AN EMPIRICAL STUDY ON MEASURING THE SUCCESS OF KNOWLEDGE REPOSITORY SYSTEMS

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Summary

As knowledge has been regarded as the most important resource to produce long-term sustainable competitive advantages for organizations, Knowledge Management (KM) and Knowledge Management Systems (KMS) are of great interest to academics as well as to practitioners. However, despite heavy investments in the KMS such as Knowledge Repository Systems (KRS), their success has been rarely measured. Due to the unique nature of knowledge and knowledge management, the well-cited DeLone and McLean's Information Systems (IS) success model, which was developed for a more traditional IS context, may not be entirely adequate for measuring KMS success. This study focuses on KRS, a kind of KMS which follows a codification strategy, and presents a more comprehensive KRS success model.

Our model is based on Manson's information measurement framework, combining DeLone and McLean's IS success model and Markus's knowledge reusability concept. We suggest that KRS success should be measured at each stage of knowledge reuse as well as its influence on knowledge users. In additional, we argue that these success dimensions are interrelated and hypothesize their relationships.

In order to validate the proposed KRS success model, an empirical study was conducted among 110 KRS users in China and Singapore. Reported results provide preliminary support for our model and indicate the multidimensional and

interdependent nature of KRS success as well as the uniqueness of KRS to other information systems. Besides the relationships demonstrated and validated in DeLone and McLean's model, we find success in knowledge acquisition, which includes nurturing trust climate in the organization and motivating employees intrinsically to contribute their knowledge into repositories, and knowledge refinement leads to high output quality of KRS. The findings of this study offer organizations a set of guidelines in evaluating and predicting the success of complex KRS.

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Chapter 1. Introduction

Knowledge Management Systems (KMS) and Information Systems (IS) Success are gaining increasing popularity in IS research area. This thesis attempts to contribute to these two streams of research by probing into success dimensions of KMS. Specifically, it presents a more comprehensive success model for Knowledge Repository Systems (KRS) by combining DeLone and McLean's IS success model with knowledge reuse process. This chapter provides an overall understanding of this study. It illustrates the research background first. Then it presents the study objectives, followed by thesis organization.

1.1 Research Background

The resource-based view of the firm defines organizational strategic assets as being valuable, rare, imperfectly imitable, and nonsubstitutable to sustain competitive advantages (Wernerfelt, 1984; Michalisn et al., 1997). Recently, the emerging knowledge-based view of the firm considers that knowledge is the firm's most important strategic assets because it represents intangible resources that are unpurchasable and hard to imitate (Grant, 1996; Spender, 1996). With the increasing attention on knowledge as an important weapon for sustaining competitive edge, there is a growing awareness of the importance of having a structured and systematic approach to what is being known as Knowledge Management (KM) and KM is rapidly becoming an integral business function for many organizations.

Information and communication technologies have been proposed as effective tools to support KM, in form of Knowledge Management Systems (KMS). IT has challenged the old inefficient methods of managing knowledge and facilitated organizational processes of knowledge creation, storage/retrieval, transfer, and application (Arora, 2002). Alavi and Leidner (2001) define KMS as “a class of information systems applied to managing organizational knowledge”.

As knowledge has been recognized as an organization’s source of sustainable competitive advantages, KM and KMS are of great interest to academics, as well as to practitioners. This is evidenced by the fact that more and more businesses have embarked upon implementing KMS. In parallel, there is the increasing body of literature on the subject of KM/KMS.

Another topic with rapidly expanding interest within the Information Systems (IS) research community is that of IS success and effectiveness, which is an important phenomenon for both researchers and practitioners. After considerable resources are invested by organizations in IS, organizations need evidence to justify the investment. Without measurable success, enthusiasm and support for IS are unlikely to continue. To measure the success of IS, it has been proposed to compute the contribution of IS to organizational performance (Gelderman, 1998), especially in monetary terms and traditional investment analysis techniques and criteria, such as return on investment, net present value, or payback period could be used. But in real practice, successful financial measurement of IS contribution is hard to achieve, because a large portion of costs and benefits of IS will be qualitative or intangible and confounding factors often make it difficult to ascertain the influence of IS implementation (Scott, 1995; Grover et al., 1996; Gelderman, 1998).

Partially due to the difficulty of direct measurement, subjective judgment and surrogate measures gain acceptance. Two of the best known of these scales are usage the User (Information) Satisfaction (Ives et al., 1983; Baroudi et al., 1986), both are supposed to be proxies for IS success. The rationales behind the application of usage and UIS as IS success measures are the ideas that IS do not contribute to performance if they are not used and their effectiveness is presumed to increase user satisfaction (Scott, 1995; Geldman, 1998). Despite their prominence, these two measures have also been widely criticized. (Srinivasan, 1985; Galetta et al., 1989; Saarinen 1996; Grover et al., 1996). One of the main criticisms is their narrow scope. Some researchers argue that it is questionable whether they cover all essential issues related to the success of IS. The IS success is not only a multi-item, but a multi-dimensional concept (Saarinen, 1996). Other criteria, such as information quality and organizational impact, although less-explored, should be included in the measurement framework. Another problem of these two measures is poor theoretical base. “Theory and measurement issues are often intertwined and having one makes it easier to develop or better understand the other.” (McLean et al., 2002) But application of usage and UIS lacks an overarching framework grounded on theories regarding the context with which effectiveness criteria are applied (Grover, 1996).

DeLone and McLean (1992) analyzed all the different streams of research about IS success and proposed an integrated IS success model. This model based on Shannon and Weaver's (1949) theory of communication and Mason's (1978) information influence theory, highlights the multidimensional and interdependent nature of IS success. Due to the fact that it is comparably comprehensive, well-defined, and theoretically founded, DeLone and McLean's model is probably the one enjoying most wide acceptance. For instance, in Garrity and Sanders's (1998) book *Information Systems Success Measurement*, eight out of nine papers refer to, and make use of, the DeLone and McLean's model.

As KMS continue to grow in volume and importance to organizations, the need for KMS success measurement and evaluation also escalates. However, for KMS, a special kind of IS, their success has been rarely measured. Due to the unique nature of knowledge and knowledge management, KMS success measurement is even more difficult than that of traditional information systems and regarded as a critical issue which is left unsolved, yet is essential for effective KM implementation (Garvin, 1993).

1.2 Research Objectives

Combining these two popular research streams: KMS and IS success, within the context of Knowledge Repository Systems (KRS), this study attempts to investigate the success dimensions of KRS and their relationships by integrating the generic framework of DeLone and McLean's IS success model with Markus's (2001) knowledge reusability process based on Manson's (1978) information influence theory. We expect to develop a more comprehensive framework for KRS success measurement and suggest the issues which organizations should tackle to measure and improve the success of KRS.

1.3 Thesis Organization

The remainder of the thesis is organized as follows: chapter 2 reviews the relevant literature on pervious studies on KMS success, knowledge repository systems along with DeLone and McLean's model and knowledge reuse process which provide theoretical foundations for this study. Based on extant literature, the theoretical framework, research model and hypotheses are presented in chapter 3. In Chapter 4, the research method is described and definitions of variables and their measurements are developed. Chapter 5 reports and analyses the results of empirical study. Chapter 6 interprets theses results and discusses the contributions and limitations of this research. Finally, we present the concluding remarks.

Chapter 2. Literature Review

This chapter presents a brief literature relevant to the present study. It begins with reviewing previous studies on KMS success measurement. The next section covers DeLone and McLean's (1992) IS success model, including its theoretical background and its strength and weakness when applied to KMS success. Then the introduction to Knowledge Repository Systems (KRS) is given. Finally, we discuss Markus's (2001) knowledge reuse process to illustrate how knowledge is reused in knowledge repositories.

2.1 Measuring the Success of KMS

Since implementing KMS requires significant financial investment and management effort, it is necessary for managers to measure the success of such systems, which provides a basis for company valuation, stimulates management to focus on what is important, and justifies investment in KM initiatives (Turban and Aronson, 2001). But practice and research on KMS measurement still remain as challenges and are not well developed (KanKanhalli and Tan, 2004).

2.1.1 KMS Success Measurement in Practice

In practice, because the costs and the benefits of implementing KM initiatives are notoriously hard to pin down, it is difficult to apply the traditional financial metrics such as ROI and payback time to KM programs. At early stage of KM, there was only anecdotal evidence about the benefits and success of implementing KMS. To meet the requirements of organizations for more systematic approaches to evaluate the success of KMS, KM consultants, vendors, and practitioners have proposed some measurement models which are increasingly used in organizations. From a practitioner's perspective, a KMS is an integrative part of a whole KM initiative and their biggest concern is the final results of implementing KMS (i.e. benefits to organizations), therefore measuring KMS success is often equivalent to measuring the effectiveness of KM initiatives.

The balanced scorecard (BSC) developed by Kaplan and Norton (1992) is one of the most popular performance measurement models. Some practitioners extended BSC to KM metrics to look at KM activities from the four scorecard perspectives: financial, customer, internal process, and learning (Foster, 1999; Roberts, 2001). Others took a perspective of knowledge assets to study KM success by measuring the value of intellectual capital (Bontis, 2001; Liebowitz and Suen, 2000). The most famous and widely used models include Skandia Navigator (Edvinsson and Malone, 1997) and IC-index (Roos et al., 1998). Some organizations suggested that KM effectiveness measurement should be tied to the maturity of KM initiatives, which progresses through a series of phases (Lopez, 2001). APQX (American Productivity and Quality Center) outlined a measurement plan for each stage of the KM implementation. However, KM practitioners narrowly focus on measuring the outcomes of implementing KMS and these measures lack theoretical grounding of causal and process models of KM/KMS success.

2.1.2 Research on KMS Success Measurement

In the academic community of IS research, the literature on KMS success measurement is mainly in the form of individual case study, and only limited studies devoted to the development of the generalizable KMS success models (KanKanhalli and Tan, 2004). Some researchers (e.g. Wasko and Faraj 2000, Jarvenpaa and Staples 2000) measured KMS at the user level to evaluate the motivation of users to contribute and seek knowledge, as well as the consequent usage of KMS (KanKanhalli and Tan, 2004). But these studies only focus on user involvement and lack an integrated view to provide an in-depth analysis of KMS success.

Jennex and Olfman (2003) applied DeLone and McLean's model to KMS to evaluate the success in terms of system quality, knowledge quality, use/user satisfaction, perceived benefit, and net benefits. Furthermore, they identified three independent constructs : the technological resources of the organization, the form of the KMS, and the level of the KMS to measure system quality; in information/knowledge quality, they included richness and linkage, which are affect by knowledge strategy/process. After reviewing relevant studies on KM success, they concluded that compared with other KM success models, this model, based on solid theoretic foundation, meets KMS success criteria better (Jennex and Olfman, 2004). Maier (2002) also selected DeLone and McLean's model as the basis for KMS success and extended it by adding two constructs: knowledge-specific service and impact on collectives of people. Although both Maier (2002), and Jennex and Olfman (2003; 2004) argued that DeLone and McLean's model is an appropriate theoretic basis for KMS success measurement and proposed their measurement models, neither of them conducted empirical study to test their models. In addition, much of the literature does not consider the fact that the effective functioning of KMS is associated with ongoing use as well as the initial adoption of the technology (Huber, 2001) and fails to take a process-oriented perspective of organizational knowledge to look into the steps by which knowledge is managed in organizations.

To fill this gap, the study presented here seeks to enhance the existing knowledge about KMS success by combining DeLone and McLean's model with knowledge reuse process in KRS context and empirically testing the proposed KRS success model.

2.2 DeLone and McLean's IS Success Model

After reviewing 100 papers containing empirical IS success measures that had been published in seven publications during the 1981-1987, Delone and Mclean proposed six major dimensions of IS success: System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact. Moreover, they suggested these dimensions are interrelated and interdependent, forming an IS success model. This model not only provides a scheme for classifying the multitude of IS success measures, but also suggests the temporal and causal interdependencies between these categories, making an important contribution to the literature on IS success measurement (Seddon 1997; Seddon et al., 1999; McGill and Hobbs, 2003).

2.2.1 Theoretical Foundations

The underlying theoretical foundation which DeLone and McLean use as a basis for their derivation of the IS success model is the work of Shannon and Weaver (1949) and Mason (1978). Shannon and Weaver (1949) classified the communication problems into three hierarchical levels: the technical level, which concerns how well the system transfers the symbols of communication; the semantic level, which relates to the level of success in interpreting the desired meaning of the sender by the receiver; and the effectiveness level, which is about the effect of the information on the receiver's actual behavior. Manson (1978) adapted and extended Shannon and Weaver's three-level model to an IS context. In his information influence theory, he presented a framework for measuring an information system from four levels: technical level, semantic level, functional level, and influence level. Manson argued that in an information system, it involves "the means by which one system, the producer P, affects another system, the receiver R." (p. 231) Based on the three levels of communication theory, an output flow from the producer P to the receiver R can be measured. He relabeled "effectiveness" as "influence" and presented this level as a series of events that take place at the receiver system R including receipt of information, influence on recipient and influence on system. Moreover, in order to measure the effectiveness of producer system P, Mason added a fourth level – functional level to "analyze information output in terms of the processes which produce it."

Based on Manson's measurement framework, DeLone and McLean (1992) categorized the empirical IS success measures collected from seven top publications into six dimensions. According to DeLone and McLean's taxonomy, System Quality belongs to the technical level, Information Quality belongs to the semantic level, and Use, User Satisfaction, and impact belong to influence (effectiveness) level. But they did not include functional level in the model. The hierarchy of levels provides a basis for the temporal and causal interdependencies between these six dimensions (Figure 1.).

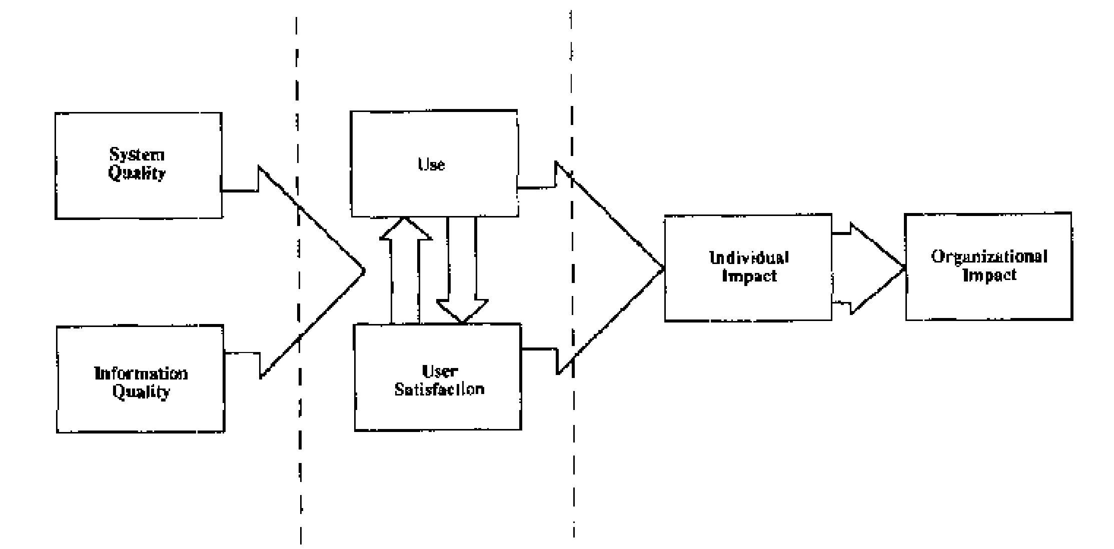

Figure 1. DeLone and McLean's IS Success Model

(DeLone and McLean 1992, Figure 2, p.87)

2.2.2 Empirical Studies

DeLone and McLean's IS success model, which systematically combines individual IS success measures, reflects multidimensional and interdependent nature of IS success. It is contended:

"*System quality and information quality singularly and jointly affect both use and user satisfaction. Additionally, the amount of use can affect the degree of user satisfaction - positively or negatively - as well as the reverse being true. Use and user satisfaction are direct antecedents of individual impact; and lastly, this impact on individual performance should eventually have some organizational impact*." (DeLone and McLean, 1992, p.83)

This relational model is one of the most comprehensive and widely cited IS assessment model offered by IS research (Garrity and Sanders, 1998; Gable, 2003; Heo and Han, 2003). Yet Delone and Mclean did not provide empirical validation of the model and emphasized that additional research is required to authenticate the model's validity. Since the publication of this model, a number of studies have undertaken empirical investigations of the proposed interrelationships among the measures of IS success. Many researchers have adopted this model to study different kinds of information systems, such as decision support systems (McGill, 2003), e-commerce (Molla and Licker, 2001; DeLone and McLean, 2003), integrated student information systems (Rai et al., 2003), data warehousing (Wixom and Watson, 2001; Shin, 2003), accounting information systems (Seddon and Kiew, 1996), and enterprise systems (Gable, 2003). These empirical studies provide strong support for the suggested associations among the IS success constructs and help to confirm the causal structure in the model (DeLone and McLean, 2003).

Despite the huge and growing interest in KMS in IS research, there is a surprising paucity of empirical research on adopting DeLone and McLean's model to KMS to investigate the success dimensions and their interrelationships. Maier (2002) and Jennex and Olfman (2003) are among the first to apply DeLone and McLean's model in KMS context. But they just proposed their KMS success models and did not test them empirically.

2.2.3 Critical Analysis

Despite a lot of theoretic and empirical validations and wide popularity of DeLone and McLean's model, several articles have been published that challenge and critique this model. A number of researches which employ this model suggest the incompleteness of this model in certain areas (Garrity and Sanders, 1998). For example, Li (1997) argued that it is deficient that the six dimensions of DeLone and McLean's model encompass only the system aspect of IS success and overlook the human one. Seddon and Kiew (1996) suggested that system importance is an important factor which should be included in the model. These critical assessments expose the need for a broader model when adopting it to KMS. Just as DeLone and McLean (1992) mention, this success model clearly needs further development when applied in specific research contexts.

Although Delone and Mclean (1992) argued that "Mason's adaptation of communication theory to the measurement of information systems suggests that there may need to be separate success measures for each of the levels of information," (p.62) their model only measures technical success, semantic success, and effectiveness success of an information system, and does not include the functional level explicitly. When DeLone and McLean developed their model in early 1990s, information systems typically included those which processed many routine transactions, such as payrolls, stock controls and invoices. For the transactional information systems, the focus was on automating the information process functions where they could make large efficiency gains. These functions such as sorting or calculating were completed by machines. So it is reasonable for DeLone and McLean to exclude functional level and just measure system quality in the technical level, which has covered the information production process. However, after the introduction of KMS, and KRS in particular, the processes which produce the output are not only a technical issue. Advanced distributed technologies, such as Lotus Notes or intranets, can be useful for disseminating information. But they are not enough for a successful KM program which involves a lot of human intervention (Cross and Baird, 2002). Therefore, IS managers and researchers cannot limit their attention to only the hardware and software components ignoring the effects of the people or motivational problems on the performance of KMS. This suggests that DeLone and McLean's model which was developed for a more traditional IS context may not be entirely adequate for measuring KMS success. In order to study the success of KRS, there is a need to supplement DeLone and McLean's model by including the function level separately and explicitly in the success model to analyze the processes which produce the knowledge in the repositories.

2.3 Knowledge Repository Systems

Previous studies explicate two dimensions of knowledge in organizations: tacit knowledge, which is deeply embedded in the human brain and hard to formalize and communicate, and explicit knowledge, which is transmissible in a codified form (Nonaka and Tackeuchi, 1995; Alavi and Leidner, 2001). Related to this dichotomy of knowledge are two KM strategies which involve an organization's primary approach to knowledge transfer: personalization and codification (Hansen et al., 1999). With the personalization strategy, knowledge is shared mainly through person-to-person contact. In the codification strategy, knowledge is carefully codified and stored in repositories where it can be accessed and used easily by anyone in the company. Choosing which strategy depends on the competitive base of organizations and the fit of the strategy to their needs (Hansen, et al., 1999; KanKanhalli et al., 2003).

IT plays different roles in these two KM strategies. The codification strategy centers on IT to store explicit knowledge; while the personalization strategy focuses on direct interaction among people with the help of IT (Hansen et al., 1999) and the KMS itself plays a much smaller role than it does in the codification strategy. So the role of IT and KMS is central to the success of a codification KM strategy, but may be less important to the success of a personalization strategy (Ko and Dennis, 2002). Therefore, in this study we choose to focus on KMS that follow the codification strategy, more specifically Knowledge Repository Systems (KRS).

KRS are key components of codification strategy for knowledge management, which have been defined by many researchers. Some authors view them as KMS that utilize IT to capture, organize, store and distribute explicit organizational knowledge (Bowman, 2002). Others regard a knowledge repository as an online, computer-based storehouse of expertise, knowledge, experience, and documentation about a particular domain of expertise (Liebowitz and Beckman, 1998). Huber (2001) described that in knowledge repository, knowledge originally possessed by one or few people is deposited into a computer-resident knowledge archive from which it can be subsequently accessed by many potential users.

Base on previous literatures on KRS, in this study we define the Knowledge Repository System as:

A kind of KMS that focus primarily on capturing, organizing, storing, and distributing explicit organizational knowledge, in which people codified their knowledge into knowledge base for facilitating their colleagues to access and use so as to achieve economic reuse of knowledge.

KRS users are both knowledge contributors and knowledge seekers. Through transferring an individual entity to public good, KRS essentially capture knowledge in forms and through processes that enable access throughout the company (Ruggles, 1998), which contributes to the maintenance of the firm's shared intellectual assets and opens up the possibility of achieving scale in knowledge reuse and thus of growing the business (Hansen et al., 1999).

As one of the best-know approaches to using technology in KM, a lot of energy has been spent on KRS (Davenport et al., 1998). In a survey on KM in practice by Ruggles (1998), 57% of respondents reported that the implementation of KRS to be under way or in the planning stage. Davenport and Prusak (1998) found that 80% of the KM projects they reviewed involved some form of knowledge repository.

2.4 Knowledge Reuse Process

In KRS, explicit knowledge is stored for later reuse (Zack 1999). By looking explicit knowledge as a kind of information product and studying the architecture of information products (Meyer and Zack, 1996), Zack (1999) proposed five stages in the process for creating and distributing the knowledge in a repository: acquisition, refinement, storage and retrieval, distribution, and presentation. Similarly, in the theory of knowledge reusability, with emphasis on knowledge repositories, Markus (2001) defined the process of knowledge reuse in terms of four steps: capturing knowledge, refining knowledge for reuse, distributing knowledge, and reusing knowledge.

2.4.1 Knowledge Acquisition

Knowledge can be acquired either externally or internally (Davenport et al., 1998). External knowledge, for example, competitive intelligence, can be bought from the market or captured from the internet. But from a resource-based view, it may provide limited strategic advantages, because these resources are also open to the competitors. Similarly, employees, as individuals, cannot be regarded as a strategic asset, because they easily transfer from one organization to another (Meso and Smith, 2000). But when people codify their tacit knowledge into explicit knowledge and make them available to other users, the collection of employees' know-how is valuable, unpurchasable and inimitable, which brings sustainable competitive advantages (Michalisin et al., 1997; Meso and Smith, 2000). The main source of the valuable knowledge in the repositories is knowledge holders' contribution. This first step of knowledge reuse is very important for successful KRS. Davenport et al. (1998) observed that unsuccessful KM projects had "struggled to get organizations member to contribute to repositories."

2.4.2 Knowledge Refinement

Before adding captured knowledge into repositories, organizations should subject it to refining process (Zack, 1999) to make existing knowledge useful. This process normally includes culling, cleaning, sorting, indexing, standardizing, recategorizing and integrating (Zack, 1999; Markus, 2001). Refining the knowledge contributed by organizational members reduces redundancy, enhances consistent representation and hence improves efficiency (Gold et al. 2001). It is instrumental in ensuring that the knowledge repositories are meaningfully created with high quality. Since some of the refinement activities for knowledge products are intellectual in nature, intermediation cannot be fully substituted by technologies (Vishik and Whinston, 1999). Markus (2001) argued that a great deal of effort is required in this stage and knowledge producers often fail to assume this responsibility due to lack of both the motivation and the resources. The burden of refining knowledge for quality improvement should be shifted onto knowledge intermediaries (Vishik and Whinston, 1999; Markus, 2001). So successful knowledge repositories require assigning explicit responsibility for knowledge refinement to ensure high refinement quality (Zack, 1999; Markus, 2001).

2.4.3 Knowledge Distribution

KRS basically provide functions for the publication, search, and retrieval of knowledge elements to support knowledge distribution (Maier, 2002). IT plays an important role in this stage. Drawing on the information technologies, such as web-based intranet and database, organizations make repository content accessible to employees. Corporate intranet, providing a low-cost, more convenient way for intra-organizational communication, has become the technology platform to implement KRS. Based on intranet, at the heart of a KRS is an enterprise database or knowledge base which contains reports, memos, and other work documents about experience and lessons that can be shared among employees. Advanced database technologies, such as distributed systems, provide robust functionalities of knowledge storage, maintenance, retrieve and dissemination. The key component in distribution stage is technology. In order to make the organizational knowledge widely available throughout the organization, a system which is powerful, easy to use and reliable is needed.

2.4.4 Knowledge Reuse

The final stage of knowledge reuse process is actual usage of knowledge by knowledge seekers, including query, response, and application of the knowledge retrieved from the repository (Markus, 2001). In this stage, knowledge consumers “recontexualize” the knowledge “decontextualized” when it was codified (Markus, 2001). Through utilizing the knowledge in working tasks, knowledge consumers realize the potential benefits of KRS to have positive impact on individual performance and finally lead to organizational performance improvement. Sustainable competitive advantages come from the application of the knowledge rather than the knowledge itself (Alavi and Leidner, 2001). This finally stage of knowledge reuse can be affected by previous stages. Kanknahalli et al. (2001) study knowledge seeking behaviors in electronic knowledge repositories and find that the quality of the knowledge captured in a KRS is positively related to usage of the KRS. They also hypothesize that well-organized content and high system quality will increase usage of KRS, but fail to provide empirical support.

Chapter 3. Research Model

Based on the theoretical foundations discussed in previous chapter, this chapter aims to set up a research model for the study of KRS success. A conceptual diagram is first presented. Then we identify the relevant constructs and hypothesize their relationships.

3.1 Conceptual Diagram and Research Model

As discussed above, DeLone and McLean's model just includes technical level, semantic level, and influence level to measure the output of an information system. But for KRS, the processes which produce the output, such as knowledge creation and classification, are much more complex and human beings play an important role in the knowledge creation process. Therefore, for KRS success measurement, besides measuring the impact of the KRS output on recipients, as is suggested in DeLone and McLean's model, we need to supplement it by the functional level, which "analyses information output in term of the processes which produce it." (Manson, 1978)

Based on Manson's (1978) four levels of information output measurement, we present a conceptual paradigm (Figure 2) by combining DeLone and McLean's model (1992) with Markus's (2001) knowledge reuse process. In the evaluation framework, the process should be assessed for effectiveness at each stage of the knowledge reuse. With the ultimate objective of successful application of KRS in organizations, the indicated activities at each stage should be performed well.

In Manson's (1978) framework, functional level is to analyze how information is produced in information systems. In KRS after acquisition and refinement, knowledge is "produced" and ready for use. So we include these two steps of knowledge reuse in functional level. The product of KRS is knowledge, which belongs to semantic level and is represented by information quality in DeLone and McLean's model. After knowledge is "produced", the next step is knowledge distribution in which the repository content is made accessible to KRS users through information technologies such as intranet and database. In this stage, the focus of success is mainly technical issues, corresponding to DeLone and McLean's system quality at the technical level. The last stage is knowledge reuse which is oriented toward the consumption of the output of KRS, equivalent to use in DeLone and McLean's model. Finally, the consumption of knowledge will have a series of influence on knowledge recipients, such as satisfaction and perceived impact, which belongs to measures in influence level.

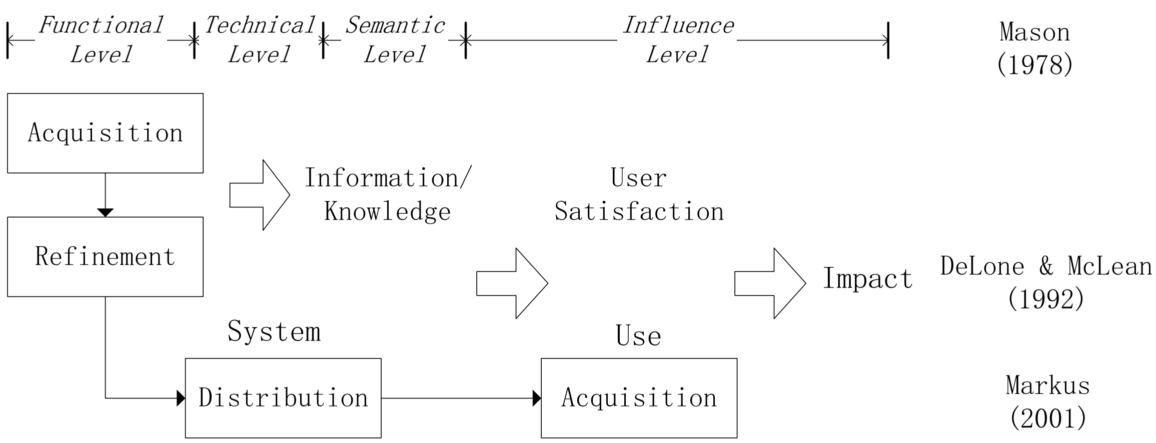

Figure 2. Conceptual Diagram

In our conceptual diagram, there are two flows: one is knowledge reuse process, which can be seen as measuring the effectiveness of producer system P; the other is the influence flow on the receiver system R through a series of stages from its use to its impact on individual and/or organization. The point which combines these two flows is reusing knowledge.

IS success is a multidimensional and interdependent concept which requires “careful attention to the definition and measurement of each aspect.” It is also important to “measure the possible interactions among the success dimensions in order to isolate the effect of various independent variables with one or more of these dependent success dimensions.” (DeLone and McLean, 2003, p.10)

In our KRS success measurement framework, the two flows are not only combined but interrelated. Markus (2001) argued that the effective reuse of knowledge is clearly related to the positive impact of KRS on organizations to improve their effectiveness. Knowledge acquisition and refinement are supposed to directly affect the quality of the knowledge stored in repositories. The knowledge and the effectiveness of its distribution will, singularly or jointly, affect subsequent “reuse” and “satisfaction”. Finally the consumption of knowledge will have a positive impact on the user to improve his/her decision making productivity, and the impact will go on to the organizations.

Based on the conceptual paradigm, we proceed to identify the measurable constructs reflecting each aspect for empirical study and propose the research model, which is depicted in figure 3. We shall next explain the research variables and hypotheses in detail.

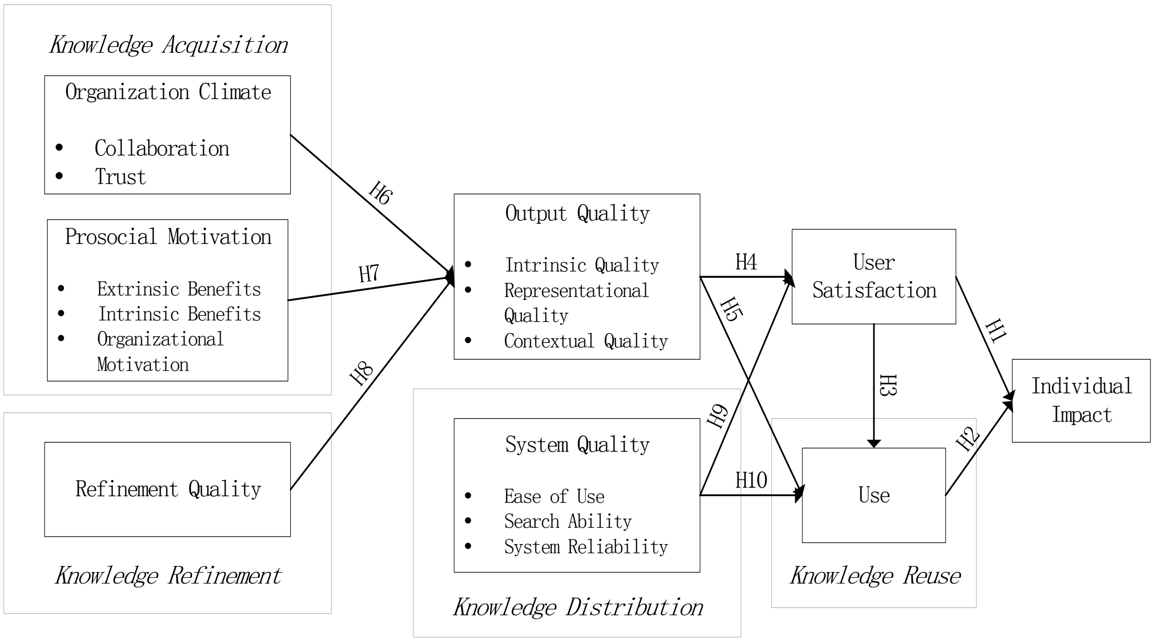

Figure 3. Research Model

3.2 Research Variables and Research Hypotheses

3.2.1 Dependent Variables

User Satisfaction

User satisfaction for KRS can be defined as the extent to which users believe the KRS available to them meets their knowledge requirements (Ives et al., 1983). It represents the recipient response to the output of an information system (DeLone and McLean, 1992). As one of the most common used dependent variables in IS research, User

Satisfaction is traditionally employed as a good surrogate for IS effectiveness. It has been measured indirectly through information quality, system quality, and other variables (Ives et al., 1983; Doll and Torkzadeh, 1988; Baroudi and Orlikowski, 1998), which will be discussed in other constructs. Therefore in the context of an integrated KRS success model, measures which directly assess User Satisfaction are desired.

Use

Use is oriented toward the consumption of the output of a KRS. This is the final stage of knowledge reuse. Knowledge seekers apply the knowledge retrieved in practice, thus realize the potential value of knowledge as intangible assets in organizations. On the research side, system use is a pivotal construct which bridges between upstream research on the causes of IS success and downstream research on the impacts of IS (Doll and Torkzadeh, 1998).

DeLone and McLean's model assumes volitional usage, but utilization is not always voluntary. For many system users, utilization is just how jobs are designed or a management mandate. Therefore, Gable et al. (2003) suggested that Use is an inappropriate measure of Enterprise Systems (ES) success. But for KRS, even sometime the retrieval of knowledge could be partially mandatory, the actual application of knowledge in practice is totally voluntary. From this perspective, the degree of system use may constitute a good indicator for KRS success.

Individual Impact

Individual Impact refers to the effect of KRS on the behavior of the user. The purpose of implementing KRS is to improve employees' effectiveness and efficiency. Users applying the knowledge in the repositories in their working practice are supposed to have positive impacts on their performance. Since generic objective measures of individual impacts are not available across individuals with different task portfolios, perceived individual performance impact is adopted in this study.

Theses three dependent variables and their interrelationships are directly borrowed from DeLone and McLean's model. But we modify it in two ways:

Firstly, we only specify one-direction causal path from User Satisfaction to Use, because we are interested in the impact of User Satisfaction on on-going Use of the KRS not the impact of initial Use on either User Satisfaction or technology adoption. We believe that only on-going use can be a success measurement of a system. The system which is only initially adopted cannot be regard as success. Rai (2002) argued that in DeLone and McLean's model User Satisfaction is an attitude toward a system while Use is a behavior and according to Technology Acceptance Model, Theory of Planned Behavior (Davis, 1989) and the system to value chain (Torkzadeh and Doll, 1991), it is attitude causes behavior rather than vice versa. McGill et al. (2003) drew the similar conclusion that according to previous research, the causal path between these two constructs should be specified as one direction from User Satisfaction to

Use.

Secondly, we focus on individual performance impact as the final dependent variable of interest instead of organizational performance. Although the impacts are definitely beyond the immediate user, we do not include Organizational Impact in our model for the following reasons:

1. There is much discussion about the difficulty to study organizational impact as a measurement for IS success. Goodhue and Thompson (1995) point that it is difficult to measure the organizational impact of individual IS initiative. Some aspects of organizational performance, such as financial performance, are mainly determined by factors (e.g. business environment) that cannot be influenced by IS and their users (Gelderman, 1998).
2. In some empirical studies the correlation between individual impact and organizational impact is found to be quite low. For example, when testing DeLone and McLean's model, McGill et al. (2003) found very low R^2 value for organizational impact, indicating only 0.2% of the variance was explained by perceived individual impact.
3. In this study the target respondents are ordinary employees who are using KRS. It is not practical to expect them to give an accurate evaluation of the performance of their organizations.
4. Our study was conducted in many organizations in various industries using the

survey method. It is very hard to develop the generic performance measure instruments for all organizations.

Based on these reasoning and DeLone and McLean's model, we hypothesize:

H1: The positive impact of a KRS on an individual's performance increases as user satisfaction increases.

H2: The positive impact of a KRS on an individual's performance increases as use increases.

H3: User satisfaction positively affects the use of a KRS by employees.

3.2.2 Output Quality

The output of KRS is knowledge. This is the construct that bridges between knowledge production and knowledge consumption. A successful KRS should provide contents that are useful, accurate and current (Gray, 2001). Markus's (2001) knowledge reuse process suggests that successful knowledge acquisition and refinement will result in knowledge with high quality in repositories. The high quality knowledge will eventually improve both user satisfaction and use according to DeLone and McLean's model.

Knowledge is information possessed in the mind of individuals and does not exist outside of an agent (Alavi and Leidner, 2001). In this sense, what gets stored and transmitted electronically in KRS is either data or information (Javerpaa and Staple, 2002). Actually, in practice the terms information, knowledge, and even data are often used synonymously and interchangeably (Huang et al. 1999). So as a construct to represent the quality of KRS product, we use output quality (Kankanhalli et al. 2001) instead of knowledge quality or information quality.

Output (information) Quality has been defined as "the degree to which (the output) has the attributes of content, accuracy, and format required by the user." (Rai et al., 2002) Here we adopt a more systematic framework suggested by Wang and Strong (1996) with four information quality dimensions. This framework is appropriate for this study for two reasons. Firstly, it implicitly assumes that information is treated as a product of an information manufacturing system (Huang et al., 1999). Secondly, KRS output is "produced" for actual use by knowledge seekers and Wang and Strong (1996) took the consumer viewpoint of "fitness for use" to conceptualize the underlying aspects of information quality through empirical approaches. This framework contains four Information Quality categories: intrinsic quality, representational quality, contextual quality, and accessibility quality. Because accessibility quality emphasizes the importance of the role of systems, mainly dealing with the technical issues, this dimension is excluded from our model due to the overlap with the System Quality construct.

In our study Output Quality consists of three dimensions: *Intrinsic output quality* denotes that output has "quality in its own right," such as accuracy, trustworthy, and reputation. *Representational output quality* deals with output understandability. It should be easy to understand and presented concisely and consistently. *Contextual output quality* emphasizes that output quality "must be considered with the context of the task at hand". It should be relevant and current. Output Quality is supposed to have a direct impact on User Satisfaction and Use:

H4: Employees are more satisfied with the KRS with higher output quality.

H5: Output quality of a KRS is positively related to the use of the KRS by employees.

3.2.3 Independent Variables

The independent variables consist of the first and second stages of knowledge reuse, knowledge acquisition and refinement, and the third stage of it, knowledge distribution. This section will explain each variable under these three stages.

Organizational Climate and Prosocial Motivation

As discussed in previous section, successful knowledge acquisition means employees are willing to contribute their valuable knowledge into the repositories. Dunford (2000) pointed that the quality of knowledge may be impaired at a very basic stage by knowledge holders failing to feed knowledge into their firm's KRS. So the key issue in knowledge acquisition is how to encourage KRS users to "share the real good stuff."

Litwin and Stringer (1968) proposed a motivation and climate model of organizational behavior integrating management theory, organizational theory and theories of individual behavior. They argued that organizational climate, a direct behavioral manifestation of organizational culture, arouses (or suppresses) particular motivational tendencies, which result in employees' behaviors. They also highlighted the direct interaction between organizational climate and motivated behavior. Based on Litwin and Stringer's (1968) model, we choose organizational climate and prosocial motivation as success criteria in knowledge acquisition to study KRS users' contribution behavior.

Nonaka and Takeuchi (1995) proposed four basic modes for organizational knowledge creation: socialization (form tacit to tacit), externalization (from tacit to explicit), combination (from explicit to explicit), and internalization (for tacit to explicit). In KRS, the transition process from tacit knowledge embedded in individuals to explicit knowledge stored in repositories has been conceptualized as "**externalization**." Based on a social-technical theory, Lee and Choi (2003) tried to discovery the relationships among KM enablers and knowledge creating process. They found that the success of externalization is only positively affected by two organizational climate factors: collaboration and trust. Collaboration is defined as people "actively help one another in their work"; trust means "maintaining reciprocal faith in each other in terms of intention and behavior." (Lee and Choi, 2003) Collaborative and trust climate foster knowledge sharing by reducing knowledge holders' fear and increasing openness to other organizational members. When organizational members collaborate and have mutual trust, they are more interested in sharing knowledge and less likely to hold back their valuable expertise (Krogh, 1998; Lee and Choi, 2003), which leads to higher knowledge quality in repositories. Hence, we hypothesize:

H6a: There is a positive relationship between collaborative climate and KRS output quality.

H6b: There is a positive relationship between trust climate and KRS output quality.

Because KRS reduce a provider's control over his or her input knowledge and eliminate many of the social exchange benefits of sharing knowledge through face to face interaction, knowledge holders are sometimes reluctant to contribute (Gray, 2001). Constant et al. (1996) applied theories of prosocial motivation to explain people's knowledge sharing behavior with electronic weak ties. They proposed two kinds of procosial motivation: personal benefits (e.g. rewards and self-respect) and organizational motivation (e.g. organizational citizenship and norms of reciprocity) and concluded that these two kinds of motivation affect the usefulness of the knowledge contributed by knowledge holders. Moreover, Osterloh and Frey (2000) argued that people are actually motivated by two kinds of personal benefits: extrinsic rewards (e.g. monetary rewards) and intrinsic rewards (e.g. self-respect). While extrinsic motivation is encouragement that satisfies people's needs indirectly, intrinsic motivation is the stimulation that stems from within oneself to be self sustained (Osterloh and Frey, 2000). Motivation is crucial for the knowledge holders to contribute "the real good stuff." Therefore, we hypothesize:

H7a: There is a positive relationship between perceived extrinsic personal benefits and

KRS output quality.

H7b: There is a positive relationship between perceived intrinsic personal benefits and KRS output quality.

H7c: There is a positive relationship between employees' organizational motivation and KRS output quality.

Refinement Quality

Refinement Quality refers to the degree to which how well the KRS content is classified and maintained. After knowledge holders contribute their knowledge into the KRS, knowledge refinement is needed to make the knowledge in the repository intellectually accessible and meaningful, which is normally assumed by specialized employees in the roles of, for example, knowledge intermediaries or subject matter specialists (Zack, 1999; Markus, 2001; Maier, 2002) It includes indexing and integrating the captured knowledge and deletion of obsolete knowledge elements. This construct is meant to assess the success of these knowledge-related services which are directly related to output quality:

H8: There is a positive relationship between refinement quality and KRS output quality.

System Quality

Information technologies provide a pipeline for the flow of explicit knowledge from a repository to knowledge seekers. Because IT plays a key role in knowledge distribution, System Quality should be the focus of success study in this stage. System Quality reflects technical, performance-oriented, engineering criteria of KRS. Among many potential dimensions of system quality, this study includes Ease of Use, Search Ability, and System Reliability.

System Quality has been represented in many researches by Ease of Use (Seddon and Kiew,1996; Kankanhalli, et al. 2001; Rai et al., 2002), which is defined as the degree to which a system is ”user friendly” (Doll and Torkzadeh, 1988) or using it is free of effort (Davis, 1989). Ease of Use is probably the most widely used construct when talking about system quality. But for KRS, we need to effectively represent the entirety of system characteristics instead of limiting our attention to ease of use.

In studying system quality of Data warehousing, Shin (2003) suggested that it is necessary to include ability to locate data as well as ease of use as a sub-dimension of System Quality. Similarly, Bowman (2002) argued that one of the most obvious functionalities of KRS is the ability to retrieve information, so search ability is an important technology feature. So for KRS, which can be regarded as a kind of information retrieval system, we consider Search Ability as another aspect of System Quality.

As discussed earlier, Accessibility Output Quality “emphasizes the importance of the role of systems.” (Wang and Strong, 1996) That means the system should be accessible and available whenever knowledge seekers need it. A system cannot be regarded as being successful if it is subject to frequent problems and crashes. Therefore we include System Reliability in System Quality, which also can be found in many studies about system success (Goodhue and Thompson, 2001; McGill and Hobbs, 2003) According to DeLone and McLean's model, we hypothesize:

H9: Employees are more satisfied with the KRS of higher system quality.

H10: System quality of a KRS is positively related to the use of the KRS by employees.

Chapter 4. Research Methodology

This chapter describes the research methodology employed in this study. It discusses the operationalization of the constructs, survey administration and data analysis procedures.

4.1 Measures

We adopted the survey method as the main method for data collection. A questionnaire comprised of tailored measurement scales was used in this study. Where possible, measures were adapted from previous studies to enhance validity. Items which were not appropriate for the applications under consideration were excluded.

A three-item scale measuring Collaborative Climate and a six-item scale measuring Trust Climate were directly adopted from Lee and Choi (2003). For Posocial Motivation, instrument developed by Constant et al. (1996) was employed to measure Personal Benefits and Organization Motivation. Although Constant et al. (1996) emphasized the difference between intrinsic and extrinsic benefits, they did not distinguish them when measuring Personal Benefits. Therefore, we classify the items for Personal Benefits into two categories: Extrinsic Benefits and Intrinsic Benefits, according to Osterloh and Frey's (2000) definition. Knowledge refinement is unique for KRS and there are few empirical studies in this regard, therefore widely accepted measures for Refinement Quality is not available. Six items for Refinement Quality were derived from theoretical statements made in the literature on knowledge reuse (Zack, 1999; Markus, 2001) and measures for knowledge-specific services suggested by Maier (2002).

To measure Output Quality, ten items were developed based on Wang and Strong's (1996) framework, with three items for Intrinsic Quality, three items for Representational Quality and four items for Contextual Quality. Three sub-dimensions of System Quality, namely Ease of Use, Search Ability and System Reliability were measured using widely used measurement scales from Doll and Torkzadeh (1988), Xie et al. (1998), Rai et al. (2002), and Maier (2002).

As one of the best known and most applied IS construct, User (Information) Satisfaction was well established by Bailey and Person (1983), Ives et al. (1983), and Doll and Torkzadeh (1988). But these instruments are quite extensive and fall into the categories of System Quality and Information Quality (Maier 2002). Given the confounding of User Satisfaction with Information Quality and System Quality in previous measurements, in this study Seddon & Yip's (1992) four-item overall satisfaction measurement was employed.

Use should ideally be measured by objective, quantitative measures. Unfortunately, they are extremely difficult to ascertain in field study (Goodhue and Thompson, 1995). More often, subjective measures such as, regularity and intensity, are used. In addition, successful KRS require on-going use. Goodhue and Thompson (1995) conceptualized utilization as the extent to which the IS have been integrated into each individual's work routine, which reflects the institutionalization of the system. In KRS, as more knowledge is consumed to fulfill job tasks, the more the KRS is integrated into the users' work routine, and the more dependent the person becomes on the system (Rai et al. 2002). Therefore, one more item was designed to ask the respondents their "dependency" on KRS.

Individual Impact was measured by perceived individual performance impact since objective measures of individual impact were not available in this field context when respondents are from different organizations in different industries. Three questions were adopted from Goodhue and Thompson (1995) and McGill and Hobbs (2003) asking individuals to self-report on the perceived impact of KRS on their effectiveness, productivity, and performance in their job.

We adopted five-point Likert scales to measure all items. Totally, 56 items were included in the questionnaire. Since most of the items have been validated in previous studies, no sorting exercise was carried out. Instead, one professor and a group of research students in IS research area checked the questionnaire to ensure the face and content validity. Based on the academics' review, ambiguous sentences were reworded and inappropriate questions were dropped. Research constructs and their related literature are summarized in table 1 and all items are listed in *Appendix A*.

Table 1. Research Constructs

Constructs		Acronym	Items	References
Collaboration Climate		COL	3	Lee & Choi 2002
Trust Climate		TRU	6	
Extrinsic Benefits		EXB	3	Constant et al. 1996
Intrinsic Benefits		INB	3	
Organizational Motivation		OM	4	
Refinement Quality		RQ	6	Maier 2002, Self-developed
Output Quality*	Intrinsic Quality	INT	3	Huang et al. 1999, Wang & Strong 1996
	Representational Quality	REP	3	
	Contextual Quality	CON	4	
System Quality*	Ease of Use	EOU	4	Doll & Torkzadeh 1988, Rai et al. 2002, Shin 1995
	Search Ability	SEA	3	Kankanhalli et al. 2001, Maier 2002, Xie et al. 1998
	System Reliability	REL	3	Goodhue & Thompson 1995, McGill & Hobbs 2003
User Satisfaction		US	4	McGill & Hobbs 2003, Seddon & Yip 1992
Use		USE	4	Goodhue & Thompson 1995, Rai et al. 2002
Individual Impact		IMP	3	Goodhue & Thompson 1995, McGill & Hobbs 2003

* Output Quality and System Quality are formative second-order constructs, and other constructs are all reflective.

4.2 Survey Administration

Evaluation of IS success must be appropriately framed within either a micro or macro evaluation perspective (Grover et al., 1996). In this study we take a micro perspective to study the extent to which a KRS satisfies the knowledge requirements of the organizational members. Our analysis is conducted at the individual level, therefore the target respondents were business workers who are using KRS. In this study, these KRS users are both knowledge seekers and knowledge contributors.

The survey was administrated among organizations in China and Singapore through mail (for respondents in Singapore) and email (for respondents in China) during 4 month time from February 2004 to May 2004. Because some data were collected in China, in order to ensure the translation equivalency between the Chinese and English versions of questionnaire, two bilingual translators were invited to do back-translation (Mullen, 1995; Singh, 1995). KRS are mainly adopted by big companies and high-tech companies in China and their employees are normally well-educated and English literate. Therefore, for the questionnaires distributed in China, we included English as well as Chinese wording to minimize any possible inequivalency between English and Chinese. The questionnaires were distributed among 12 companies with KRS in use in China and Singapore and a group of part-time postgraduate students who have relevant experience of using KRS. Among about 300 distributed survey packets, 110 useable responses returned (37% responses rate). Table 2 shows the respondents' characteristics according to industry type. The 110 respondents (82 respondents are from China and 28 are from Singapore) constitute an acceptable representative organizational sample.

Table 2. Profile of Organizations

Industry	# of Response	Percentage	Industry	# of Response	Percentage
Financial Industry	12	10.9	Electric Machinery and Electronics	19	17.3
Telecom	24	21.8	Research Institute	18	16.3
Software	25	22.7	Consulting	6	5.5
Others	6	5.5	Total	110	100

4.3 Analytical Procedures

The data were analyzed using PLS Graph (Version 3.00), a software package based on structural equation modeling (SEM) techniques. The SEM techniques combine aspects of multiple regression and factor analysis to allow us to perform path analytic modeling with multiple latent variables and evaluate causal relationships among multiple interested constructs simultaneously (Joreskog and Sorbom, 1982; Chin, 1998). While superior to other multivariate techniques, SEM requires strong theoretical justification for the model.

In this study PLS was employed for several reasons (Barclay et al., 1995; Chin, 1998). Firstly, this study is an early attempt to incorporate knowledge reuse process into success measurement model, and PLS is an ideal tool for this kind of exploratory study. Secondly, PLS is able to handle formative as well as reflective constructs, as is the case with our study. Lastly, PLS requires small sample size to validate a model. In spite of our great efforts to collect as many responses as possible, the sample size of 110 available is not large. PLS requires a minimal sample size that equals 10 times (1) the number of the indicators on the most complex formative construct, or (2) the largest number of independent constructs influencing a single dependent construct (Barclay et al., 1995), hence our sample size is considered enough for PLS analysis.

The measurement model was assessed through reliability, convergent and discriminant validity. However, reflective and formative measures should be treated differently. Reflective indicators are viewed as affected by the same underlying concept. On the other hand, formative indicators are measures that form or cause the creation of change in a latent variable, therefore different dimensions are not expected to correlate or demonstrate internal consistency (Chin 1998).

In our model, there are two second-order variables: Output Quality and System Quality, and their associated first-order variables are formative indicators. Since there is no clear-cut between formative and reflective constructs (Chwelos, et al. 2001; Diamantopoulos and Winklhofer, 2001), the modeling of formative indicators in this study reflects our best judgment. For example, high system quality of a KRS is caused by having high search ability and/or being reliable. And the fact that the system is reliable does not necessarily ensure that the KRS has high search ability.

Internal consistency reliability and unidimensionality cannot be used to judge the quality of formative measures (Chin, 1998; Chwelos, et al. 2001), as Output Quality and System Quality in this study. Instead, item weights and t-statistics were examined to identify the relevance of the items to the research model (Wixom and Watson, 2001). Item weights can be interpreted as a beta coefficient in a standard regression and normally have smaller values than item loadings (Chwelos, et al. 2001). However, since their first-order variables (i.e. Intrinsic Quality, Representational Quality, Contextual Quality, Ease of Use, Search Ability and System Reliability) have reflective indicators, their reliability and convergent and discriminant validity should be assessed.

To test the structural model, we examined path coefficients (loadings and significance), which indicate the strength of the correlations between dependent and independent variables, and R^2 values, which demonstrate the amount of variance explained by the independent variables (Wixom and Watson, 2001). To determine the significance of the paths within the structural model, a Jackknife resampling procedure was performed. We chose Jackknifing over the use of Bootstrapping because Bootstrap resampling procedure essentially treats the researcher's data set as the population and requires the original sample to be large and representative (Kline, 1998). Considering our relatively small sample size and convenience-sample method, Jackknifing is more appropriate for our study.

Chapter 5. Data Analysis and Results

This chapter deals with data analysis results. It discusses the validation tests taken to ensure the validity and reliability of the instruments and the results of statistical analysis carried out to assess the research hypotheses.

5.1 Validity of Instrument

5.1.1 Content Validity

Content validity means how representative and comprehensive the measurement instrument is to reflect a theoretical construct. In this study the content validity is established through adoption of the instruments validated by other researchers and a series of reviews with the help of colleagues in IS research area.

5.1.2 Reliability

Reliability is the dependability or consistency of a measuring instrument, that is, the extent to which the respondent answers the same question in the same way (Neuman and Kreuger, 2003). The internal consistency reliability was assessed through calculating Cronbach's alpha values. Since most of the instruments were adopted from previous research, a higher cutoff value of 0.7 may be used to indicate the acceptable level of internal consistency (Nunnally, 1978). According to the table 3, all constructs have alpha values higher than 0.7 which shows the evidence that the scales used in the study are reliable.

Table 3. Summary Statistics for Measures of the Survey

Construct	Items	Loading /Weight	t-value	Cronbach's Alpha	Composite Reliability	AVE
Collaboration Climate	COL1	0.706	5.922	0.776	0.867	0.687
	COL2	0.901	22.177			
	COL3	0.863	12.211			
Trust Climate	TRU1	0.818	17.307	0.851	0.891	0.577
	TRU2	0.750	10.855			
	TRU3	0.792	17.536			
	TRU4	0.758	13.061			
	TRU5	0.727	11.199			
	TRU6	0.711	7.760			
Extrinsic Benefits	EXB1	0.906	21.52	0.834	0.888	0.729
	EXB2	0.951	26.825			
	EXB3	0.662	4.7836			
Intrinsic Benefits	INB1	0.873	28.079	0.804	0.886	0.721
	INB2	0.865	20.293			
	INB3	0.808	15.483			
Organizational Motivation	OM1	0.821	12.878	0.808	0.862	0.613
	OM2	0.744	6.440			
	OM3	0.675	5.460			
	OM4	0.877	14.368			
Refinement Quality	RQ1	0.832	21.080	0.876	0.907	0.621
	RQ2	0.713	10.204			
	RQ3	0.879	29.572			
	RQ4	0.753	14.975			
	RQ5	0.761	14.085			
	RQ6	0.776	13.179			
Intrinsic Quality	INT1	0.893	25.255	0.866	0.918	0.789
	INT2	0.896	43.824			
	INT3	0.875	27.378			
Representational Quality	REP1	0.881	20.974	0.750	0.856	0.665
	REP2	0.806	12.451			
	REP3	0.735	7.429			
Contextual Quality	CON1	0.809	19.369	0.823	0.883	0.656
	CON2	0.883	36.511			
	CON3	0.841	27.048			
	CON4	0.699	9.972			

Construct	Items	Loading /Weight	t-value	Cronbach's Alpha	Composite Reliability	AVE
Ease of Use	EOU1	0.757	11.502	0.872	0.913	0.725
	EOU2	0.894	35.733			
	EOU3	0.894	45.466			
	EOU4	0.853	23.946			
Search Ability	SEA1	0.870	23.291	0.883	0.928	0.81
	SEA2	0.916	44.991			
	SEA3	0.914	53.137			
System Reliability	REL1	0.854	24.299	0.863	0.915	0.782
	REL2	0.894	31.714			
	REL3	0.904	33.990			
User Satisfaction	US1	0.859	29.755	0.902	0.932	0.774
	US2	0.881	30.343			
	US3	0.87	36.343			
	US4	0.909	52.611			
Use	USE1	0.900	43.136	0.904	0.934	0.78
	USE2	0.914	47.057			
	USE3	0.902	41.229			
	USE4	0.812	22.770			
Individual Impact	IMP1	0.932	48.560	0.936	0.959	0.887
	IMP2	0.952	78.285			
	IMP3	0.941	71.102			
Output Quality	INT*	0.255	1.976			
	REP*	0.051	0.483			
	CON*	0.815	7.692			
System Quality	EOU*	0.260	1.568			
	SEA*	0.463	2.291			
	REL*	0.540	2.487			

* For formative indicators, only weights and their t-values are reported.

Another measure of reliability is composite reliability developed by Fornell and Larcker (1981). This measure is more general than Cronbach's alpha, because it is not influenced by the number of items in the scale (Barclay et al., 1985). Nunnally (1978) recommended the threshold value of 0.7 as an indicator of 'modest' reliability. Table 3 shows that all composite reliability values exceed 0.7 ranging from 0.856 (for Representational Quality) to 0.959 (for Individual Impact).

5.1.3 Construct Validity

Construct validity "asks whether the measures chosen are true constructs describing the event or merely artifacts of the methodology itself," (p.150) and can be assessed through principal components or confirmatory factor analysis (Straub, 1989).

Principal components factor analysis with varimax rotation was first carried out on twenty-five items that measure the antecedents of Output Quality and on eleven items that measuring three dependent variables, namely Use, User Satisfaction and Individual Impact. For two second-order variables with formative indicators: Output Quality and System Quality, factor analysis is not applicable. However, their first-order variables are reflective, therefore factor analysis is performed on the twenty items measuring the six dimensions of Output Quality and System Quality. *Appendix B* reports the principal components factor analysis results, which show that all items have high loading (>0.5) on the intended factor and low loading (<0.411) on unintended factors.

A confirmatory factor analysis was then conducted to assess construct validity by examining convergent and discriminant validity. Convergent validity ensures that all items measure a single underlying construct. It can be assessed by computing the composite reliability, and average variance extracted of each construct (Hair et al., 1998). As discussed before, our composite reliability values are all above the threshold value suggested by Nunnally (1978). As for average variance extracted, Fornell and Larcker (1981) suggested a score of 0.5 indicates an acceptable level. As shown in table 3, all AVE values are larger than 0.5. Another evidence of convergent validity is that items load highly (loading > 0.5) on their associated constructs (Wixom et al. 2001). According to table 3, all reflective items have significant loadings much higher than suggested threshold.

Discriminant validity reflects the extent to which the measures for each construct are distinctly different from each other (Anderson, 1987). It can be assessed by comparing the correlation between two constructs and the respective AVE (Fornell and Larcker, 1981). In our study, the square root of the AVE for each construct is greater than the correlations between it and all other constructs, which shows evidence of high discriminant validity (Table 4).

Table 4. Correlation between Constructs

	COL	TRU	EXB	INB	OM	RQ	INT	REP	CON	EOU	SEA	REL	US	USE	IMP
COL	0.829														
TRU	0.504	0.760													
EXB	0.062	-0.049	0.854												
INB	0.196	0.251	0.094	0.849											
OM	0.246	0.308	0.245	0.529	0.783										
RQ	0.149	0.246	-0.042	0.223	0.296	0.788									
INT	0.223	0.253	-0.162	0.309	0.168	0.430	0.888								
REP	0.094	0.252	-0.252	0.215	0.138	0.472	0.531	0.815							
CON	0.156	0.347	-0.161	0.375	0.207	0.337	0.521	0.470	0.810						
EOU	0.111	0.121	0.054	0.308	0.113	0.498	0.312	0.293	0.317	0.851					
SEA	0.068	0.126	0.071	0.145	0.021	0.357	0.296	0.338	0.340	0.462	0.900				
REL	0.177	0.282	0.055	0.325	0.304	0.496	0.509	0.402	0.381	0.432	0.389	0.884			
US	0.226	0.366	-0.112	0.205	0.140	0.548	0.506	0.390	0.660	0.385	0.496	0.469	0.880		
USE	0.157	0.305	0.016	0.259	0.291	0.327	0.347	0.209	0.677	0.338	0.303	0.384	0.609	0.883	
IMP	0.075	0.251	-0.030	0.362	0.289	0.374	0.487	0.287	0.702	0.282	0.227	0.325	0.672	0.724	0.942

The shaded numbers in the diagonal row are square roots of the average variance extracted.

5.1.4 Multicollinearity Test

In addition to the validity assessment, we conducted the multicollinearity test. Mulitcollinartiy is caused by too high shared variance among dependent variables. It could distort research results substantially or make them quite unstable, and thus make it difficult to draw conclusive conclusion from the data (Hair et al., 1998). Two measures commonly used for assessing multiple variable collinearity are the tolerance value and its inverse, variance inflation factor (VIF). A common cut-off threshold is a VIF value of 10. In our study the values of VIF for the independent constructs range from 1.11 to 1.79, which shows no multicollinearity problem. Therefore, our instruments exhibit evidence of being reliable and validated, and are deemed adequate for further analysis of the structural model.

5.2 Testing the Structural Model

With adequate measurement model and an acceptable level of multicollinearity, the proposed model is tested with PLS Graph (Version 3.00) employing a jackknife resampling techniques. The results of hypotheses testing are depicted in Figure 3 and summarized in Table 5.

Hypotheses 1 to 5 and hypothesis 9 and 10 follow from DeLone and McLean's model directly. The results provide strong support for six of the hypotheses except the relationship between System Quality and Use (H10).

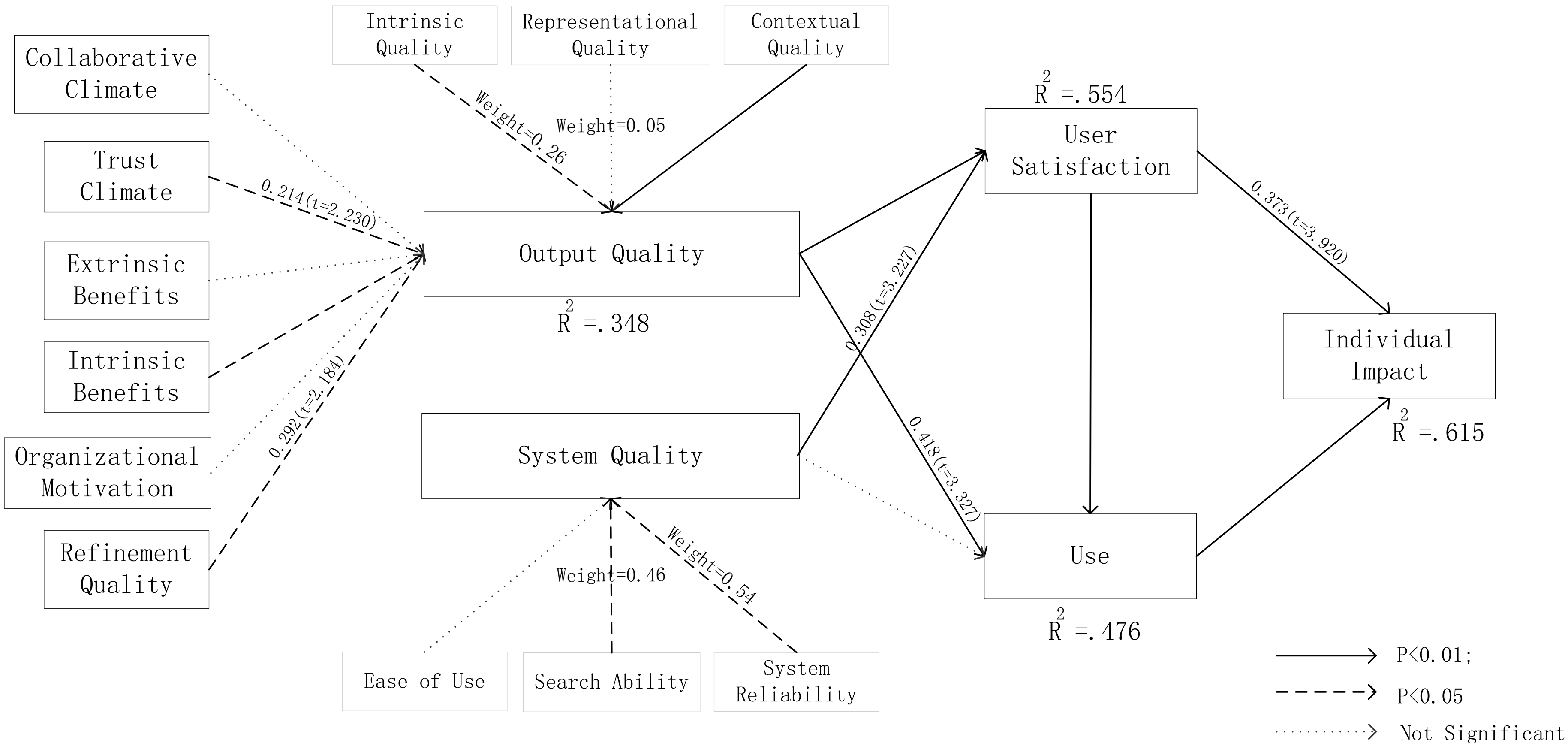

Figure 4. Results of PLS Analysis

Hypotheses 6 to 8 are about the relationships between knowledge acquisition and refinement and KRS output quality. While the positive impact of Trust Climate on Output Quality (H6b) is supported, there is no significant relationship between Collaborative Climate and Output Quality (H6a). For motivational hypotheses, only the positive impact of Intrinsic Benefits (H7b) on Output Quality is supported. We also discover that Refinement Quality affects Output Quality (H8) significantly.

Table 5. Hypotheses Test Results

Hypotheses	Results
H1: The positive impact of a KRS on an individual's performance increases as user satisfaction increases.	**Supported**
H2: The positive impact of a KRS on an individual's performance increases as use increases.	**Supported**
H3: User satisfaction positively affects the use of a KRS by employees.	**Supported**
H4: Employees are more satisfied with the KRS with higher output quality.	**Supported**
H5: Output quality of a KRS is positively related to the use of the KRS by employees.	**Supported**
H6a: There is a positive relationship between collaborative climate and KRS output quality.	**Not Supported**
H6b: There is a positive relationship between trust climate and KRS output quality.	**Supported**
H7a: There is a positive relationship between perceived extrinsic personal benefits and KRS output quality.	**Not Supported**
H7b: There is a positive relationship between perceived intrinsic personal benefits and KRS output quality.	**Supported**
H7c: There is a positive relationship between employees' organizational motivation and KRS output quality.	**Not Supported**
H8: There is a positive relationship between refinement quality and KRS output quality.	**Supported**
H9: Employees are more satisfied with the KRS of higher system quality.	**Supported**
H10: System quality of a KRS is positively related to the use of the KRS by employees.	**Not Supported**

Moreover, in PLS the item weights of formative constructs can be interpreted to be similar to estimated coefficients from a multiple regression, thus display the importance of each subconstruct's impact on dependent variables (Chwelos, et al. 2001). By looking at the indicator weights in table 3, we discover that Intrinsic Quality (0.26) and Contextual Quality (0.82) are more important in affecting User Satisfaction and Use, and out of three sub-dimensions of System Quality, only Search Ability (0.46) and System Reliability (0.54) significantly contribute to User Satisfaction.

Chapter 6. Discussion and Implications

This chapter first interprets the research findings in this research. The following sections discuss the limitations and implications of this study for theoretical research and practice.

6.1 Discussion of Results

The objective of the empirical test is to validate the interrelationships suggested in our research model. In general our findings support major hypotheses in our proposed KRS success.

In KRS, a knowledge provider has much less control over who has access to his or her knowledge than that in face to face knowledge sharing. Hence, a trust organizational climate which alleviates the fear of this risk is important to encourage people to participate in knowledge sharing (Lee and Choi, 2003). In an organization with trust climate, KRS users are less likely to hoard their knowledge, and more willing to contribute their personal expertise into KRS. As a result, they will perceive the knowledge in the repository to be of higher quality. However, the results do not support the relationship between collaborative climate and output quality. It is probably due to the fact that people tend to communicate more directly in a climate that promotes collaboration and prefer knowledge exchange through direct interaction to inputting their knowledge into repositories. So in this sense, collaborative climate is a more important aspect of success for KMS which follow personalization strategies rather than KRS.

For motivational factors, our findings are consistent with Constant et al. (1996) in that it is perceived intrinsic benefits, not extrinsic benefits that predict the output quality of KRS. Through sharing their valuable expertise, KRS users expect to earn more respect from others and increase personal identification and reputation. It is surprising to find insignificant relationship between organizational motivation and the quality of knowledge. One possible explanation is when knowledge holders are organizationally motivated and regard contributing as their obligation and responsibility, they tend to put more emphasis on quantity rather than quality of knowledge they input into the repositories. Our findings suggest that people contribute their knowledge with high quality out of personal benefits of heightening self-esteem and pride other than organizational citizenship and reciprocity.

Our results also confirm the important role of knowledge refinement in a successful KRS. Refinement quality and output quality are significantly related. Markus (2001) and Zack (1999) propose that successful KRS require a special organizational role of knowledge intermediary responsible for packaging and refining the knowledge contributed by knowledge holders. Our study provides empirical evidence for these arguments.

Furthermore, the results validate DeLone and McLean's model in KRS context, except for the relationship between system quality and system use. Unlike traditional information systems (e.g. transaction processing systems), the KRS do not help users complete their job and improve their performance directly. They only facilitate users to have access to knowledge which really matters for KRS users. Therefore, employees' decisions on whether to use or not are not based on a system itself, but what is "contained" in the system.

After a more careful investigation into each sub-dimension of output quality and system quality, we get some interesting findings. For output quality, two sub-dimensions, intrinsic quality and contextual quality, emerge to be important for KRS users. The large weight on contextual quality demonstrates that if the knowledge is relevant to KRS users' tasks is the key consideration in evaluating the quality of knowledge in KRS. However, KRS users do not care too much about the understandability of the knowledge in KRS, at least compared with the other two quality dimensions. It is probably due to that when KRS users seek knowledge in repositories, they expect to get something new, complex or even difficult for them rather than very easy to understand.

For system quality, it is a little surprising to find that only system search ability and reliability matter for user satisfaction of KRS, while the weigh for ease of use is not significant. It is inconsistent with Technology Acceptance Model (Davis, 1989), where attitudes about using a system are impacted by beliefs about ease of use. In our model, as a success measurement, Use means on-going rather than initial use. While ease of use is important for system adoption, as suggested in Technology Acceptance Model, it is not the key consideration when KRS decide whether to keep using KRS or not. Instead, they put more emphasis on whether accurate and quick search results can be achieved through system search engines and whether the system is available when they need to use the KRS.

6.2 Limitations

Before discussing the implications of our study, it should be noted that our findings are subject to at least three potential limitations. Firstly, we do not include organizational impact in our KRS success model due to the difficulty in securing the factual and generic data on organizational performance from participating organizations. However, a successful KRS definitely has impact beyond the immediate users. The ultimate goal for organizations to implement KRS is to derive benefits from appropriately explicating tacit knowledge embedded in employees into the repositories so it can be effectively and meaningfully shared and reapplied, which leads to competitive edge. Thus, the impact of KRS on organizational bottom-line performance could be examined in future studies, especially when the study is conducted in a specific organization.

Secondly, the sample used in this study may be biased because the survey was taken by the convenience-sample method and the questionnaire respondents were limited to KRS users in China and Singapore. This may cast doubt on the representativeness of the sample and generalizability of the findings.

Thirdly, it is possible to have other causal relationships among the variables. We discovered a significant correlation between Refinement Quality and System Quality through linear regression. It is probably due to the fact that when the knowledge in the repositories is well-classified and well-organized, it is easier to get quick and relevant search results from search engines. While high refinement quality could improve system search ability, for the other two aspects of system quality, i.e. Ease of Use and System Reliability, their relationships with Refinement Quality make no sense. This suggests that the relationship between Refinement Quality and System Quality should be investigated in more detail in future studies.

Finally, except for output quality and system quality, our model fails to include other factors that may affect the use of KRS. These factors could be candidates for another KRS success dimensions. For example, Theory of Reasoned Action (Ajzen and Fishbein, 1980) suggests that subjective norm will influence system use, and in future studies researchers can investigate whether normative beliefs on using KRS constitute an important aspect of KRS success.

6.3 Implications

Despite some limitations above mentioned, this study makes several contributions to the academics as well as to practitioners. Firstly, knowledge can be viewed as both an object to be stored and consumed and a process of applying expertise (Alavi and Leidner, 2001). Taking these two perspectives and building upon Manson's information influence theory, we apply DeLone and McLean's model to KRS and extend it by analyzing how knowledge is produced and reused in repositories based on Markus's reusability process to propose a more comprehensive KRS success measurement model. We suggest KRS success should be measured at each stage of knowledge reuse as well as the influence on knowledge users. In addition, our model is based on the overarching theoretical framework of Mason's information output measurement, which deflects "concerns over lack of theoretical justification by conceiving dimensions of a measurement model." (Gable et al., 2003)

Secondly, this study is among the first to empirically validate KMS/KRS success models. The empirical study results give evidence of the validity of our KRS success model which captures the multidimensional and interdependent nature of KRS success. In a success measurement model various success categories should "represent distinct dimensions of a complex, high-order phenomenon." (Gable et al., 2003) In our model each construct address an important aspect/stage of KRS success and the confirmative factor analysis results ensure that each measure does not overlap with another. Moreover, our study provides empirical support for the causal interdependencies between different success dimensions. We find success in knowledge acquisition, which includes nurturing trust climate in the organization and motivating employees intrinsically to contribute their knowledge into repositories, and knowledge refinement leads to high output quality of KRS. The quality of knowledge stored in the repository along with the technical characteristics of the system will affect user satisfaction, system use and finally have some impacts on the KRS users. Differently from what suggested in DeLone and McLean's model, system quality will not affect system use directly, but through user satisfaction in KRS context.

From a practical point of view, our model offers a practical means for organizations to evaluate and predict the success of complex KRS. KRS success is multidimensional and interdependent in nature, it is therefore necessary for managers to understand the interrelationships among, or to control for, those dimensions. The success of a KRS should be measured at different stages of knowledge acquisition, knowledge refinement, knowledge distribution and knowledge use as well as knowledge quality, user satisfaction and perceived impact. In knowledge acquisition, managers should examine if trust climate and intrinsic reward system are established properly in organizations. We also discover the important role of knowledge refinement in successful KRS. Another interesting finding is that among different aspects of system quality, search ability and system reliability are more dominant in affecting user satisfaction than ease of use. All these suggest that when implementing or evaluating KRS, managers should also pay special attention to the quality of knowledge refinement, system reliability and system search engines. In case of low levels of success, intervention strategies can then be formulated accordingly to improve KRS success in meeting users' knowledge needs.

Concluding Remarks

With the enthusiastic embracement of KMS, more specifically KRS, by IS researchers and practitioners, the measurement of the success of these KM initiatives is crucial to understanding how these systems should be implemented and evaluated in organizations (Jennex and Olfam, 2003). Therefore, the purpose of this research is to give a holistic view of KRS success by systematically combining different measures for KRS success. The study complements prior literature by integrating DeLone and McLean's IS success model with Markus's knowledge reuse process concept and offers an encompassing picture of KRS success. Furthermore, the empirical study validates the interrelationships between the success dimensions in our model and demonstrates the uniqueness of KRS to other IS.

Since our interests are focused on KRS, the proposed success model is only applicable to KMS that follow a codification strategy. More future studies can be expanded into other type of KMS (e.g. discussion forum) which aims to facilitate knowledge sharing through direct interaction among employees. We hope our research could provide some additional insights regarding KMS success research for future studies to incorporate the unique features of knowledge, knowledge management and knowledge management systems into the success measurement models.

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Appendix A: Questionnaire items

Construct	Items	Description	Mean	S.D.
Collaboration Climate	COL1	The company members are satisfied with the degree of collaboration.	3.6364	.7133
	COL2	are supportive.	3.8545	.7274
	COL3	are helpful.	3.9000	.7161
Trust Climate	TRU1	are generally trustworthy.	3.7818	.7216
	TRU2	have reciprocal faith in other members' intentions and behaviors.	3.6000	.7687
	TRU3	have reciprocal faith in others' ability.	3.6182	.7292
	TRU4	have reciprocal faith in others' behaviors to work toward organizational goal.	3.3727	.9273
	TRU5	have reciprocal faith in others' decision toward organizational interests than individual interests.	3.0727	.7865
	TRU6	have relationships based on reciprocal faith.	3.8364	.6977
Extrinsic Benefits	EXB1	The reasons for contributing knowledge is I could get bonuses for my contribution.	2.5727	1.0268
	EXB2	it could help me get promotions.	2.9091	1.0168
	EXB3	the company rewards knowledge sharing.	2.9727	.9811
Intrinsic Benefits	INB1	I enjoy helping others.	3.8364	.7235
	INB2	I enjoy earning respect.	3.9545	.7343
	INB3	I enjoy solving problems.	3.8727	.7794
Organizational Motivation	OM1	I want to be a good company citizen.	3.8909	.8278
	OM2	this knowledge is important to my company.	3.8909	.8278
	OM3	it is part of my job to contribute to the KRS.	3.5636	.9436
	OM4	I expect to benefit from others' knowledge in the KRS, so it's only fair to contribute.	4.1545	.8798
Refinement Quality	RQ1	The KRS has well-organized contents.	3.1545	.9596
	RQ2	There is no redundancy in the KRS.	2.6909	.8099
	RQ3	The newly-added knowledge is integrated into the KRS.	2.9636	.8342
	RQ4	The KRS is updated regularly.	3.1818	.9402
	RQ5	The obsolete knowledge is removed from the KRS in time.	2.5455	.8420
	RQ6	The out-dated knowledge in the KRS is replaced by up-to-date one.	2.7545	.8902
Intrinsic Quality	INT1	The output (knowledge) of the KRS is: accurate.	3.6000	.7566
	INT2	trustworthy.	3.6636	.7453
	INT3	of good reputation.	3.5182	.6871

Representational Quality	REP1	easy to understand.	3.6818	.7534
	REP2	consistently represented.	3.4727	.7258
	REP3	concisely represented.	3.3091	.7135
Contextual Quality	CON1	value-added for my working tasks.	3.5364	.7743
	CON2	relevant to my working tasks.	3.5727	.7952
	CON3	current for my working tasks.	3.4818	.8321
	CON4	The KRS provides me with appropriate amount of knowledge for my working tasks.	3.2545	.8177
Ease of Use	EOU1	The KRS has friendly user-interface.	3.3091	.8432
	EOU2	I find learning to use the functionalities of the KRS is easy for me.	3.5909	.8383
	EOU3	I find it easy to get the KRS to do what I want it to do.	3.3182	.8771
	EOU4	I find the KRS is easy to use.	3.4636	.8745
Search Ability	SEA1	The KRS has ability to narrow search.	3.3273	.9395
	SEA2	The KRS has quick search response.	3.3182	.9475
	SEA3	The search results are relevant to the query.	3.2273	.9449
System Reliability	REL1	I can count on the KRS to be “up” and available when I need it.	3.5000	.8323
	REL2	The KRS is rarely subject to unexpected or inconvenient down times which make it harder to do my work.	3.4727	.9258
	REL3	The KRS is seldom subject to problems and crashes.	3.5727	.9622
User Satisfaction	US1	I feel the KRS adequately meets the knowledge needs of my area of responsibility.	2.8455	.9106
	US2	The KRS is efficient.	3.1182	.8210
	US3	The KRS is effective.	3.2455	.8371
	US4	Overall, I am satisfied with the KRS.	3.1091	.9321
Use	USE1	In my work, I use the KRS frequently.	3.1455	.8656
	USE2	In my work, I use the KRS extensively.	3.0364	.8771
	USE3	In my work, I use the KRS on regular basis.	3.1636	.9533
	USE4	I depend on the KRS to execute my working tasks.	2.7818	.9324
Individual Impact	IMP1	The KRS has a large, positive impact on my effectiveness in my job.	3.1273	.8140
	IMP2	The KRS has a large, positive impact on my productivity in my job.	3.2727	.8976
	IMP3	The KRS is an important and valuable aid to me in the performance of my job.	3.2727	.8449

Appendix B: Principal Components Factor Analysis Results

Factor Matrix for Antecedents of Output Quality

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
COL1	.159	.073	.082	-.120	-.026	**.834**
COL2	-.019	.269	.076	.108	.046	**.817**
COL3	.025	.459	.068	.233	.116	**.600**
TRU1	.040	**.727**	.079	.201	-.082	.325
TRU2	.077	**.706**	.181	.019	-.003	.249
TRU3	.000	**.799**	-.160	.156	.151	.152
TRU4	.202	**.748**	.139	.086	-.149	-.071
TRU5	.215	**.743**	.244	-.056	-.036	-.088
TRU6	-.007	**.619**	.080	-.026	-.061	.398
EXB1	-.074	-.052	.124	-.062	**.891**	.056
EXB2	-.064	-.126	.000	-.023	**.869**	.105
EXB3	.065	.095	.233	.203	**.785**	-.135
INB1	.135	.212	.343	**.738**	-.016	.000
INB2	.139	.033	.249	**.817**	.077	.132
INB3	-.009	.046	.111	**.809**	.014	-.039
OM1	.079	.151	**.683**	.366	.057	.146
OM2	.031	.187	**.810**	.212	.061	-.014
OM3	.141	.037	**.743**	.011	.289	.054
OM4	.236	.099	**.664**	.291	.008	.130
RQ1	**.788**	.196	.099	.196	-.142	.075
RQ2	**.720**	.077	.010	-.041	-.019	.004
RQ3	**.859**	.191	-.024	.148	-.066	.062
RQ4	**.703**	.132	-.013	.201	-.033	.157
RQ5	**.766**	.017	.282	-.077	.061	-.006
RQ6	**.793**	-.122	.200	-.059	.090	-.071

Factor Matrix for Output Quality and System Quality

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
EOU1	**.673**	.041	.235	.144	.188	.046
EOU2	**.886**	.123	.082	.075	.188	-.023
EOU3	**.850**	.097	.090	.306	-.058	.133
EOU4	**.806**	.094	-.026	.157	.231	.173
SEA1	.185	.084	.102	**.852**	.029	.072
SEA2	.283	.104	.018	**.809**	.253	.152
SEA3	.136	.135	.133	**.866**	.155	.097
REL1	.310	.245	.193	.112	**.673**	.073
REL2	.182	.106	.196	.164	**.820**	.249
REL3	.112	.064	.205	.136	**.888**	.076
INT1	.119	.160	**.811**	.109	.183	.247
INT2	.108	.237	**.797**	.149	.275	.039
INT3	.105	.249	**.766**	.011	.146	.256
REP1	.096	.166	.439	.100	.064	**.609**
REP2	.075	.192	.213	.187	.134	**.732**
REP3	.096	.127	.077	.050	.152	**.842**
CON1	-.002	**.774**	.199	.020	.243	.157
CON2	.051	**.857**	.178	.081	.126	.138
CON3	.202	**.729**	.347	.098	.087	.027
CON4	.202	**.621**	-.005	.307	-.094	.317

Factor Matrix for Dependent Variables

	Factor 1	Factor 2	Factor 3
USE1	**.784**	.292	.318
USE2	**.805**	.198	.374
USE3	**.842**	.306	.197
USE4	**.754**	.168	.270
US1	.137	**.832**	.275
US2	.313	**.825**	.164
US3	.385	**.674**	.369
US4	.202	**.862**	.234
IM1	.302	.280	**.852**
IM2	.391	.297	**.814**
IM3	.411	.381	**.744**