well as other factors relevant to system adoption. A particular challenge will be dealing with the different levels of analysis appropriately. The factors related to contribution are at the individual level, while the factors related to organizational culture may not necessarily be. They might be recast as perceived culture to avoid the problem, or the model could be made explicitly multi-level with some organizational level factors. A further challenge in future research will be developing an appropriate sample for the study. KPs are likely found in larger organizations, which poses challenges to developing a reasonable sampling frame. A study carried out within only one or a few organizations is much more tractable, but may not provide adequate variance on organizational-level variables.

To address the challenges of KP deployment more systemically, the hypotheses presented above might be used as the basis for a design theory for KPs (e.g., Gregor and Jones 2007, Mueller-Wienbergen et al. 2011). Such a theory would support designing KPs more likely to be successful. We have already identified the eight elements of an information systems design theory according to Gregor and Jones (2007: 322): "(1) purpose and scope, (2) constructs, (3) principles of form and function, (4) artifact mutability, (5) testable propositions, (6) justificatory knowledge (kernel theories), (7) principles of implementation, and (8) an expository instantiation". The purpose and scope (1) of the design theory is to support organizations in their efforts to deploy KPs in the business context by describing the form and function of KPs and by suggesting challenges in deploying KP and ways to address these challenges. The constructs (2) and the principles of form and function (3) for KPs were outlined above, and include a knowledge organization system, the artifacts in knowledge repositories, search, applications and services, communication and collaboration tools, personalization and role management, and a unified interface.

The main body of the paper presented a number of testable propositions (5), here hypotheses, based on various kernel theories (6). However, not all of the hypotheses are suitable for inclusion in a design theory, as not all are within the control of a designer. For example, it may be helpful for designers to know that a competitive organizational culture will make the success of a KP less likely, but there is probably not much that designers can do with a system to directly affect the supportiveness of the organizational culture. On the other hand, the hypotheses suggest the value of including network-oriented functionalities, a factor that is directly in the control of system designers. We also hypothesize about the importance of knowledge integration, though more research is needed to identify specific KP features that can provide this benefit. Finally, the proposed hypotheses suggest that knowledge validation efforts can have both positive and negative impacts on KP success, demanding the need to ensure data quality without discouraging contributions. The literature review (see Appendix) presented above provides numerous examples of instantiations (8) of KPs. However, principles of implementation (7) are still being worked out. Also, research does not as yet seem to have addressed artifact mutability (4), that is, how a KP system changes over time. Addressing these latter two points is a good topic for further research to develop a full design theory.

Finally, looking more broadly, further research may want to examine other kinds of phenomena that in some respects are like KP and thus might inform the hypotheses presented above. For example, factors related to sufficient contribution to a KP parallel those for contributions to other shared knowledge repositories such as Wikipedia or scientific data repositories. The theory presented above should be of use in these areas as well. Further, taking knowledge reuse as the main outcome variable may encourage future research on this outcome on other platforms, studies of how knowledge from Wikipedia is used, which is as yet relatively unstudied.

Appendix:
42 Empirical Studies Reviewed and KP Challenges Identified

Author(s) (Year)	Paper Title / Journal	KP Design Challenge Identified*
Directly KP related (11 Papers)		
Braganza et al. (2009)	Organizational Knowledge Transfer Through Creation, Mobilization and Diffusion: A Case Analysis of InTouch within Schlumberger. *Information Systems Journal*	KI, SC, OC
Chau et al. (2006)	Building a Scientific Knowledge Web Portal: The NanoPort Experience. *Decision Support Systems*	KI
Garud, Kumaraswamy (2005)	Vicious and Virtuous Circles in the Management of Knowledge: The Case of InfoSys Technologies. *MIS Quarterly*	KI, SC, OC
Lee et al. (2009)	A Contingent Approach on Knowledge Portal Design for R&D Teams: Relative Importance of Knowledge Portal Functionalities. *Expert Systems with Applications*	KI, SC, OC
McKemmish et al. (2009)	Consumer Empowerment through Metadata-Based Information Quality Reporting: The Breast Cancer Knowledge Online Portal. *Journal of the American Society for Information Science & Technology*	KI, SC, OC
Schwabe, Salim (2002)	Integrating Knowledge Management Applications in the Enterprise – The Xerox Knowledge Portal Project. *Knowledge & Process Management*	KI, SC, OC
Teo (2005)	Meeting the Challenges of Knowledge Management at the Housing and Development Board. *Decision Support Systems*	KI, SC, OC
Teo, Bing (2008)	Knowledge Portals in Chinese Consulting Firms: A Task-Technology Fit Perspective. *European Journal of Information Systems*	KI, SC, OC
Van Baalen et al. (2005)	Knowledge Sharing in an Emerging Network of Practice: The Role of a Knowledge Portal. *European Management Journal*	KI, SC, OC
Voelpel et al. (2005)	Five Steps to Creating a Global Knowledge-Sharing System: Siemens' ShareNet. *Academy of Management Executive*	KI, SC, OC
Zhang (2006)	Wonders Knowledge Portal, *Communications of the AIS*	KI, SC, OC
Focus on Repository Aspects (6 Papers)		
Bock et al. (2006)	Are Norms Enough? The Role of Collaborative Norms in Promoting Organizational Knowledge Seeking. *European Journal of Information Systems*	KI, SC, OC
Desouza et al. (2006)	Factors Governing the Consumption of Explicit Knowledge. *Journal of the American Society for Information Science & Technology*	KI

Durcikova, Gray (2009)	How Knowledge Validation Processes Affect Knowledge Contribution. *Journal of Management Information Systems*	SC, OC, KI
Kankanhalli et al. (2005a)	Contributing Knowledge to Electronic Knowledge Repositories: An Empirical Investigation. *MIS Quarterly*	SC, OC, KI
Kankanhalli et al. (2005b)	Understanding Seeking from Electronic Knowledge Repositories: An Empirical Study. *Journal of the American Society for Information Science & Technology*	SC, OC, KI
Poston, Speier (2005)	Effective Use of Knowledge Management Systems: A Process Model of Content Ratings and Credibility Indicators. *MIS Quarterly*	SC, OC, KI
Focus on Networking Aspects (12 Papers)		
Chiu et al. (2006)	Understanding Knowledge Sharing in Virtual Communities: An Integration of Social Capital and Social Cognitive Theories. *Decision Support Systems*	SC, OC
Cummings (2004)	Work Groups, Structural Diversity, and Knowledge Sharing in a Global Organization. *Management Science*	KI
Hansen et al. (2005)	Knowledge Sharing in Organizations: Multiple Networks, Multiple Phases. *Academy of Management Journal*	SC, OC, KI
Levin, Cross (2004)	The Strength of Weak Ties You Can Trust: The Mediating Role of Trust in Effective Knowledge Transfer. *Management Science*	SC, OC, KI
Lin, Lee (2006)	Effects of Socio-Technical Factors on Organizational Intention to Encourage Knowledge Sharing. *Management Decision*	SC, OC
Patnayakuni et al. (2007)	Systems Development Process Improvement: A Knowledge Integration Perspective. *IEEE Transactions on Engineering Management*	KI
Reagans, Mc Evily (2003)	Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly*	SC, OC, KI
Robert et al. (2008)	Social Capital and Knowledge Integration in Digitally Enabled Teams. *Information Systems Research*	KI
Sarker et al. (2005)	Knowledge Transfer in Virtual Systems Development Teams: An Exploratory Study of Four Key Enablers. *IEEE Transactions on Professional Communication*	KI
Tiwana, Bush (2005)	Continuance in Expertise-Sharing Networks: A Social Perspective. IEEE Transactions on Engineering Management	SC, OC
Wasko, Faraj (2005)	Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice. *MIS Quarterly*	SC, OC
Zboralski (2009)	Antecedents of Knowledge Sharing in Communities of Practice. *Journal of Knowledge Management*	SC, OC
General KMS-Related (13 Papers)		
Alavi et al. (2005)	An Empirical Examination of the Influence of Organizational Culture on Knowledge Management Practices. *Journal of Management Information Systems*	SC, OC, KI
Benbya (2006)	Mechanisms for Knowledge Management Systems Effectiveness: Empirical Evidence from the Silicon Valley. *Academy of Management Proceedings*	SC, OC
Bock et al. (2005)	Behavioral Intention Formation in Knowledge Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate. *MIS Quarterly*	SC, OC

He, Wei (2009)	What Drives Continued Knowledge Sharing? An Investigation of Knowledge-Contribution and -Seeking Beliefs. *Decision Support Systems*	SC, OC, KI
Hwang, Kim (2007)	Understanding Affective Commitment, Collectivist Culture, and Social Influence in Relation to Knowledge Sharing in Technology Mediated Learning. *IEEE Transactions on Professional Communication*	SC, OC
Janz, Prasarnphanich (2009)	Freedom to Cooperate: Gaining Clarity into Knowledge Integration in Information Systems Development Teams. *IEEE Transactions on Engineering Management*	KI
Kulkarni et al. (2006)	A Knowledge Management Success Model: Theoretical Development and Empirical Validation. *Journal of Management Information Systems*	SC, OC, KI
Lin, Huang (2008)	Understanding Knowledge Management System Usage Antecedents: An Integration of Social Cognitive Theory and Task Technology Fit. *Information & Management*	SC, OC
Malhotra, Galletta (2005)	A Multidimensional Commitment Model of Volitional Systems Adoption and Usage Behavior. *Journal of Management Information Systems*	SC, OC
Marks et al. (2008)	Sharing Knowledge. *Communications of the ACM*	SC, OC
Patnayakuni et al. (2006)	Managing the Complementarity of Knowledge Integration and Process Formalization for Systems Development Performance. *Journal of the Association for Information Systems*	KI
Quigley et al. (2007)	Multilevel Investigation of the Motivational Mechanisms Underlying Knowledge Sharing and Performance. *Organization Science*	SC, OC
Siemsen et al. (2007)	Incentives that Induce Task-Related Effort, Helping, and Knowledge Sharing in Workgroups. *Management Science*	SC

* SC = Sufficient Contribution, OC = Favorable Organizational Culture, KI = Knowledge Integration

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