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An Empirical Investigation of Factors Influencing Knowledge Management System Success

John F. Whitfield Jr.

AN EMPIRICAL INVESTIGATION OF FACTORS

INFLUENCING KNOWLEDGE MANAGEMENT SYSTEM

SUCCESS

THESIS

John F. Whitfield, Jr., Major, USA
AFIT/GIR/ENV/08-M24

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GIR/ENV/08-M24

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John F. Whitfield, Jr., BS

Major, USA

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John F. Whitfield, Jr., BS
Major, USA

Approved:

//signed//	18 Mar 08
Jason M. Turner, Major, USAF, Ph.D (Chairman)	Date
//signed//	10 Mar 08
David P. Biros, Ph.D (Member)	Date
//signed//	24 Mar 08
David K. Vaughan, Ph.D (Member)	Date

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Abstract

Knowledge has been viewed as a critical component for organizations. Consequently, organizations implement Knowledge Management Systems (KMSs) to seek competitive advantages but encounter mixed results. This research draws on previous information system and knowledge management system success related literature and selects eight factors that are believed to be critical for the successful implementation of a KMS. These factors were derived through a literature search of current KMS success related literature. The purpose of this study is to identify factors that could have a clear influence on the development and implementation of KMSs. The study presents the empirical examination of a theoretical model of KMS success for predicting system use by law enforcement officers. The research findings were accomplished through a validated questionnaire that surveyed 10 law enforcement officers from various agencies. These results contribute to the literature by empirically supporting the hypothesized relationships between identified success factors and KMS success. Though limited in sample size, this research can serve as a foundation for future studies, which can help identify other factors critical for KMS success. The comprehensive model can be used to undertake further research and thus add value to knowledge management system based literature. In addition to its theoretical contributions, this study also presents important practical implications through the identification of specific infrastructural capabilities leading to KMS success.

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To My Wife and Daughter

Acknowledgments

I first would like to thank my Heavenly Father for blessing me with a supportive network of family, friends, and associates. I want to send a personal "Thank You" to my parents for instilling in me a spiritual foundation and for encouraging me to be the best I can be. I would like to express my sincere appreciation to my faculty advisor, Major Jason Turner, for his guidance and support throughout the course of this thesis endeavor. The insight and experience was certainly appreciated. I would, also, like to thank my sponsors, Dr. David Biros from Oklahoma State University and Dr. Steve Michael from the Defense Cyber Crime Center for both the support and latitude provided to me in this endeavor. I am also indebted to my committee member, Dr. David Vaughan, who spent his valuable time challenging me to think critically and was always available to answer my questions.

John F. Whitfield, Jr.

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AN EMPIRICAL INVESTIGATION OF FACTORS INFLUENCING KNOWLEDGE MANAGEMENT SYSTEM SUCCESS

I. Introduction

Knowledge Management System Overview

Knowledge and the ability to marshal and deploy knowledge across an organization are key factors for an organization's competitive advantage (Vizcaino, Soto, Portillo, & Piattini, 2007; Vouros, 2003; Teece, 1998; Tsai & Ghoshal, 1999). In order for organizations to remain competitive, knowledge management systems (KMSs) have been designed to manage an organization's knowledge (Vizcaino et al., 2007). In light of these developments, knowledge management systems are becoming ubiquitous in today's corporations (Davenport & Prusak, 1998).

KMSs are tools that affect the management of knowledge and are manifested in a variety of implementations (Hahn & Subramani, 2000). Examples of knowledge management systems include knowledge repositories, expertise databases, discussion lists, context specific retrieval systems, corporate directories, and knowledge networks. Alavi and Leidner (2001) define a KMS as an information technology-based system developed to support and enhance the processes of knowledge creation, storage and retrieval, transfer, and application. For a system to be classified as a KMS, the system must promote one or more of the processes just mentioned above.

KMSs encompass a variety of technology-based initiatives such as the creation of databases of experts, expertise profiling, and the hardwiring of social networks to aid access to resources of non-collocated individuals (Davenport & Prusak, 1998; Pickering & King, 1995). The primary focus of many of the KMS efforts has been on developing new applications of information technology such as data warehousing and document repositories linked to search engines to support the digital capture, storage, retrieval and distribution of an organization's explicitly documented knowledge (Hahn & Subramani, 2000). Today's KMSs store vast amounts of information and address the needs of an individual to interpret and reason about collective knowledge (Tiwana, 2000; Fahei, Srivastava, & Smith, 2001; Shin, Holden, & Schmidt, 2001).

KMS Successes and Failures

Despite the potential for return associated with KMSs, these systems are not without their problems. To date, organizations that have implemented KMSs have seen a wide range of outcomes from enormous savings to significant loses (Ambrosio 2000; Bose 2004; Malhotra 2005; Rigby, Reichheld, & Schefter 2002). Although KMSs have become a popular focus in many firms, many KMS initiatives fail. Despite the increase in sophistication and capabilities of information technology, many KMSs become obsolete even before completion. Others do not meet user expectation and many are never used. KMSs fail partially because their representation of knowledge does not satisfy the needs and the interpretation schemes of the knowledge user.

According to Wareham (1999), a study by the International Data Corporation shows that Fortune 500 companies would lose $12 billion in 1999 resulting from a lack of tools and processes for effectively capturing, managing, and connecting organizational knowledge and expertise. The losses could reach $31.5 billion by 2003. Additionally, an estimated 3.2% of organizational knowledge becomes incorrect or obsolete every year, and another 4.5% of knowledge becomes unavailable because of employee turnover, information mismanagement, and knowledge hoarding.

Although some organizations implement knowledge management systems unsuccessfully, other organizations reported gains from implementing tools and processes for capturing and managing knowledge. In 1998, British Petroleum (BP) Amoco CEO, John Browne, implemented a KMS to improve performance by sharing best practices, reusing knowledge, and accelerating learning his company gained from developing prior oil fields. In one year, BP Amoco saved $50 million in drilling costs at the Schiehallion Oil Field off the coast of Scotland (Ambrosio, 2000). Buckman Labs increased its new-product sales by 50% in 1994 by implementing a KMS to use simultaneous language translation to facilitate knowledge sharing on a global basis (McCune, 1999). Peoplesoft deployed a knowledge management software (Case-Base Reasoning) through its company's intranet which provided a platform for employees to share information and find answers to their own questions anytime during the day. Within six months of deploying their KMS, Peoplesoft saved $150,000 (Sarker, 2000). Chevron's commitment to seeking and sharing information knowledge was embodied in a best practice database program entitled "The Chevron Way." This system allowed employees to exchange questions and post insights using key words and categories. As a result, Chevron achieved a 30% productivity gain, a 50% improvement in safety performance, and more than $2 billion in operating cost reductions during the 1990s (Sarker, 2000).

Even though some organizations had success with implementing KMSs, some of those implementations can run into difficulties when organizations try to urge users to contribute, ultimately resulting in KMSs containing a great deal of knowledge that is inconsistent and irrelevant for most of its users (Markus & Keil, 1994). Specifically, if the users are not motivated to do what the system enables them to do, the KMS may not be used.

Similarly, if KMSs make it more difficult to do what the users are really motivated to do, they tend to fall out of use (Malhotra & Galletta, 2004). Mismatching users' viewpoints and expectations is a clear sign of failure. Furthermore, users would regard the system as rigid and complicated. Identifying the factors and variables that define KMS success is crucial to understanding how KMSs should be designed and implemented. The need for a more systematic and deliberate study of critical success factors for implementing KMS is essential.

Research Focus

This research draws on existing information system (IS) and knowledge management system models and literature and selects factors that are believed to be critical for the success of a KMS. This study hypothesizes which of these factors are more critical for knowledge management system success. It is hoped that by properly considering the moderating effect on the factors that influence KMS success, one can explain the success of a KMS using a greatly simplified list of success factors. More specifically, this research will examine and explain some of the mixed research findings in terms of the influence of various factors on KMS success and empirically investigate the blend of success factors that determines KMS success. The empirical findings of this study can confirm the positive relationships between the identified success factors and KMS success while serving as a foundation upon which future KMS studies can build on. The identification of these core sets of KMS success factors would provide practitioners with a means to more easily assess whether or not their organization has in place the conditions necessary for implementing a successful KMS. Based on the findings of this study, firms should gain initial insights into which of the tested factors are most critical to improve the success of their KMS.

Specifically, this study will address the following fundamental research question in the context of some digital forensic examiners, ultimately leading to the development of a comprehensive KMS success model.

- What are the factors that influence the success of a KMS?

Thesis Overview

In the sections to follow, the literature will introduce theoretical information that will provide a review of existing knowledge management, KMS, and IS literature that will set the stage for my methodology which discusses the theory behind the KMS success model and presents testable hypotheses. After the literature review, the method used to test these hypotheses will be presented. Then the conclusions drawn from this research and the potential contributions will be discussed.

II. Literature Review

Introduction

Organizations perceive knowledge as a valuable commodity that is crucial to the continued success of the organization. As a result, knowledge management systems (KMS) are often introduced into an organization in order to meet the challenges of collecting, sharing, and retaining knowledge. An important topic in KMS literature is the discourse of empirical research of factors, conditions, and mechanisms affecting the influence of successful KMS implementation. This topic is important because the key to understanding the issues affecting successful KMSs lead to the ability to identify the relevant knowledge to manage and to extract value out of that knowledge. While there are many examples and designs for knowledge management systems, there is no single approach to creating and implementing a KMS. Organizations need to develop a way to tailor their knowledge needs to clearly design and deploy a KMS that resolves their knowledge management problem. This research examines the benefits to establishing a KMS and the potential impediments to successful implementation.

What is Knowledge?

To better understand the issues surrounding successful KMS implementation, we must first define the notions of knowledge and knowledge management because how you define knowledge determines how you manage knowledge, therefore impacts the systems upon which such knowledge is created, stored, manipulated, or transferred. There are no universal definitions of knowledge. For example, Alavi and Leidner (2001) describe knowledge view from any of a number of various perspectives:

- Knowledge is a state of mind – the state of knowing and understanding gained through experience or learning
- Knowledge is an object to be stored and manipulated
- Knowledge is a process of applying expertise
- Knowledge is a condition of having access to information
- Knowledge is the capability to influence action

Attempts at defining the concept of knowledge range from the practical to the conceptual. To facilitate the understanding of knowledge, several researchers have provided more explicit definitions. The following are just a sample of such definitions of knowledge:

- A fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories, but also in organizational routines, practices and norms (Davenport & Prusak, 1998)

- A justified personal belief that increases an individual's capacity to take effective action (Alavi & Leidner, 1999; Huber, 1991; Nonaka, 1994).

- Information possessed in the mind of individuals: it is personalized information (which may or may not be new, unique, useful or accurate) related to facts, procedures, concepts, interpretations, ideas, observations, and judgments (Alavi & Leidner, 2001).

- The knowledge we now consider proves itself in action. What we now mean by knowledge is information effective in action, information focused on results. These results are seen outside the person-in society and economy, or in the advancement of knowledge itself (Drucker, 1993).

- Basically, knowledge is simply actionable information. Actionable refers to the notion of relevant, and nothing but the relevant information being available in the right place, at the right time, in the right context, and in the right way so anyone (not just the producer) can bring it to bear on decisions being made every minute. Knowledge is the key resource in intelligence, decision making, forecasting, design, planning, diagnosis, analysis, evaluation, and intuitive judgment making (Tiwana, 2000).

People have an understanding of what knowledge is without being capable of defining it precisely. The issues to follow are nevertheless some of the foundational concerns that seem to surround all treatments of knowledge and are ultimately informative to a discussion of KM and KMS success.

Data, Information, and Knowledge

Some research authors address the question of defining knowledge by distinguishing among knowledge, information, and data. The terms have often been used interchangeably. However, knowledge is neither data nor information, though it is related to both, and the differences between these terms are often a matter of degree (Davenport & Prusak, 1998). Some studies have defined the concepts of data as being raw numbers and facts, information as being processed data interpreted into a meaningful context, and knowledge as being authenticated information made actionable (Vance, 1997; Maglitta, 1995). However, many authors have attempted to provide more clarity on these definitions (Table 1).

Table 1

Recognized definitions of data, information, and knowledge (Stenmark, 2002)

Authors	Data	Information	Knowledge
Choo, Detlor, & Turnbull (2000)	Facts and messages	Data vested with meaning	Justified true beliefs
Davenport (1997)	Simple observations	Data with relevance and purpose	Valuable information from the human mind
Davenport & Prusak (1998)	A set of discrete facts	A message meant to change the receiver's perception	Experiences, values, insights, and contextual information
Nonaka & Takeuchi (1995)		A flow of meaningful messages	Commitments and beliefs created from these messages
Quigley and Debons (1999)	Text that does not answer questions to a particular problem	Text that answers the questions who, when, what, or where	Text that answers the questions why and how
Spek & Spijkervet (1997)	Not yet interpreted symbols	Data with meaning	The ability to assign meaning to data and thereby generate information
Wiig (1999)		Facts organized to describe a situation or condition.	Truths and beliefs, perspectives, judgments and expectations, methodologies and know how

Ultimately, knowledge contains information, but information is not necessarily knowledge. Although researchers have distinguished data, information, and knowledge with variation in context, the key to effectively differentiating knowledge from information and data lies in the understanding that knowledge is information processed in the minds of individuals and is inseparable from knowledge users (Alavi & Leidner, 2001). Despite the ongoing debate, Davenport and Prusak's (1998) knowledge definition is adopted for the purposes of this study due to its general acceptance and widespread use within the scholarly literature.

Tacit and Explicit Knowledge

Nonaka (1994) suggests two dimensions of knowledge exist in organizations: tacit and explicit. Tacit knowledge refers to the knowledge that has a personal quality that makes it hard to articulate or communicate the knowing or the deeply rooted know-how that emerges from action in a particular context (Hahn & Subramani, 2000). Tacit knowledge is obtained by individual processes and stored in human beings. In contrast, explicit knowledge refers to the codifiable component of knowledge that can be disembodied and transmitted, which can be extracted from the knowledge holder and shared with other individuals (Hahn & Subramani, 2000). Explicit knowledge is stored in a mechanical or technological device, such as documents or databases (Nonaka, 1994). Explicit knowledge would be more useful if it could be used among organizations that work together using collaborative technology at anytime or anyplace (Abdullah, Selamat, Sahibudin, & Alias, 2005).

The knowledge that differentiates companies from one another is mostly tacit in nature and embedded within human minds, processes, relationships, services, and products (Jennex, 2005a). The conversion of tacit into explicit knowledge, a process of "externalization" according to Nonaka and Takeuchi (1995), allows knowledge to be codified, stored, and disseminated throughout the organization, facilitating knowledge creation (Jennex, 2005a). However, converting tacit knowledge from human memory and processes into organizational memory is a challenging task to master (Gold, Malhotra, & Segars, 2001). The difficulty arises due to the intangible nature of tacit knowledge, which is personal, intuitive, and embedded within intangible resources (Jennex, 2005a). Hence, a critical concern for professionals remains how to institutionalize individual tacit knowledge to secure the intangible assets that otherwise would remain hidden (Zack, 1999a).

Regardless of the definition, knowledge is at the heart of knowledge management. The different perspectives on tacit and explicit knowledge lead to different perceptions of knowledge management (Carlsson, Sawy, Erickson, & Raven, 1996). Specifically, each perspective suggests a different strategy for managing the knowledge and a different perspective of the role systems play in support of knowledge management (Alavi & Leidner, 2001).

Knowledge Management

Knowledge must be effectively managed because it is recognized as an organization's most valuable resource (Holsapple & Joshi, 2000). Therefore, if an organization is to be competitive in the modern economy, knowledge management (KM) must be a core competency (Davenport & Prusak, 1998). The general area of knowledge management has attracted an enormous amount of attention in recent years. Although there is a great deal of interest in knowledge management, literature suggests that knowledge management does not yet have a consensus definition just as there is no agreement as to what exactly constitutes knowledge. Nevertheless, various definitions of knowledge management have been articulated by a number of researchers (Alvai & Leidner, 1999; Sousa & Hendriks, 2006; Hult 2003: Sabherwal & Beccera-Fernandez, 2003; Zarrag & Garcia-Falcon, 2003). For example, Alvai & Leidner (1999) defined knowledge management as the systematic and organizationally specified process for acquiring, organizing, and communicating knowledge of employees so that other employees may make use of it to be more effective and productive in their work. The many interpretations of KM have resulted in very vague requirements for the creation of viable systems or tools to harness an organization's knowledge. As an evolving concept, knowledge management is generally regarded as a process through which people generate value from their organization's knowledge. Although not comprehensive or exceedingly descriptive, such definitions are still a starting point for developing a more thorough understanding of knowledge management. In this study, the definition by Alavi and Leidner (1999) and Davenport, DeLong, and Beers (1998) is adopted as follows:

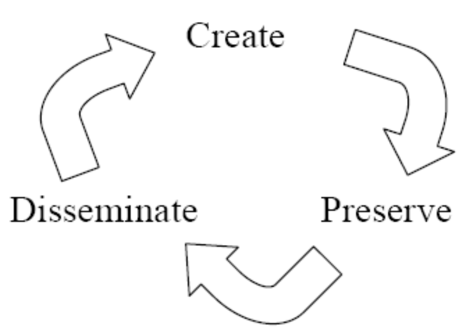
> A systematic and organizational specific framework to capture, acquire, organize, and communicate both tacit and explicit knowledge of employees so that other employees may utilize them to be more effective and productive in their work and maximize the organization's knowledge.

The above definition highlights important elements of KM (emphasizing explicit knowledge and creating new knowledge). The definition also emphasizes the primary purpose of KM which is to add or create value to the organization. The goal of knowledge management is not to manage all of the knowledge, but to manage the knowledge that is essential to the organization. In order to do this, organizations must utilize information technology and tools to develop and share knowledge within their organizations and to connect those who possess knowledge to those who need the knowledge (Anantatmula, 2005). Therefore, applying the collective knowledge and experience of the workforce to achieve organizational objectives involves identifying and leveraging the collective knowledge in an organization to help the organization remain competitive (Von Krogh, 1998).

Knowledge management will increase an organization's innovativeness and responsiveness (Hackbarth, 1998) as long as the organization creates a new working environment where knowledge and experience can easily be shared. The organization can also addresses business problems particular to an organization; whether it is creating and delivering innovative products or services, managing and enhancing relationships with existing and new customers, partners, and suppliers, or administering and improving work practices and processes (Tiwana, 2000). Successful companies are those that have consistently created new knowledge, disseminated it widely, and quickly incorporated it into new technologies and products (McCampbell, Clare, & Gitters, 1999).

In general, KM is a cyclic process involving three related activities: creation, preservation, and dissemination as represented in Figure 1 (Salisbury, 2003). This KM cycle provides a means of describing how organizations should approach all aspects of knowledge management.

Figure 1. The Knowledge Management Cycle (Salisbury, 2003)



Salisbury (2003) described the first phase, creation, taking place when new members in the organization solve a unique problem or when they solve smaller parts of a larger problem such as the ones generated by an ongoing project. The next phase, preservation, includes the recording of the description of the problem as well as its new solution. The dissemination phase involves sharing this new knowledge with the other members of the organization and includes sharing the solutions with the stakeholders affected by the problems that were solved. The utilization of the disseminated knowledge increases an organization's ability to solve problems. This cycle becomes a knowledge spiral in the organization as described by Nonaka and Takeuchi (1995), because an organization must continuously create, preserve, and disseminate the knowledge required to understand and solve its unpredictable problems. The dissemination phase is historically the most supported phase of the knowledge management cycle (Turban & Aronson, 1998).

Knowledge Management Systems

In order for organizations to maximize the creation, dissemination, and preservation of knowledge, they must choose the proper technologies and tools (knowledge management systems) to support a successful knowledge management environment. Typically, a KMS can be classified according to how it performs these activities. For example, a KMS may store knowledge that was created in the past and disseminate the knowledge throughout an organization or group (Fischer & Ostwald, 2001). Understanding the KM cycle is critical to understanding the process of implementing a KMS.

KMSs are a class of information systems or computer-based systems developed for the facilitation of the extracting, collecting, disseminating, and maintaining organization-specific knowledge assets for diverse organizational activities (Alavi & Leidner, 2001).

They consist of processes and technologies for identifying, capturing, and processing knowledge for storage and retrieval and are seen as enabling technologies for effective and efficient knowledge management (Schwartz, 2006). KMSs are developed to support and enhance knowledge intensive tasks, processes, or projects (Deltor, 2002; Jennex & Olfman, 2003a) and are applied in a large number of applications. Some of the common applications of KMSs are (1) organizing and sharing of internal benchmarks or best practices, (2) constructing corporate knowledge directories, such as corporate yellow pages, people information archives, and (3) creating knowledge networks and knowledge maps (Alavi & Leidner, 2001).

Recent literature in the information systems field extols the virtue of knowledge management systems as the next state-of-the-art innovation pertinent to business practitioners (Adams & Lamont, 2003). For example, researchers such as Davenport & Prusak (1988), Johnson (1988), Zack (1999b), and Alvai & Leidner (2001) emphasize the criticality of corporations developing organizational-wide KMSs to create and maintain competitive advantages in increasingly dynamic business environments (Adams & Lamont, 2003). To more effectively manage and use both tacit and explicit knowledge within an organization and add value with knowledge management, organizations need knowledge management systems which facilitate the generation, preservation, and dissemination of knowledge (Quaddus & Xu, 2005). KMSs are consequently an organization's effort to facilitate knowledge sharing through the use of information technology in order to obtain organizational benefits.

In fact, the use of knowledge management systems is no longer a matter of choice for the contemporary organizations. Rather, a KMS is one of an organization's most essential features, which provides it with a source of competitive advantage (Evangelou & Karacapilidis, 2005). The introduction of a KMS can not be expected to resolve all of the challenges currently faced by the organization. However, it provides a tool for solving or minimizing many of the issues currently hampering the success of the organization.

There is no single model or single technology comprising a KMS. KMSs have appeared in various formats in different industries and are the necessary infrastructure for organizations to implement knowledge management processes (Quaddus & Xu, 2005). The goal of a KMS is to bring knowledge from the past to bear on present activities, thus resulting in increased levels of organizational effectiveness (Lewin & Minton, 1998; Stein & Zwass, 1995). In general, KMSs serve to inform the user and instigate learning via knowledge transfer and reuse (Cooper, 2003), the process by which an entity is able to locate and use shared knowledge (Alavi & Liedner, 2001).

There are a variety of KMSs such as knowledge repositories, corporate directories, and knowledge networks (Alavi & Liedner, 2001; Grover & Davenport, 2001). Of these three types of KMSs, knowledge repositories are the most prevalent KMS initiatives used in western organizations (Grover & Davenport, 2001). These repositories are used to codify the organization's explicit knowledge, such as best practices. A typical knowledge repository is simply the compilation of structured, explicit knowledge-usually in document form (Davenport & Prusak, 1998) and often takes the shape of an intranet portal that acts as a window to an organizations' knowledge and includes various initiatives such as discussion forums and newsgroups (Ruppel & Harrington, 2001). Consequently, knowledge repositories help in efficiently storing and reapplying workable solutions.

Knowledge Management System Success

A difficult task for most organizations is managing all aspects of knowledge well. Even though an organization may deploy a KMS to manage its knowledge, the success or failure of the KMS is ultimately determined by a combination and incorporation of factors within the organization. Therefore, KMS success is a performance area of critical importance which involves achieving effectiveness and high productivity.

KMS success is a term that has not been fully defined by researchers. Jennex, Smolnik, and Croasdell (2007) explored the notion of KMS success based on their discussions with 30 members of the editorial review board of the International Journal of Knowledge Management who were asked to provide a definition of KMS success. The following definition was derived from the members' responses:

> KMS success is a multidimensional concept. It includes capturing the right knowledge, getting the right knowledge to the right user, and using this knowledge to improve organizational and/or individual performance (p. 5).

Furthermore, KMS success can be expressed as the improvement in organizational performance that comes from using knowledge as a result of the use of the KMS or the effective implementation of the KMS processes (Schwartz, 2006). By increasing KMS effectiveness, decision-making capability is enhanced ultimately leading to positive impacts on the organization (Jennex, Smolknik, & Croasdell, 2007). Therefore, a successful KMS is determined by how well its components perform its intended function or functions as they relate to performance.

KMS Success Factors

To assist in the definition of KMS success, Jennex & Olfman (2004) reviewed and provided a summary of success factors and their importance across a multitude of studies.

These success factors were analyzed for key concepts and combined into generic success factors as depicted in Table 2. The success factors were derived from the following studies:

- A study of six organizations that implemented a KMS designed to grow organizational memory in the context of help-desk situations (Ackerman, 1994)
- Design recommendations from three KM projects for building a successful KMS (Jennex & Olfman, 2000).
- A study of 31 KM projects in 24 companies (Davenport, Delong, & Beers, 1998)
- A delphi study consisting of 31 recognized KM researchers and practitioners investigating the influencing factors of KM in organizations (Holsapple & Joshi, 2000).
- An investigation of 22 projects to determine if KM would improve business performance simply by using technology to capture and share lessons learned (Cross, 2000).

Based on Jennex and Olfman's (2004) analysis of the above studies, they identified potential success factors in rank order. Success factors (SF) 1 through 4 are considered key success factors as they were mentioned by at least half of the success factor studies examined. Knowing and understanding these essential KMS success factors is useful because such factors specify the basic requirements for building a successful KMS.

Table 2

KMS success factor summary (Jennex & Olfman, 2004)

ID	Success Factor	Source
SF1	An integrated technical infrastructure including networks, databases/repositories, computers, software, KMS experts	Alavi and Leidner (1999), Barna (2003), Cross (2000), Davenport et al. (1998), Ginsberg and Kambil (1999), Jennex and Olfman (2000), Mandviwalla et al. (1998), Sage and Rouse (1999), Yu et al. (2004)

SF2	A knowledge strategy that identifies users, user experience-level needs, sources, processes, storage strategies, knowledge, and links to knowledge for the KMS	Barna (2003), Ginsberg and Kambil (1999), Holsapple and Joshi (2000), Jennex et al. (2003), Koskinen (2001), Mandviwalla et al. (1998), Sage and Rouse (1999), Yu et al. (2004)
SF3	A common enterprise-wide knowledge structure that is clearly articulated and easily understood	Barna (2003), Cross (2000), Davenport et al. (1998), Ginsberg and Kambil (1999), Jennex and Olfman (2000), Mandviwalla et al. (1998), Sage and Rouse (1999)
SF4	Motivation and commitment of users including incentives and training	Alavi and Leidner (1999), Barna (2003), Cross (2000), Davenport et al. (1998), Ginsberg and Kambil (1999), Jennex and Olfman (2000), Malhotra and Galletta (2003), Yu et al. (2004)
SF5	An organizational culture that supports learning and the sharing and use of knowledge	Alavi and Leidner (1999), Barna (2003), Davenport et al. (1998), Jennex and Olfman (2000), Sage and Rouse (1999), Yu et al. (2004)
SF6	Senior management support including the allocation of resources, leadership, and providing training	Barna (2003), Davenport et al. (1998), Holsapple and Joshi (2000), Jennex and Olfman (2000), Yu et al. (2004)
SF7	Measures established to assess the impacts of the KMS and the use of knowledge, as well as to verify that the right knowledge is being captured	Alvai and Leidner (1999), Davenport et al. (1998), Jennex and Olfman (2000), Sage and Rouse (1999)
SF8	A clear goal and purpose for the KMS	Ackerman (1994), Barna (2003), Cross (2000), Davenport et al. (1998)
SF9	A learning organization	Barna (2003), Cross (2000), Sage and Rouse (1999), Yu et al. (2004)
SF10	Easy knowledge use supported by the search, retrieval, and visualization functions of the KMS	Alavi and Leidner (1999), Ginsberg and Kambil (1999), Mandviwalla et al. (1998)
SF11	Work processes designed to incorporate knowledge capture and use	Barna (2003), Cross (2000), Jennex and Olfman (2000)
SF12	The security/protection of knowledge	Jennex and Olfman (2000), Sage and Rouse (1999)

Successful KMS Implementation

The measurement of a KMS success is critical to understanding how the system should be implemented. The successful implementation of a KMS is measured by providing specialized and customized knowledge to users, functioning as a platform that allows users to connect to experts, and reducing the time spent on routine tasks (Barrow, 2001; Hansen, Nohria, & Tierney, 1999; Sarvary, 1999). Once an organization implements a KMS, the KMS is expected to have a positive impact on the organization by improving organizational effectiveness and by helping the organization find individuals with particular knowledge to help analyze complex problems, thereby improving the diversity of knowledge in analyzing problems (Jennex, Smolnik, & Croasdell, 2007). The end results of a successful KMS implementation should include one of more of the following outcomes (Davenport, DeLong, & Beers, 1998):

- Growth in the resources attached to the project, including people and budget
- Growth in the volume of knowledge content and usage
- A high likelihood that the project would survive without the support of a particular individual or two
- Evidence of financial return either for the knowledge management activity itself or for the larger organization (Davenport, DeLong, & Beers, 1998).

Why Do KMSs Fail?

Despite the potential benefits of an effective KMS, a number of organizations have implemented KMSs only to find that the systems are not used or do not contribute value to the organization (Hansen & Von, 2001). It is often suggested that failures are caused by an over reliance on information technology (Grant & Qureshi, 2006). However, the challenges of implementing a KMS are not only dependent on the system's technological abilities, but on how well the systems meet the needs of the system users and organization. Issues such as motivating employees to share knowledge (Wasko & Faraj, 2005), creating positive attitudes around knowledge sharing (Bock, Zmud, Kim, & Lee, 2005), and trust (McEvily, Perronne, & Zaheer, 2003) continue to be addressed by organizations. The success of such systems inevitably begins with the individual; individual use and adoption are critical (Money & Turner, 2004). Understanding and creating conditions under which KMSs will be adopted and used by individuals remains a high priority because many organizations have made large investments in KMSs (Venkatesh & Davis, 2000). Furthermore, issues of adoption within the organization can result in lost productivity as systems are either not used at all, or not used to their full capabilities (Jasperson, Carter, & Zmud, 2005). Challenges to developing successful KMSs generally fall into three primary areas. First, there are challenges relating to information technology and organizational resource mismatches. Second, there are challenges related to organizational practices used to build KMSs. Finally, there are challenges related to the people who generate and use the knowledge. Each of these issues will be discussed in turn within the following sections.

KMS Mismatches

One of the fundamental reasons for KMS failures highlighted in the literature is a misalignment of a KMS such that it does not satisfy users' needs which originate in work practices (Cooper, 2003; Stenmark & Lindgren, 2004; Wing & Chua 2005). If a user is not content with the knowledge in the KMS or if the knowledge is hard to find, the user may not use the KMS. KMSs that fail to deliver user expected benefits are eventually abandoned either because of poor project implementation or content deficiencies related to creation, capture, and access of knowledge content (Chua & Lam, 2005). Poor project implementation is often a result of excessive technology cost, a shortfall in required expertise, and a lack of project support. Content deficiencies result from out of date knowledge, knowledge hoarding, and poor knowledge access. A KMS that does not provide knowledge that is considered valuable to the organization or does not provide it in a timely manner is considered a failure.

KMS Design Practices

The most common error in implementing KMS is failing to coordinate efforts between information technology and organizational resources (Ambrosio, 2000). The design of a KMS should ensure that the innovation of the business performance outcomes occur in alignment with the changing dynamics of the business environment (Malhotra, 2004). Organizational mismatch occurs when a KMS initiative is not grounded in the organization's strategy or existing roles (Chua & Lam, 2005).

Knowledge management systems are best developed within the context in which they will be used. Particularly when developing a KMS for a targeted organization, developers need to work closely with the members of that organization. Introducing a new KMS into an organization should not disrupt the normal business operations of that organization. Therefore, any KMS that is introduced must be robust and complete. Failure to take into account the possible barriers and deal with them in a proactive and decisive manner will greatly hamper the chances for a KMS to be successful implemented within an organization.

KMS User Issues

Another issue with implementing KMSs is the requirement for users to share their knowledge with others (Hayduk, 1998; King 1996). Beyond the tangible costs of buying and implementing a KMS, users bear certain costs in deciding whether to contribute their knowledge or whether to seek and reuse information stored in these systems (Gallivan, Eynon, Rai, 2003). Considerable attention has been focused on identifying the attributes of firms where employees will readily share information (Davenport, 1996; Orlikowski, 1993). Some factors that have been found to impede knowledge sharing and KMS participation are fear and suspicion of new technology, unintentionally rewarding hoarding information, individual effort not being recognized, employee owner interest conflicts, and lack of alignment of information technology with business resources (Tiwana, 2000). Several studies suggest that achieving a critical mass of content is an important concern when implementing a KMS (Dennis, Pootheri, & Natarajan, 1998; Damsgaard & Scheepers, 2000). In fact, even if technology developers convince enough users to initially adopt the KMS, the users will likely be discouraged and abandon the system if they find an insufficient quantity of useful content (Gallivan, Eynon, & Rai, 2003).

Conventional wisdom suggests that a KMS must fit the organization's existing culture, norms, and incentive schemes; lacking such a fit, the outcome is highly uncertain (Gallivan, 1997). Therefore, an organization wishing to implement a KMS, thereby attempting to tap into all of its knowledge resources, would be wise to carefully select systems suited for its organizational culture (Davenport et al., 1998; Davenport & Prusak, 1998). As organizations become more dependent on knowledge management systems and their use spreads across the modern business landscape, the concern for developing effective knowledge management systems that will be used becomes even more important.

Modeling KMS Success

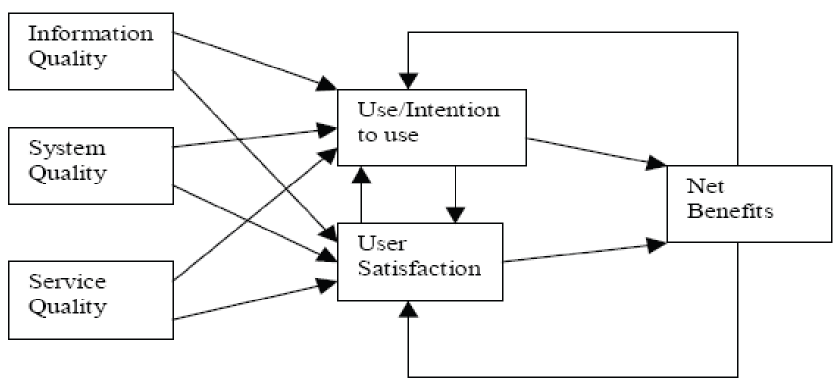
The Information Success Model

In the academic community of information system (IS) research, there are limited studies devoted to the development of KMS success models (Ciganek, Nicholls, & Srite, 2008). Given that KMSs are a special class of information systems, and that KMS success is still a relatively new topic with little empirical support (Alavi & Leidner, 2001), the extensive empirical research on the more established topic of IS success should serve as a starting point for research on KMS success. Any IS must effectively recognize the primary mechanisms by which users work and build technological solutions (Wu & Wang, 2006). The success measurements should capture both technological and human elements (Skok & Kalmanovitch, 2005) as well as any effective KMS (Davenport, DeLong, & Beers, 1998).

As with most information systems, KMS success partially depends upon the degree of use (Poston & Speier, 2005), which itself may be tied to system quality, information quality, user satisfaction, and usefulness.

The DeLone and McLean model of IS success (1992, 2002, 2003) has received much attention among IS researchers and provides a foundation for research in the KMS domain (Clay, Dennis, & Ko, 2005; Jennex, 2005b). It comprises six theoretical dimensions: Information Quality, System Quality, Service Quality, Intentions to Use/Use, User Satisfaction, and Net Benefits (DeLone & McLean, 2003). Figure 2 illustrates the DeLone and McLean IS Success Model.

Figure 2. DeLone and McLean's (2003) IS Success Model



The DeLone and McLean model is a general framework for understanding IS effectiveness and must be adapted to specific contexts. For example, DeLone and McLean (2003) provide an adaptation of the most recent iteration of their model to e-commerce.

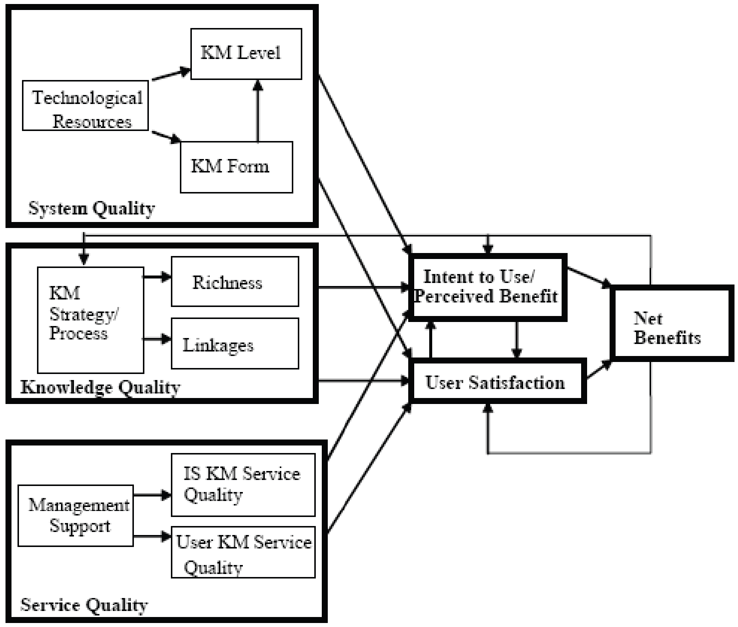
Jennex and Olfman (2003b) applied the DeLone & McLean IS success model to KMS to evaluate success in terms of system quality, knowledge quality, use and user satisfaction, perceived benefit, and net benefits. After reviewing relevant studies on KM success and comparing the model with other KM success models, they conclude that the

DeLone & McLean IS success model, based on solid theoretic foundations, meets KMS success criteria better (Jennex & Olfman, 2004). Maier (2002) also selected the Delone & McLean model as the basis for KMS success.

The KMS Success Model

In 2003, Jennex and Olfman published a success model particular to KMSs. Specifically, Jennex, Olfman, and their colleagues adapted the DeLone & McLean model to the KM context (Jennex, Olfman, Pituma, & Park, 1998; Jennex, Olfman, & Addo, 2003; Jennex & Olfman, 2002, 2004). The earliest version of the model (Jennex, Olfman, Pituma, & Park, 1998) was developed by conducting on site observations of KMS use in an engineering setting and framing those observations within the context of the 1992 DeLone & McLean IS Success Model and current thinking about KM and organization memory (Stein & Zwass, 1995). A further revision of the model was informed by a longitudinal study of engineering use of a KMS over a 5-year period and as well as the 2002 revised DeLone & McLean model, and more recent developments in KM research (Alavi & Leidner, 2001). The latest version (2004) version of the Jennex & Olfman model reflects the rationale behind the latest version of the DeLone & McLean Model (DeLone & McLean, 2003) and the accumulated and most contemporary thinking of various researchers in the KM field. See Figure 3 below.

Figure 3. Jennex and Olfman's (2006) KMS Success Model



This model evaluates KMS success as an improvement in organizational effectiveness based on the impact from use of the knowledge from the KMS (Jennex, 2008).

The following are brief descriptions of the components of the model:

- *System quality* defines how well the KMS performs the functions of knowledge creation, storage/retrieval, transfer, and application, how much of the knowledge is codified, and how the KMS is supported by the IS staff and infrastructure.
- *Knowledge/Information quality* ensures that the right knowledge with sufficient context is captured and available for the right users at the right time.
- *Service Quality* measures management support, KM governance, and organizational support of KM.
- *User Satisfaction* indicates the satisfaction of the users with their "use" of the KMS. This reflects that the KMS has been used but does not focus on the quantity of "use."

- *Intention to Use/Perceived Benefit* measures perceptions of the benefits and impacts of the KMS by users. The extension of the perceived benefit concept (compared to DeLone & McLean IS Success Model) allows it to reflect social and job related characteristics of user expectations that would not otherwise be captured (Jennex & Olfman, 2006). This dimension is good for predicting that the KMS will be used when appropriate.
- *Net Benefits* shows that an individual's use of a KMS will produce an impact on that person's performance in the workplace. Each individual impact will in turn have an effect on the performance of the whole organization. The association between individual and organizational impacts is often difficult to draw and is why all impacts are combined into a single dimension (Jennex, 2008).

As illustrated by the works by DeLone and McLean (1992, 2003) and Jennex and Olfman (2003a), the success of any type of KMS requires success along multiple dimensions before the KMS can be considered an "overall success".

Developing an Integrated Research Model

Literature Search and Inclusion Criteria

Search engines and electronic databases are popular tools for locating a vast and impressive amount of information. They provide a user a single solution to entering queries and receiving results from a huge index of Web sites. To study and assess the influential factors of KMSs, a literature search was performed primarily on electronic databases and search engines (see Table 3) for articles published from 2002 to 2008 based on KMS success research. The search was done using keywords: "Successful KMSs", "KMS success models", "KMS implementation", "KMS projects", "KMS initiatives", and "KMS success."

Along with terms related to KMSs: “information system”, “information technology” and one or more of several terms related to KMS success: “satisfaction”, “quality”, “use”, “usefulness”, and “usage.” Several articles were excluded from the preliminary screening because they: examined KMS outsourcing or strategic KMS decision making processes; developed or refined factors of KMS success but did not investigate their relationship with any other constructs in the research model; dealt with constructs not related to KMS development, adoption or success; did not present a research framework to validate; or did not examine an organizational KMS used by the organization’s members.

Table 3

Electronic Databases and Search Engines

Electronic Databases	Search Engines
ABI/Inform	Google
ACM Digital Library	Google Scholar
EBSCO Business Source Premier	Intelways Cross Engine
IEEE Xplore	Dogpile Metasearch
InfoTrac	Wikipedia
Inspec	
Science Citation Index	
ScienceDirect	

Table 4 summarizes the various studies that have explicitly addressed models of KMS success or issues of why KMSs are used. Table 5 then illustrates the conceptual similarities or overlaps (as well as the differences and distinctions) of the various constructs and concepts responsible for KMS success that appeared in those studies.

Table 4

List of Studies on KMS Success or KMS use

Source #	Author(s), Year	Title
1	Al-Buisaidi & Olfman (2005)	An investigation of the determinants of knowledge management systems success in omani organizations

2	Butler, Heavin, & O'Donovan (2007)	A theoretical model and framework for understanding knowledge management system implementation
3	Ciganek, Nicholls, & Srite (2008)	Organizational culture for knowledge management systems: A study of corporate users
4	Clay, Dennis, & Ko (2005)	Factors affecting the loyal use of knowledge management systems
5	Hu, Lin, & Chen (2005)	User acceptance of intelligence and security informatics technology: A study of COPLINK
6	Khalifa & Liu (2003)	Determinants of successful knowledge management programs
7	Liu, Olfman, & Ryan (2005)	Knowledge management system success: Empirical assessment of a theoretical model
8	Maier (2002)	Knowledge management systems: Information and communication technologies for knowledge management
9	Malhotra & Galletta (2005)	A multidimensional commitment model of volitional systems adoption and usage behavior
10	Money & Turner (2005)	Assessing knowledge management system user acceptance with the technology acceptance model
11	Simon & Paper (2007)	User acceptance of voice recognition technology: An empirical extension of the technology acceptance model
12	Thompson, Compeau, & Higgins (2006)	Intentions to use information technologies: An integrative model
13	Vitari, Moro, Ravarini, & Bourdon (2007)	Improving KMS acceptance: The role of organizational and individual's influence
14	Wu & Wang (2006)	Measuring KMS success: A respecification of the DeLone and McLean's model
15	Xu & Quaddus (2007)	Exploring the factors influencing end user's acceptance of knowledge management systems: Development of a research model of adoption and continued use

Table 5

List of Constructs Used in KMS Success Studies

Construct	**Source(s)**	**Times Used**	**Construct**	**Source(s)**	**Times Used**
Perceived ease of use	2,3,4,5, 9,10,11,12	8	Knowledge specific service	8	1
Perceived usefulness	3,4,5,9,10, 11,12	7	Leadership	6	1
Behavioral intentions	3,9,10,11,13	5	Management support	1	1
Subjective norms	3,5,11,13	4	Motivation	4	1
Knowledge quality	4,7,8,14	4	Organic growth	15	1
System quality	4,7,8,14	4	Organizational culture	3	1
Attitude	5,9,13	3	Organizational impacts	8	1
Perceived KMS benefits	7,14,15	3	Organizational infrastructure	1	1
User satisfaction	8,14	2	Peer's influence	13	1
Organizational factors	2,15	2	Perceived behavioral control	12	1
Affect	12	1	Perceived ease of contribution	13	1
Availability	5	1	Perceived usefulness of contribution	13	1

Computer self efficacy	12	1	Perceived user friendliness	15	1
Culture	6	1	Personal innovativeness with IT	12	1
Economic return	1	1	Reward policy	1	1
Efficiency gain	5	1	Service quality	7	1
Impact on collectives of people	8	1	Social factors	12	1
Individual factors	15	1	Strategy based factors	2	1
Individual impact	8	1	Superior's influence	13	1
Information technology	6	1	Task complexity	15	1
KM infrastructural capabilities	6	1	Technical infrastructure	1	1
KM process capabilities	6	1	Use	7	1
KM strategy	6	1	Vision clarity	1	1
Knowledge culture	1	1	Voluntariness	4	1

Several conceptual overlaps led to a few "conceptual rollups" of certain constructs, each of which is highlighted in Table 5 with a different color coding. For example, the peer's influence and superior's influence constructs from Vitari, Moro, Ravarini, and Bourdon (2007), were added to the subjective norms construct (Ciganek, Nicholls, & Srite, 2008) depicted in blue. Secondly, the organizational culture construct (Ciganek, Nicholls, & Srite, 2008); the management support, knowledge culture, organizational infrastructure, and vision clarity constructs from Al-Busaidi and Olfman, (2005); the organizational impacts and impact on collectives of people constructs (Maier, 2002); and the culture and leadership constructs from Khalifa and Liu (2003) were added to the organizational factors construct from (Bulter, Heavin, & O'Donovan, 2007) depicted in green. Third, the perceived KMS benefit construct from (Liu, Olfman, & Ryan, 2005; Wu & Wang, 2006; Xu & Quaddus, 2007) were added to the perceived usefulness construct depicted in red. Finally, the perceived user friendliness construct (Xu & Quaddus) was added to the perceived ease of use construct depicted in yellow. This consolidation of concepts and definitions was made because there were marked similarities between how the constructs were used and defined across the studies. For example, Xu & Quaddus defined perceived user friendliness as:

> Reflects the perspectives of end-user focus on the KMS and is made up of simple to learn and use, cheap to learn and use, speed, accessibility, security, complexity, and risk of knowledge (p. 66).

The above definition highlighted the key aspects of perceived ease of use (degree in which individuals believe that using a particular system would be free of mental or physical or mental effort) as it had been defined in its foundational studies (i.e., Davis, 1989). Consequently, perceived user friendliness was combined with perceived ease of use.

Although Service Quality sounds like a subset of System Quality, the two are quite different. Service Quality was developed to measure the overall success of an information system organization as opposed to the success of individual systems (Delone & McLean, 2002). Basically, Service Quality measures how well an information system organization provides a service to meet the expectations of its customers (Parasuraman, Zeithaml, & Berry, 1985; Reeves & Bednar, 1994). On the other hand, System Quality is more broadly about how hardware and software are manifested in the overall performance of a system (Bailey & Pearson, 1983; Srinivasan, 1985). Moreover, Perceive Usefulness and Perceived Ease of Contributing were not added to Perceive Usefulness or Perceive Ease of Use, because contribution to KMS rather than usage was the focus on these constructs. Vitari, Moro, Ravarini, & Bourdon (2007) want the construct to capture the degree to which the KMS user believes that contributing knowledge to the KMS would be free of effort and enhance performance.

Limiting the Playing Field – A Power Analysis

A power analysis on the frequency of appearance of these constructs within the literature was conducted in accordance with the techniques demonstrated in Northcutt and McCoy's (2004) interactive qualitative analysis for establishing criteria of inclusion and exclusion for elements of complex and multifaceted systems. The power analysis table (Table 6) depicts the KMS success constructs in descending order of frequency of appearance in the cited literature and provides an indication as to the point at which the consideration of one more construct would no longer add *increasing* "value" to the discussion of KMS success-related constructs within the sum of the referenced literature.

Table 6

Power Analysis Cumulative Frequency Chart of Selected Constructs

Construct Name	Frequency Sorted (Descending)	Cumulative Frequency	Cumulative Percent (Construct)	Cumulative Percent (Frequency)	Power
Organizational factors	11	11	2.9	13.8	10.9
Perceived Usefulness	10	21	5.7	26.3	20.5
Perceived ease of use	9	30	8.6	37.5	28.9
Subjective norms	6	36	11.4	45.0	33.6
Behavioral intentions	5	41	14.3	51.3	37.0
Knowledge quality	4	45	17.1	56.3	39.1
System quality	4	49	20.0	61.3	41.3
Attitude	**3**	**52**	**22.9**	**65.0**	**42.1**
User satisfaction	2	54	25.7	67.5	41.8
Affect	1	55	28.6	68.8	40.2
Availability	1	56	31.4	70.0	38.6
Computer self efficacy	1	57	34.3	71.3	37.0
Economic return	1	58	37.1	72.5	35.4
Efficiency gain	1	59	40.0	73.8	33.8
Individual factors	1	60	42.9	75.0	32.1
Individual impact	1	61	45.7	76.3	30.5
Information technology	1	62	48.6	77.5	28.9
KM Infrastructural capabilities	1	63	51.4	78.8	27.3
KM process capabilities	1	64	54.3	80.0	25.7
KM strategy	1	65	57.1	81.3	24.1
Knowledge specific service	1	66	60.0	82.5	22.5
Motivation	1	67	62.9	83.8	20.9
Organic growth	1	68	65.7	85.0	19.3
Perceived behavioral control	1	69	68.6	86.3	17.7
Perceived ease of contribution	1	70	71.4	87.5	16.1
Perceived usefulness of contribution	1	71	74.3	88.8	14.5
Personal innovativeness with IT	1	72	77.1	90.0	12.9
Reward policy	1	73	80.0	91.3	11.3
Service quality	1	74	82.9	92.5	9.6
Social factors	1	75	85.7	93.8	8.0
Strategy based factors	1	76	88.6	95.0	6.4
Task complexity	1	77	91.4	96.3	4.8

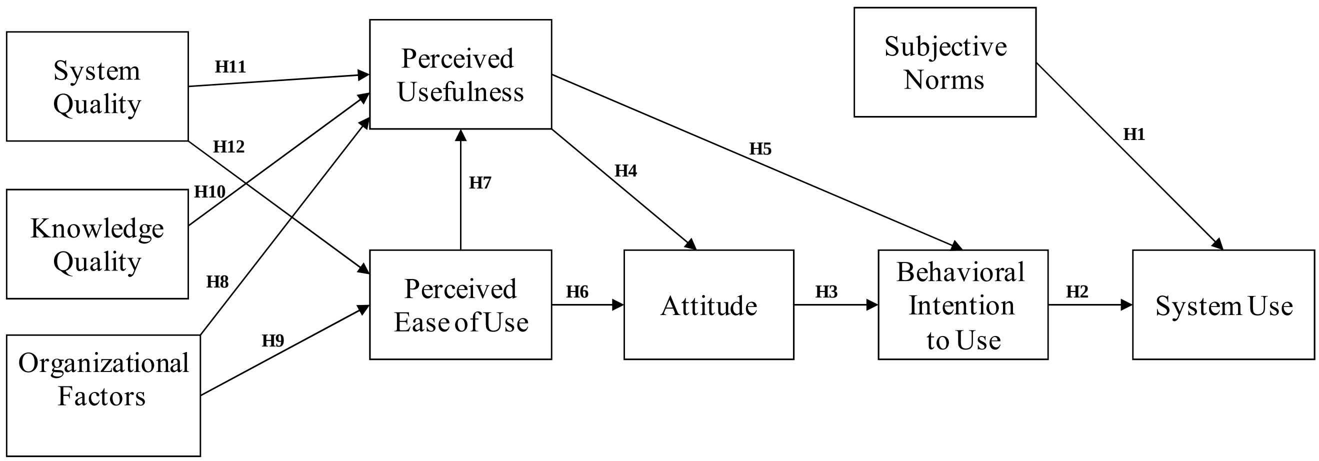
Technical infrastructure	1	78	94.3	97.5	3.2
Use	1	79	97.1	98.8	1.6
Voluntariness	1	80	100.0	100.0	0.0
Total Frequency	**80**	Equal Total Frequency	Equals 100%	Equals 100%	Power = CPF-CPC

Specifically, any construct receiving a citation count of less than three did not provide for a marginal increase in explanatory power (indicated in the last column) as it related to the variance in the total citation counts for all constructs. This selection criteria (cutoff point) optimized the trade-off between accounting for maximum variability (cumulative percent by frequency) and minimizing the number of constructs for the sake of parsimony (cumulative percent by construct). Based on the change in marginal explanatory power, the optimum decision point is where any factor that appeared three or more times in the literature. The power analysis table indicates that the first eight constructs: perceived usefulness, organizational factors, perceived ease of use, behavioral intentions, subjective norms, attitude, knowledge quality, and system quality account for 65% of the total variance in the appearance of KMS success-related constructs. These eight constructs were retained for further study and ultimately included in the final research framework.

Research Model

The research model as shown in Figure 4 was developed using the foundational constructs identified by the power analysis reported in the previous section. These factors are among the most widely cited and widely used success factors in the KMS literature pertaining to technological, organizational, and individual concerns. The following sections will outline the nature and rationale of the proposed linkages between each of the selected success factors and KMS success.

Figure 4: Theoretical KMS Success Model



Constructs and Hypotheses

System Use

Although *Use* per se was not one of the critical KMS success factors identified by the power analysis above, System Use as an *outcome variable* was incorporated into the framework for this study as a proxy for KMS success. Specifically, System Use is an appropriate dependent variable, because it captures the prolonged systematic appropriation of a KMS. Other studies have used system use as a dependent variable with subjects self-reporting their results (Davis, et al., 1989; Adams, Nelson, & Todd, 1992; Igbaria, Guimaraes, & Davis, 1995). System Use reflects that users have adopted the system and is one of the most frequently assessed categories in measuring IS success (Straub, Limayem, & Evaristo, 1995). As Seddon (1997) pointed out, System Use is also a good proxy for IS success when the use is optional. Doll and Torkzadeh (1988) and DeLone and McLean (2003) argued that System Use is an appropriate measure of success in most cases and is a key variable for understanding IS success.

However, simply measuring the amount of time a system is in use is often not enough. The effective functioning of a KMS associated with ongoing use as well as the initial adoption of the KMS, are both important indications of KMS success (Wu & Wang, 2006). A reasonable measure of success could also be determined by assessing whether the full functionality of a system is being used for its intended purposes. Hence, System Use could be an appropriate proxy for KMS success if it captures all the richness and complex nature of KMS implementation (Wu & Wang). For the purposes of this study, system use is therefore evaluated in terms of the eight critical success factors appearing in the proposed KMS success model: subjective norms, behavioral intentions, attitude, perceived usefulness, perceived ease of use, organizational factors, knowledge quality, and system quality.

Subjective Norms

Subjective norms refer to the person's perceptions of whether most people who are important to him or her believe that person should or should not use KMSs to perform a task (Ajzen & Fishbein, 1980). Subjective norms relate to the perceptions of general social pressure and reflect the social influence that may affect a person's intention to use KMSs (Xu & Quaddus, 2007). In short, people often take action based on their perceptions of what others (coworkers, supervisors, and top management) think they should do. Research (Liker & Sindi, 1997; Lucas & Spitler, 1999; Thompson, Higgins, & Howell, 1991) has shown that subjective norms are positively associated with individual's adoption of new technology. Thus, an end users' use of a KMS can be influenced by others, such as leaders, peers, respected people, superiors, and subordinates. Consequently, we would expect to observe a direct relationship between subjective norms and systems use.

Hypothesis 1: Organizational norms concerning KMS Use has a direct impact on KMS use.

Behavioral Intentions

Behavioral intention is defined as a measure of the strength's of a person's intention to perform a specified behavior (Davis, et al., 1989). It is a construct borrowed from the discipline of social psychology and an important construct in most previous Technology Acceptance Model (TAM) research (Money & Turner, 2005). The significance of behavioral intention derives from the theoretical notion that behavioral intentions are the best predictors of an individual's behavior (Jackson, Chow, & Leith, 1997). The purpose in measuring intention is to therefore predict future behavior. Davis et al., (1989) demonstrated that the behavioral intention to use a system is a reasonably reliable predictor of use. Indeed, the role of intention as a predictor of behavior (system use) is critical and has been well established in IS and the reference disciplines (Vankatesh, Morris, Davis, & Davis, 2003). Therefore:

Hypothesis 2: Behavior intentions to use a KMS will exhibit a significant positive relationship with KMS use.

Attitude

Attitude was originally proposed within the TAM as a moderating variable between the perceptions of usefulness and of ease of use and intention to use (Davis, 1989). Fishbein and Ajzen (1975) defined attitude as the learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object. In the KMS context of this study, attitude concerns specifically an individual's positive feelings about using a system, which could positively impact the intention to use. Consistent with the Technology Acceptance Model (Davis, 1989), attitude towards using the system has a direct effect on behavioral intentions to use the system. In other words, an individual embracing a positive attitude toward a technology are more likely to accept the technology than those showing a non-positive attitude. This leads to the following hypothesis:

Hypothesis 3: Attitude towards a KMS has a direct effect on a person's intention to use the KMS.

Perceived Usefulness

Perceived usefulness is defined as the prospective user's subjective probability that using a specific application system will increase his or her performance within an organizational context (Davis et al., 1989). Davis (1989) theorized that an individual's perception to usefulness would influence intention to use the system primarily through the creation of a positive attitude. User adoption of systems is driven by the perceived usefulness due to the reinforcement of value outcomes (Adams, Nelson, & Todd, 1992; Davis et al., 1989). In addition, the TAM proposes a direct impact of perceived usefulness on attitude and behavioral intention to use. These propositions lead to the following hypotheses:

Hypothesis 4: Perceived usefulness positively influences attitude toward a KMS.

Hypothesis 5: Perceived usefulness will have positive influence on behavioral intention to use a KMS.

Perceived Ease of Use

Perceived ease of use has been defined as the degree to which an individual believes that using a particular system would be free of physical or mental effort (Moore & Benbasat, 1991). This conceptualization of perceived ease of use focuses upon the ease of using a system separate from quality of the system itself. According to Davis (1989), there exists a direct effect of perceived ease of use on attitude. Furthermore, there is extensive empirical evidence (Davis et al., 1989; Venkatesh, 1999) that perceived ease of use is significantly linked to attitude.

Hypothesis 6: Perceived ease of use will positively influence user attitudes towards use a KMS.

It also follows that knowledge management systems that are easier to use require less mental effort (Clay, Dennis, & Ko, 2005). Lower levels of mental effort to use a system mean that the content of the system can be accessed with less effort, increasing the relative value of the use of the system. Therefore, the productivity gains from systems that are easier to use should foster a sense of increased perceived usefulness. Consequently, perceived ease of use is anticipated to have a direct impact on perceive usefulness.

Hypothesis 7: Perceived Ease of Use increases the Perceived Usefulness of the KMS.

Organizational Factors

Gold, Malhotra, and Segars (2001) suggest that knowledge infrastructure capability (technology, structure, and culture) along with knowledge process capability (acquisition, conversion, application, and protection) is an essential precondition for effective a KMS (Xu & Quaddus, 2007). The unconditional support of top management, a knowledge-sharing culture, and appropriate reward systems to participate and contribute to the KMS are also important factors for effective KMSs and their successful implementation (Ma & Hemmje, 2001). In fact, Davenport, DeLong, and Beers (1998) suggest that one of the most important determinants of a successful KMS is a knowledge-friendly culture, where people have a positive orientation toward knowledge, people are not inhibited in sharing knowledge, and the KM project fits with the existing culture.

Organizational factors in the proposed research model are represented by organizational structure, organizational culture, information technology infrastructure, and top management support. Past research finds that organizational factors have significant impact on the use of innovations (Belassi & Fadalla, 1998; Kim & Srivastava, 1998; McGowan & Madey, 1998; Sarvary, 1999; Sultan & Chan, 2000; Thong, 1999). In addition, the technology acceptance model proposes that external factors, such as organizational factors, will influence system use by affecting perceived usefulness benefits and perceived ease of use (Davis, 1986). Taken together, the relevant literature suggests that:

Hypothesis 8: Organizational factors directly impact the Perceived Usefulness of KMSs.

Hypothesis 9: Organizational factors directly impact the Perceived Ease of use of KMSs.

Knowledge Quality

Information quality has been used as a success measure for traditional IS (DeLone & McLean, 1992; Rai, Lang, & Welker, 2002; Seddon, 1997). In the KMS context, the distinction between knowledge and information depends on context and the user (Wu & Wang, 2006). For instance, one processor's knowledge can be another's information; knowledge to a given processor for a certain task at a certain time may be only information for another task or at a different time (Holsapple, 2003). Therefore, it is reasonable to consider the literature and thought surrounding information quality as a starting point for defining knowledge quality.

One component of every information system is the quality of the information, it provides. In the context of KMS success, Knowledge Quality is substituted for Information Quality as the type of content contained with the system. Knowledge Quality is defined as the degree to which the knowledge contained in a KMS is useful in assisting the user in accomplishing tasks, independent of the KMS in which it is contained (Clay, Dennis, & Ko, 2005). The relationship between Knowledge Quality and Perceived Usefulness is expected to be positive, reflecting increased perceived usefulness derived from using a system that contains high quality knowledge.

Hypothesis 10: The degree of knowledge quality in a KMS is directly associated with perceived usefulness of the KMS.

System Quality

Combining elements of the definitions provided by Jennex (2008) and Clay, Dennis, and Ko (2005), this construct defines how well the KMS performs the function of knowledge creation, storage, retrieval, transfer and application. System Quality is also concerned with issues such as whether there are errors in the system, its response time, its flexibility or stability. It also measures the reliability and predictability of the system independent of the knowledge it contains (Clay, Dennis, & Ko, 2005). If the use of the KMSs is volitional, the perceived usefulness of the KMS is likely to depend on the quality of knowledge content available to the users as well as the quality of the KMS itself (Kulkarni, Ravindran, & Freeze, 2007). Thus, like most information systems, the system quality of a KMS is expected to be a driver of perceived usefulness (Wu & Wang, 2006).

Hypothesis 11: The extent of system quality is directly associated with perceived usefulness of a KMS.

Previous studies (DeLone & McLean, 1992: Lin & Lu, 2000) demonstrated that high system quality had a positive effect on perceived ease of use. The determining criteria in assessing system quality are the performance of the system characteristics which include reliability, response time, and system flexibility (Hamilton & Chervany, 1981; Swanson, 1974). Therefore, a system may be supremely reliable, in that it performs the requested operations every time, thus a having high degree of system quality. High levels of system quality provide greater degrees of usability, availability, and better response time (DeLone & McLean, 2003). Research indicates that such system capabilities do indeed have a positive impact on perceived ease of use (Lederer, Maupin, Sena, & Zhuang, 2000; Liao & Cheung, 2001). Consequently,

Hypothesis 12: Higher degrees of System Quality increases the Perceived Ease of Use of the KMS.

Summary

These various hypotheses and constructs represent the many concepts and mechanisms associated with KMS and information system literature. The development of the research model appearing in Figure 4 was derived not only to reflect the Jennex and Olfman Model of KMS success, but through empirical analyses of the relevant KMS success and KMS use-based literature. The specific methodology by which the model and its various hypotheses were assessed will be discussed in the following chapter.

III. Methodology

Methodological Background

Digital Forensics - Framing the Investigative Context

One context in which there is evidence of the need for a successful, effective and widely accepted knowledge management system is in the discipline of digital forensics within our nation's law enforcement agencies. Digital Forensics is defined as scientific knowledge and methods applied to the identification, collection, preservation, examination, and analysis of information stored or transmitted in binary form in a manner acceptable for application in legal matters (Biros, Weiser, & Moiser, 2006). All facets of identification, collection, preservation, examination, and analysis, must be verifiable and repeatable, and the results generally accepted by the digital forensic community. The rapidly changing nature of digital technology makes general use of electronic information difficult to attain. Reusing techniques, tactics, and discoveries from other law enforcement agencies that have been successfully presented and accepted in a court is critical to gaining legal admissibility of the techniques. A successful or family of KMSs that aid in the knowledge process would go a long way towards addressing many of these issues within the digital forensics community.

KMS in Law Enforcement

Unfortunately, the law enforcement agencies that conduct digital forensic investigations possess a large but unstructured community memory with respect to digital forensics, primarily because there is not an explicit mechanism for disseminating the experiences of every digital forensic technician and investigator (Harrison, Aucsmith, Heuston, Mocas, Morrissey, & Russelle, 2002). Due to the technological nature of the digital forensics profession, an effective knowledge management system is needed to help law enforcement agencies accumulate more knowledge and build corporate intelligence. The explosive growth in the digital information maintained in the management systems of law enforcement agencies, and the spiraling need for cross-agency access to that information, have made utilizing such information both increasingly urgent and increasingly difficult (Hu, Lin, & Chen, 2005).

For example, incompatible content and information formats often create barriers to data access and utilization that make knowledge management a complex and daunting process (Jones & Jordan, 1998). Presently, information and knowledge are captured within law enforcement agencies in various forms ranging from computer records to documented institutional orders to the personal experience of digital forensic officers (Luen & Al-Hawamdeh, 2001). The crux of the issue for law enforcement is how to surface such knowledge and bring it to bear on the problems faced by digital forensic examiners in a timely and effective manner.

Digital forensic investigators also need timely access to relevant and accurate knowledge presented in an integrated and easily analyzed manner. According to Hauck and Chen (1999), the ideal knowledge management system for law enforcement agencies should be able to provide information about problems that have not been identified previously, and thus be able to give innovative and creative support for new investigations. In the case of digital forensics, the data may be available but not in a form that makes them useful for higher level processing (Hauck, 1999). For example, digital forensic investigators often devise tactics, techniques, and practices that are difficult to search and analyze. Often, only experienced and knowledgeable investigators may be able to use such organizational resources effectively.

There are a number of systems that currently serve as information management or intelligence analysis tools for law enforcement (Chen, Schroeder, Hauck, Ridgeway, Atabakhsh, Gupta, Boarman, Rasmussne, & Clements, 2002). Each of these systems has its own drawbacks and implements only certain aspects of the activities or functions necessary for storing and disseminating knowledge for law enforcement. For instance, Harrison et al. (2002) proposed a prototype web-based repository (Lessons Learned Repository for Computer Forensics) for sharing information, but the effort was not widely accepted because the system was not expandable to meet the demanding investigative needs of law enforcement professionals (Biros, Weiser, & Moiser, 2006).

National Repository of Digital Forensic Intelligence

The National Repository of Digital Forensic Intelligence (NRDFI) is a web-based document repository and management tool intended primarily to capture and share best practices of law enforcement agencies that would otherwise need to discover or develop similar techniques. It was designed to address the knowledge related needs of many law enforcement agencies through an integrated system that allows investigators to access and share information with other agencies. The NRDFI, a digital forensic knowledge repository development project between Oklahoma State University's Center for Telecommunications and Network Security (CTANS) and the Defense Cyber Crimes Center (DC3), is a mechanism that aims to provide a platform for digital forensic investigators to track details of cases as they are handled, and a reference system to previous investigations that might also be relevant (Biros et al., 2006). The NRDFI project aims to reduce the time required to analyze criminal records and advance the investigation of current cases by developing a

KMS that is appropriate for capturing and analyzing digital forensic intelligence related information in social and organizational contexts.

However, many issues and obstacles, such as those that serve as barriers to implementing a successful KMS, must be addressed to ensure the successful deployment of the NRDFI in the digital forensics community. For example, there is a great sense of information ownership which impacts trust and willingness to share information that creates a kind of competition between the groups (Biros et al., 2006). If no immediate gain is identified from relinquishing information, agencies may not be motivated to share information. Because there is no immediate gain in providing information for others and a very real fear that current and future criminals may improve their own skills with this knowledge, agencies are not motivated to share.

Technical and bureaucratic barriers between various law enforcement systems also contribute to the inability to integrate and access the vast number of law enforcement management systems. This inability to share with other systems prevents an agency from receiving timely information from other data sources, ultimately decreasing the efficiency of crime prevention and investigations (Hauck, 1999). Law enforcement professional and (more specifically) digital forensic investigators, like computer network security experts, tend to rely more on personal social networks or ego-centric networks rather than more formal repositories of information; further information sharing in this domain (Jarvenpaa & Majchrzak, 2005).

Yet, the increase in digital forensics cases far outpaces the growth in number of forensic examiners. General requirements for legal admissibility are strict and unchanging. With constant modifications to the technologies that are examined, mechanisms to share new knowledge are critical. A knowledge repository that allows geographic agencies responsible for the analysis to communicate and share new discoveries may be the only way to efficiently and effectively process such cases.

The NRDFI project was implemented in the hope of addressing some of these issues. The NRDFI is designed to allow geographically diverse law enforcement agencies to share digital forensic information that will hopefully aid every agency in successfully prosecuting their case. In its full implementation, the NRDFI has the potential to provide exceptional gains in efficiency for forensic examiners and investigators by providing a better conduit to share relevant information between agencies and a structure through which cases can be cross referenced to have the most impact on a current investigation (Biros et al., 2006).

Summary

The digital forensic profession is driven by the perpetual advances in electronic technology and has a demand for accurate and timely digital forensic information that is presented in a well organized manner. Furthermore, the profession daily becomes more complex because of the constant new challenges from the creativity of hackers, criminals, and terrorists who find ingenious methods for exploiting digital technology. Despite the multitude of systems that serve as intelligence analysis tools for law enforcement, they all operate in an ad hoc and somewhat arbitrary manner; there is no structured approach to collect, analyze, and disseminate digital forensic information among digital forensic examiners. The NRDFI is a platform that will hopefully address the issues, functioning as a repository for digital forensic examiners to share digital forensic information and analyses. It is a new system currently being fielded; however, as was demonstrated in the previous chapter, there are numerous issues and potential barriers to be addressed before it can effectively be called a successful KMS. Therefore, this study will examine the factors that impact KMS success relative to the various challenges and issues that DC3 and CTANS will or are experiencing with the implementation of their NRDFI. The following sections provide greater methodological detail concerning how the overcoming research questions and hypotheses were examined and tested within the specific research context described in the previous paragraphs.

Methodological Overview

A survey-based design was used to test the proposed research model and its various hypotheses. The research model was examined from the perspective of KMS users (digital forensic investigators) relative to their experiences with a new KMS (the NRDFI) because users should ideally be in the best position to assess and comment on many of the KMS success-related constructs included in the research model (such as system quality, ease of use, and perceived benefits). There are basically two types of users, those who contribute knowledge to the system and those who use the knowledge stored in the system (Jennex, 2008). This study will only focus on the users of knowledge because it is concerned about what influential factors lead law enforcement officers to retrieve knowledge content from a particular KMS and apply that knowledge in some way and because the system itself is so early in its implementation that very few users have actually contributed to the NRDFI at this time. Results obtained from these users were then analyzed to test the various hypotheses in the final sections of the previous chapter.

Survey Instrument

The literature review indicated a number of existing constructs suitable to the research model. Survey questions and measures used to operationalize the various constructs included in the research model were primarily adapted from relevant KMS literature. All original estimates of scale reliability exceed the threshold (.70) commonly suggested for exploratory research (Nunnally, 1978). However, the validity of an instrument composed of so many disparate scales and measures may not be consistent across different technologies and user groups (Straub, 1989), therefore all survey questions were pilot tested.

Pilot Test

A pilot test was used to refine the measures given the concerns expressed previously for having a valid instrument that is in fact composed of a multitude of measures. A total of 23 third party participants examined the various survey measures and scales for face validity and applicability within the proposed research context. These participants included an assistant professor of management information systems from Oklahoma State University, Oklahoma State University's CTANS Director, DC3's Digital Forensic Intelligence Analyst, four digital forensic examiners from the DC3, an assistant professor of information resource management from the Air Force Institute of Technology (AFIT), and 15 AFIT graduate students majoring in information resource management who were familiar with KMSs in general but were not aware of the specific issues or questions associated with the research endeavor. The DC3 analyst and Oklahoma State University's CTANS Director were the sponsors of this research.

Results of the pilot test included the modification of a few questions and elimination of others to ensure contextual consistency and to enhance question clarity appropriate for the NRDFI and the targeted law enforcement setting. Poorly worded, obscure, or ambiguous questions were either dropped from the survey or reworded in the hopes of increasing the reliability and validity of the scales within the research context. The number of items for some constructs was also reduced in the interest of keeping the entire questionnaire to a reasonable length (to increase participation rates and reduce the possibility of errors caused by respondent fatigue or declining interest). All changes to the survey were consistent with theory and the proposed research model.

The pilot test was conducted online to test both the ability of the scales to capture the psychometric characteristics of the constructs of interest and to test a web-based data collection site used for the administration of the survey itself. Responses for each construct were measured using a 7-point Likert-type scale ranging from "strongly disagree" (1) to "strongly agree" (7). Table 7 provides an overview of the particular measures used and adapted from publications appearing throughout the literature review and summarizes the constructs and number of items used for the construction of the final survey instrument following the pilot study (attached at Appendix A). Additional open-ended questions were included in the survey to elicit user feedback regarding general system concerns relevant to the NRDFI or other non-specific survey comments.

Table 7

Original Constructs and Measurements

Construct	Source(s)	Reported Cronbach's Alpha	Original Number of Items	Post-Pilot Study Number of Items
System Quality	Clay, Dennis, & Ko, 2005; Jennex & Olfman, 2006; Wu & Wang, 2006;	.82	4	4
Knowledge Quality	Doll & Torkzadeh, 1988; Seddon & Kiew, 1994; Rai, Lang, & Welker, 2002	.92	4	4
Organizational Factors	Gold, Malhotra, & Segars, 2001	.81	24	6
Perceived Ease of Use	Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 1996; Venkatesh & Morris, 2000	.90	4	3
Perceived Usefulness	Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 1996; Venkatesh	.92	4	4

	& Morris, 2000			
Attitude	Taylor & Todd, 1995	.85	4	4
Subjective Norm	Thompson, Higgins, Howell, 1991; Compeau & Higgins, 1995; Taylor & Todd, 1995; Limayem, Bergeron, & Richard, 1997	.78	2	2
Behavioral Intention	Davis, 1989; Venkatesh & Davis (2000)	.92	3	3
System Use	Wu & Wang, 2006; Clay, Dennis, & Ko, 2005	.91	5	5

Procedure

The final version of the questionnaire was published on a web server hosting an online survey administration and data collection service. This server was accessible by digital forensic examiners conducting a NRDFI pretest first announced and offered during the 2008 Defense Cyber Crime Conference in Saint Louis, Missouri. Initial experience with the NRDFI was provided and hosted by DC3 and CTANS during their demonstration presentations. The survey invitation was then offered online following the initial prototype familiarization training through a voluntary universal resource locator (URL). Additional participation in the web-based survey was solicited through postings to United States federal, state, and local law enforcement agencies placed by the Defense Cyber Crime Center and the Oklahoma State University's Center for Telecommunications and Network Security.

Participants

The final survey instrument was administered to members of various law enforcement agencies across the country. Qualified respondents were digital forensic examiners who were target users of the NRDFI and who had pretested the prototype version of the NRDFI deployed and sponsored by the DC3 and CTANS. These examiners were not involved in the development of the NRDFI or the survey instrument. All respondents participated in the study voluntarily and provided their survey responses anonymously via the web-based administration of the survey instrument.

Of the 70 email messages distributed to invite users to access the NRDFI, a total of 10 responses were received, showing a 7% response rate. Analysis of the respondents showed an approximate 100% in gender distribution, in favor of males. 90% of them had forensic experience and were predominantly (60%) working as a forensic examiner. Most of the participating officers had a two or four year degree (70%), followed by those having some college (20%), and one holding a masters degree (10%). Half of the respondents were in the age group between 36-50, 40% were in the age group between 20-35, and only 10% were above the age of 50. On average, the responding officers had accumulated 5.4 years of forensics experience, 15.8 years of law enforcement experience, and were assigned to their current work units for 6.5 years.

IV: Results and Analysis

Effect Sizes in Small Sample Studies

The most commonly used metric to effectively assess meaningful outcomes, other than statistical significance testing, is effect size (Cohen, 1988). An effect size is simply a measure of the magnitude of observed effect that is independent of a sample size (Field, 2005a; 2005b). Effect sizes are useful because they provide a measure of the importance of an effect. Pearson's *r* correlation is one of the most widely used effect size and is arguably the most versatile effect size (Field, 2001; Rosenthal & DiMatteo, 2001). Pearson's *r* can vary in magnitude from -1 to 1, with -1 indicating a perfect negative effect, 1 indicating a perfect positive effect, and 0 indicating no effect. Cohen (1988, 1992) has made some widely accepted suggestions about what constitutes a large or small effect. He gives the following the rules of thumb on how to interpret the magnitude of correlation or the magnitude of any effect statistic:

- r = 0.10 (small effect): in this case, the effect explains 1% of the total variance.
- r = 0.30 (medium effect): the effect accounts for 9% of the total variance.
- r = 0.50 (large effect): the effect accounts for 25% of the variance.

Table 8 provides further explanation of Cohen’s scale for interpreting the magnitude of an effect.

Table 8

Cohen’s Effect Statistics

Correlation Coefficient	Descriptor
0.0-0.1	Trivial, very small
0.1-0.3	Small, low, minor
0.3-0.5	Moderate, medium
0.5-0.7	Large, high

0.7-0.9	Very large, very high
0.9-1	Nearly, practically: perfect, distinct

Sample size has a profound effect on tests of statistical significance. There is very little information in a small sample; therefore estimates of correlations can be very unreliable resulting in low power for testing hypotheses (Allison, 1999). On the other hand, large samples contain much information that allows the researchers to estimate the correlation more precisely. Strong correlations are sometimes needed in order to reach statistical significance with small samples; however, with a very large sample very small correlation coefficients may be statistically significant (Kerr, Hall, & Kozub, 2002).

Small samples commonly produce results that do not reach a more conventional level of significance- $p<.05$ (Hoyle, 1999). Because it is difficult to get statistically significant results in small samples, *p* values are sometime raised to less conservative but still statistically acceptable significance levels, for example from 0.05 to 0.10 (Allison, 1999). By considering the notion of an effect size with small samples, one might uncover a potentially significant relationship that might have yielded even more significant results if only a larger sample was used. Because effect sizes are not dependent on sample size and have a consistent measurement interpretation, they can be used to describe the practical significance of a statistical test result (Vaske, Gliner & Morgan, 2002; Cook, 1999). Therefore, for the purposes of this study, Cohen's scale will be used to interpret the estimated magnitude of effect for relationships between variables that are not found to be statistically significant through more traditional significance testing. However, due to the extremely small obtained sample size, this study will retain a more conservative perspective on significance reporting and highlight only those results that are significant $p < 0.05$.

Data Analysis

Data analyses included reliability and internal validity analyses, correlation analysis, and multiple regression. Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 15 for Windows. Descriptive statistics were used to describe the samples. Multiple regression analysis was used to test the hypotheses from the research models. p values <0.05 were regarded as statistically significant. The next sections of this chapter describe the various stages of the data analysis.

Reliability and Internal Validity of the Survey Instrument

When the actual survey was received, reliability was assessed for each construct using Cronbach's α to test the discriminant validity and reliability of constructs and scales as recommended by Hair, Anderson, Tatham, & Black (1998). The greater Cronbach α value, the greater correlation between the question items within the scale and the higher internal consistency. Nunnally (1978) defined acceptable reliability as 0.7 and above in general basic research. The only measures that reached above 0.7 were Knowledge Quality, Perceived Usefulness, and Subjective Norms. The reliability estimates of these scales are very likely a reflection of the low sample response rates (10). For example, reliability tests were performed on System Quality and Perceived Ease of Use with eight survey responses received as of February 14, 2008. Because two more samples were received on February 17, 2008 (2 days after the data collection cut of date), another data analysis was performed on 10 samples. The System Quality scale's reliability increased from 0.289 to 0.392. Similarly, Perceived Ease of Use's scale reliability increased from 0.483 to 0.531. Therefore, the evidence suggests that a larger sample size would have increased the reliability of the scales used for this research.

The means, standard deviations, and Cronbach's α reliability estimates of the final instrument are reported in Table 9. Three scales (Knowledge Quality, Perceived Usefulness, and Subjective Norms) are above the acceptable reliability and two (Attitude and System Use) are fairly close to acceptable reliability. Overall, the analysis provided sufficient justification to suggest that most, if not all of the items used in the instrument would, especially under more ideal data collection circumstances, support an empirical examination of the research model.

Table 9

Scale Descriptive Statistics and Cronbach's Alpha Reliability Coefficients

Measures	**Number of Items**	**Mean**	**Standard Deviation**	**Cronbach's Alpha**
System quality	4	5.9	0.60323	0.392
Knowledge quality	4	5.7750	0.85351	0.915
Organizational factors	6	5.9333	0.35312	0.333
Perceived usefulness	3	5.7	0.82327	0.951
Perceived ease of use	4	6.3	0.40483	0.531
Attitude	4	6.4	.37639	0.641
Behavioral intention to use	3	6.1	.47271	0.564
Subjective Norms	2	4.6	.84327	0.750
System use	5	5.9	.32931	0.625
Overall	35			

In addition to the validity assessments, a collinearity test was conducted. In regression models, multicollinearity exists when there is a strong correlation between two or more predictors (Field, 2005a). The multicollinearity for all the variables was examined with the Variance Inflation Factor (VIF). The VIF indicates whether a predictor has a strong linear relationship with other predictors (Field, 2005a). As an indicator that multicollinearity is controlled in a measurement model, Neter and Kutner (1990) suggest that the VIF values should be less than 10. Obtained values of VIF for the constructs in this study ranged from

1.006 to 2.575 (see Table 10). Therefore, the measurement model exhibited evidence of convergent validity, further suggesting that additional analysis using the research model was appropriate for the purposes of this study.

Table 10

Independent Variables VIF Values

Dependent Variable	Independent Variables	Independent Variable VIF Value
System Use	Subjective norms	1.664
System Use	Behavioral intention	1.664
Behavioral intention	Attitude	1.591
Behavioral intention	Perceived usefulness	1.591
Attitude	Perceived usefulness	1.014
Attitude	Perceived ease of use	1.014
Perceived usefulness	Perceived ease of use	2.575
Perceived usefulness	Organizational factors	1.093
Perceived usefulness	Knowledge quality	1.631
Perceived usefulness	System quality	1.806
Perceived ease of use	System quality	1.006
Perceived ease of use	Organizational factors	1.006

Hypothesis Testing and Analysis

Correlation Analysis

The hypotheses testing analyses included initial computations of the Pearson's correlation coefficient. Responses from the questionnaires were gathered and entered into SPSS 15 for Windows. The purpose of the Pearson's statistic is to find the significant intercorrelations between variables (Liaw & Huang, 2003). Highly intercorrelated scale items are a good indication of scale reliability and also suggest that they yield a true measurement of the underlying concept (Field, 2005). If the scales are not highly intercorrelated, there may be no evidence of a real relationship between the two variables. Pearson correlation coefficients among the variables appear in Table 11 and include the associated *p*-values in the context of the research model. Significant relationships are found for all bi-variate associations except Perceived Ease of Use and Attitude (*r* = .355, moderate effect), Perceived Ease of Use and Perceived Usefulness (*r* = -.117, negative small effect), and Perceived Usefulness and Behavioral Intention to Use (*r* = .086, very trivial effect). Additionally, Table 10 illustrates several highly significant intercorrelations between variables such as attitude toward a system and behavioral intentions to use a system (r = .687, $p < .05$), and between behavioral intentions to use a system and system use (r = -.704, $p < .05$), indicating that as a person's attitude towards a system increases, intentions to use the system increases; and as a person's intentions to use a system increase, use of the system decreases.

Table 11

Correlation Matrix for Variables

		SU	KQ	ATT	PEOU	PU	BI	SN	OF	SU
System Quality (SQ)	Pearson Correlation	1	0.194	0.073	.620*	0.268	-0.091	-0.087	-0.078	-0.045
	Sig (1-tailed)		0.295	0.42	0.028	0.227	0.401	0.405	0.415	0.451
	N	10	10	10	10	10	10	10	10	10
Knowledge Quality (KQ)	Pearson Correlation	0.194	1	.636*	.579*	0.21	0.246	-0.486	0.221	-0.427
	Sig (1-tailed)	0.295		0.024	0.04	0.281	0.247	0.077	0.27	0.109
	N	10	10	10	10	10	10	10	10	10
Attitude (AT)	Pearson Correlation	0.073	0.636*	1	0.355	.610*	.687*	-0.753**	0.711*	-0.654*
	Sig (1-tailed)	0.42	0.024		0.157	0.031	0.014	0.006	0.011	0.02
	N	10	10	10	10	10	10	10	10	10
Perceived Ease of Use (PEOU)	Pearson Correlation	0.620*	0.579*	0.355	1	-0.117	0.358	-0.26	0.155	-0.467
	Sig (1-tailed)	0.028	0.04	0.157		0.374	0.155	0.234	0.334	0.087
	N	10	10	10	10	10	10	10	10	10
Perceived Usefulness (PU)	Pearson Correlation	0.268	0.21	0.610*	-0.117	1	0.086	-0.512	0.497	-0.344
	Sig (1-tailed)	0.227	0.281	0.031	0.374		0.407	0.065	0.072	0.165
	N	10	10	10	10	10	10	10	10	10
Behavioral Intention (BI)	Pearson Correlation	-0.091	0.246	0.687*	0.358	0.086	1	-0.632*	0.710*	-0.704*
	Sig (1-tailed)	0.401	0.247	0.014	0.155	0.407		0.025	0.011	0.011
	N	10	10	10	10	10	10	10	10	10
Subjective Norms (SN)	Pearson Correlation	-0.087	-0.486	0.753**	-0.26	-0.512	-0.632*	1	-0.784**	0.592*
	Sig (1-tailed)	0.405	0.077	0.077	0.006	0.234	0.065		0.004	0.036
	N	10	10	10	10	10	10	10	10	10
Organizational Factors (OF)	Pearson Correlation	-0.078	0.221	0.711*	0.155	0.497	0.710*		1	
	Sig (1-tailed)	0.415	0.27	0.011	0.334	0.072	0.011			
	N	10	10	10	10	10	10	10	10	10
System Use (SU)	Pearson Correlation	-0.045	0.427	-0.654*	-0.467	-0.344	-0.704*	0.592*	-0.752**	1
	Sig (1-tailed)	0.451	0.109	0.02	0.087	0.165	0.011	0.036	0.006	
	N	10	10	10	10	10	10	10	10	10

* Correlation is significant at $p < 0.05$ (1 tailed)

** Correlation is significant at $p < 0.01$ (1-tailed)

Highlighted cells were found to be significant.

Multiple Regression Analysis

Multiple regression analysis was then used for the specific hypothesis testing, again using SPSS for Windows for data analysis. Multiple regression analysis is a statistical technique for finding the best relationship between a dependent variable and selected independent variables (Field, 2005a). The total effect of a particular independent variable on the dependent variable is the result of the direct relationship between the independent and dependent variables, and the indirect impacts of any intervening variables.

Table 12 illustrates the findings of the multiple regression analysis. The first regression analysis was performed to check the effect of the predictor variables' (System Quality, Knowledge Quality, Perceived Ease of Use, and Organizational Factors) influence on the perceived usefulness of a KMS. Results were non-significant ($F(4,5) = 4.075$, $p=0.78$, $R^2=.765$). However, looking past non-significant values, beta weight values suggest that the biggest predictors of Perceived Usefulness were System Quality ($\beta =.864$) and Organizational Factors ($\beta =.614$).

The second regression analysis examined the effects of the independent variables (System Quality and Organizational Factors) on the Perceived Ease of Use of a KMS. Again, the results were non-significant ($F(2,7) = 2.599$, $p = .143$, $R^2 = .426$). Again, beta weight analysis suggested that the biggest predictor variable for Perceived Ease of Use was System Quality ($\beta =.636$).

A third regression analysis was performed to examine the effects of Perceived Ease of Use and Perceived Usefulness on Attitude. The results were non-significant ($F(2,7)=4.35$, $p=.058$, $R^2=.556$).

The fourth regression analysis examined the effect of Perceived Usefulness and Attitude on Behavioral Intention. Perceived Usefulness and Attitude were found to be significant predictors of Behavioral Intention (F(2,7)= 6.456, p=.026, R^2=.648). In addition, the beta weight suggested Attitude was the most significant contributor (β =1.010) to this relationship.

The last regression analysis was performed to examine the effect of Subjective Norms and Behavioral Intentions on System Use. The results again were non-significant (F(2,7)=3.979, p=.070, R^2=.532). Table 13 presents a summary of the hypotheses testing results.

Table 12

Multiple Regression Results for Predicted Path Relationships

Dependent Variable	Independent Variables	B	SE	β	R^2
Perceived Usefulness	(Constant)	.771	3.940		.765
	System quality	1.179	.397	.864*	
	Knowledge quality	.491	.267	.509	
	Perceived ease of use	-2.120	.707	-1.042*	
	Organizational factors	1.431	.528	.614*	
Perceived Ease of Use	(Constant)	2.386	2.339		.426
	System quality	.427	.193	.636	
	Organizational factors	.235	.329	.205	
Attitude	(Constant)	2.147	1.697		.556
	Perceived ease of use	.402	.236	.433	
	Perceived usefulness	.302	.116	.660*	
Behavioral Intention	(Constant)	-.284	1.862		.648*
	Perceived usefulness	-.304	.162	-.530	
	Attitude	1.269	.355	1.010*	
System Use	(Constant)	7.815	1.857		.532
	Subjective norms	.096	.130	.245	
	Behavioral intention	-.383	.232	-.549	

Beta weight significant at *p<.05 (1-tailed)

Table 13

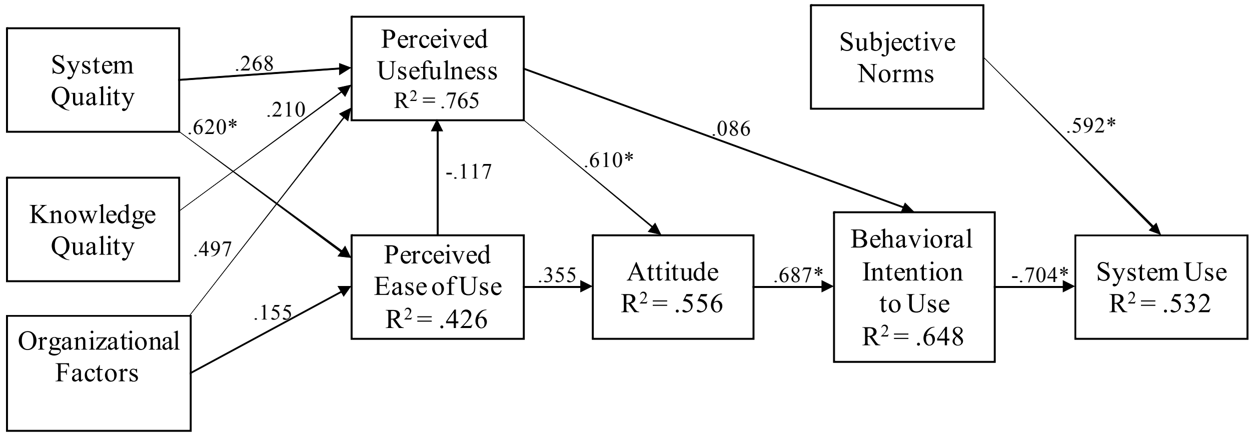
Summary of Research Hypotheses Findings Based on Correlation Analysis

Hypothesis #	Independent Variables	Dependent Variable	Result	Hypothesis Supported
H1	Subjective norms	System Use	Significant positive effect	Yes
H2	Behavioral intention	System Use	Significant negative effect	No
H3	Attitude	Behavioral Intention	Significant positive effect	Yes
H4	Perceived usefulness	Attitude	Significant positive effect	Yes
H5	Perceived usefulness	Behavioral intention	Trivial positive effect	No
H6	Perceived ease of use	Attitude	Moderate positive effect	No
H7	Perceived ease of use	Perceived usefulness	Small negative effect	No
H8	Organizational factors	Perceived usefulness	Moderate positive effect	No
H9	Organizational factors	Perceived ease of use	Small positive effect	No
H10	Knowledge quality	Perceived usefulness	Small positive effect	No
H11	System quality	Perceived usefulness	Small positive effect	No
H12	System quality	Perceived Ease of Use	Significant positive effect	Yes

Model Analysis

Figure 5 represents the final model with the standardized path coefficients, their significance, and the coefficients of determinant (R^2) for each endogenous construct. The asterisks on the paths indicate the significance level and the variance explained are presented below the dependent variables. The model's explanatory power was assessed. The model explains 53.2% of the variance in System Use of the KMS, 64.8% of the variance in respondents' behavioral intention to use a KMS, 55.6% of the variance in a respondent's attitude toward using a KMS, 42.6% of the variance in perceived ease of use of the KMS, and 76.5% of a respondents' perception of the usefulness of a KMS. The model accounts for a significant portion of the variance in the perceptions of the respondents perceived usefulness of the KMS.

Figure 5. Research Model and Observed Correlations



* Correlation is significant at p < 0.05 (1 tailed)
** Correlation is significant at p < 0.01 (1-tailed)

Based on the proportion of the variance explained, the model appears to have the exhibited some degree of satisfactory utility for explaining or accounting for law enforcement officers' use or adoption of the NRDFI.

Post Hoc Statistical Power

Statistical power is very important in quantitative research; it provides a measure of the adequacy of an investigative model to detect a hypothesized effect (Chin & Newsted, 1999; Goodhue, Lewis, & Thompson, 2006). The power of a statistical test refers to the probability of detecting a statistically significant relationship between two variables, when a relationship is actually there (Larzen & Marx, 1981). Because of this study's low sample size, most of the observed statistical power ratings for the various dependent variables are very low. Table 14 depicts the observed statistical power ratings for all dependent variables. While no formal standard has been established for what constitutes adequate statistical power, the value of 0.80 proposed by Cohen (1988) has become the standard minimal power standard for most researchers. Based on Cohen's standard, the model has adequate power to detect any effects that might exist for Perceived Usefulness and Behavioral Intention. .

Table 14

Observed Statistical Power (Sopher, 2008)

Dependent Variable	Observed Power
Perceived Usefulness	0.827819
Perceived Ease of use	0.485385
Attitude	0.715050
Behavioral intention	0.871302
System Use	0.671265

Respondents' Feedback

In addition to the statistical analysis, open ended comments (see Table 15) were provided by the respondents on the survey and during the NRDFI demonstrations at the 2008 Cyber Crime Conference in Saint Louis, Missouri. Some of the suggestions refer to usability and accessibility issues while others referred mainly to security and functionality concerns.

Table 15

Respondents' Comments

Survey Comments	Conference (14-16 Jan 08) Comments
Respondent# 1: Currently it seems the site needs more testing on other web platforms to ensure compatibility. My office uses Safari and other browsers to accomplish and would appreciate a full range of access.	Can I post information on the NRDFI that will only be accessible to my organization and not everyone?
Respondent# 4: I would like to see forensic tools added to the NRDFI. I have already utilized the system since the Cybercrime conference, but the tool listed in the document is not available. (or at least that I could find.) A document discussing a forensic tool doesn't help if you can not download the tool. Also, there seems to be some functionality problems. After searching for a topic and opening a document, the system froze. I had to log out and log back in to continue searching. Great idea for knowledge sharing, look forward to using it.	Main participation hindrance is security. Single factor authentication (password only) is a not a valid security mechanisms. More security measures need to be implemented into the system. What about issuing users encrypted passwords?
	Can the system be configured similar to my email service? When I log into the system can it depict how many new email message(s) I have?

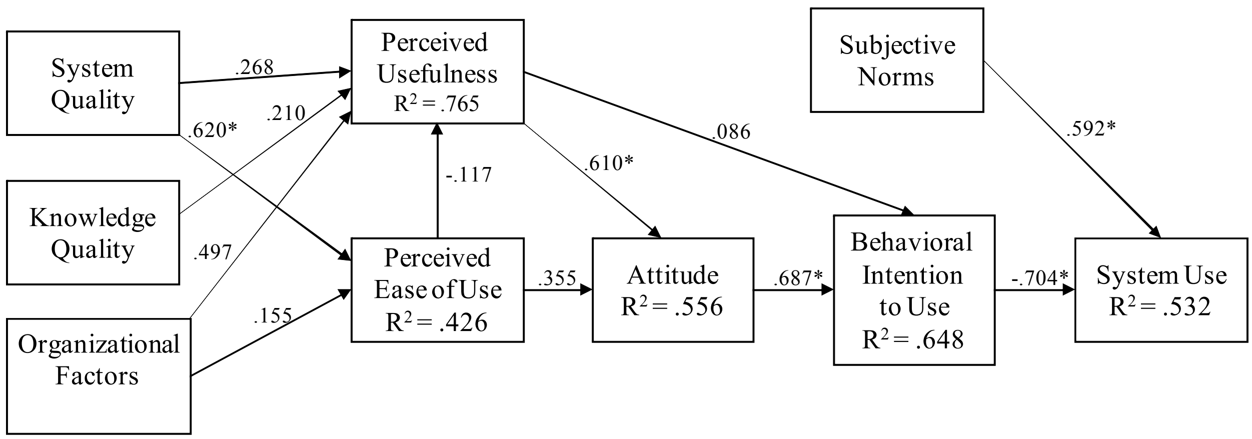
V: Discussion

Discussion

This study developed and explored a comprehensive model and measurement instrument for assessing KMS success. The selection of model constructs was grounded in an empirical analysis of contemporary KMS literature aimed at assessing and consolidating the most widely used KMS and IS success factors and models into a single investigational framework. The results suggest that the resultant model warrants further examination and consideration in either practical or academic contexts.

In general, the model proved suitable as a foundation for analysis due to its ability to account for a relatively large degree of variance observed in the surveyed law enforcement officers' perceptions of usefulness and intentions to use a particular KMS (the NRDFI). With respect to previous research where the Technology Acceptance Model was applied in the context of the other types of information systems, the study shows explicate power of Perceived Usefulness (observed power = .83) and Behavioral Intentions to Use (observed power = .87). Together, System Quality, Knowledge Quality, Organizational Factors, and Perceived Ease of Use accounted for almost 76.5% of the observed variance in responses for Perceived Usefulness. Additionally, Perceived Usefulness and Attitude accounted for 64.8% of the observed variance for Behavioral Intention to Use a system. In addition, Subjective Norms and Behavioral Intention to Use accounted for 53.2% of the observed variance for System Use (see Figure 6). At a minimum, the findings extend the literature's suggestion that Attitude, Behavioral Intention, and Subjective Norms are excellent predictors of System Use (Venkatesh & Davis, 2000; Hu, Chau, Sheng, & Tam, 1999; Mathieson, 1991; Taylor & Todd, 1995; Szanja, 1996; Davis et al., 1989; Davis, 1986). This research, in line with recent works of KMS success, extends the number of constructs in the TAM and pursues investigating a number of external variables that broadens the apparent applicability of TAM to the context of KMSs.

Figure 6. Research Model



The results provide initial support for 4 out of the 12 research hypotheses. Furthermore, examination of the findings beyond the statistically significant relationships are at least suggestive of the efficacy with which the proposed combination of eight IS and KMS-related variables can describe or account for the factors that lead to KMS success. The findings not consistent with previous TAM or KMS success literature are those concerning the relationships between Perceived Ease of Use and Perceived Usefulness, Behavioral Intention to Use and System Use, and independent variables System Quality and Knowledge Quality on Perceived Usefulness.

Perceived Ease of Use did not have a significant effect on Perceived Usefulness and Attitude as suggested by the Technology Acceptance Model (TAM). Also, Knowledge Quality did not have a significant effect on Perceived Usefulness nor did it have a greater effect on Perceived Usefulness than System Quality as suggested by Wu & Wang (2006) and Clay, Dennis, & Ko (2005). The lack of significance observed for most of the research model's relationships is likely due to the limited demonstration time of the system, system errors, and the respondents' limited interaction time with the NRDFI.

Specifically, during the Cyber Crime Conference, only one laptop--which was subject to a 15 minute Internet usage restriction-- was used to demonstrate the NRDFI to interested law enforcement officers. Because of the time and connectivity restrictions, the average demonstration lasted approximately 8 minutes, leaving only 7 minutes for the administrator to correct any system flaws without having to log back into the network. However, at least 10 to 15 minutes were needed to adequately cover all of the NRDFI's features. Additionally, a plan had been devised to allow the respondents at least 1 day minimum for interactive lessons and hands on experience during the conference. Due to the combination of these limitations, it is reasonable to conclude that not enough time was provided for participants to actually learn how to use the system, much less use it effectively—which was ultimately the dependent variable of interest in this study. As such, it is not surprising that a breakdown of some of the fundamental relationships between constructs in the research model was observed.

The study's open-ended survey results focused heavily on the need for more compatibility and functionality testing. However, the officers had expressed a desire to see something like the NRDFI come online. Such sentiments indicated that the officers would likely have both desire and reason to use the NRDFI in the future, further suggesting a predisposition to perceive the usefulness of such a system even without having much interaction with the system itself. It is reasonable to expect that more accurate data might have been collected if the officers' perceptions would have been based on their own usage experiences instead of someone demonstrating to them what the NRDFI could do in a brief span of only 7-8 minutes.

As mentioned in the sections above, the research model operationalized System Use in terms of effectiveness of use rather than on-going use. While ease of use is important for system adoption, as suggested in the TAM, it is not the key consideration when users decide whether to use the NRDFI or not. Instead, the NRDFI users seemed to put more emphasis on whether accurate and quick search results can be achieved through the NRDFI's search features.

The correlation between Behavioral Intention to Use and System Use was found to be exactly opposite from what has been typically observed in previous TAM-related research. This inconsistent finding was likely attributable to the nature of the study scenario rather than anything fundamental about the relationship between intention and actual use. In particular, system use was likely not appropriately measured in this context because the research data was collected after only a brief interaction (on average 8 to 10 minutes) with the NRDFI. Consequently, the relationship between intention and use is not conceptually meaningful because of the way in which System Use was measured. Specifically, usage effectiveness was not an appropriate dependent measure given the fact that conditions under which that use was rendered during the Defense Cyber Crime Conference did not allow for much, if any, demonstration of effective use. Because of these limitations in the demonstration and interaction experiences, the measurements underlying the System Use construct were undoubtedly confounded with the conditions of actual system use. Thus, although the relationship between Behavioral Intention to Use and System Use was significant but contrary to the Technology Acceptance Model, the negative relationship between Intention to Use and System Use was very likely an artifact of the measure subject to the unfortunate circumstances during the conference under which use of the NRDFI occurred. Until the NRDFI is actually fully operational and available for users to interact with it, ongoing measurements of System Use in terms of effectiveness may not be appropriate.

Implications of Research

Despite the methodological difficulties experienced during the study's execution within the research context, the current research provides some support for the combined KMS success model, certainly enough to prompt continued investigation and refinement. Additional work to develop this model will hopefully result in an improved and well-validated version that will provide researchers and practitioners with a sound explanation of (or roadmap to achieve) success in implementing knowledge management systems. However, the results of this research offer several potential benefits for members of both law enforcement and academia.

First, this research contributes to the KMS literature because it provides potential measurements of the many social and technical factors that are likely to contribute to KMS success. Additionally, the model can be used for practical applications in organizations embarking on KMS implementation efforts. For instance, organizations early in KMS implementation can use the constructs and factors in the study to conduct an internal audit to see if conditions are conducive to continued adoption of the KMS.

In addition to providing a contribution to KMS literature, the empirical findings of this study could offer substantial savings to practitioners. For example, by understanding the handful of success factors that are essential for a KMS, managers and decision-makers can better assess whether their organizations have the essential tools needed for promoting a successful KMS. This information will also help organizations recognize what success factors to focus on in order to create an environment that is compatible with the type of KMS needed, to prepare an organization for a new KMS, or improve non-effective KMS. To these ends, the survey instrument and relevant scales provided in Appendix A can serve to assess the current support provided by their organizations as well as the overall predicted success of their KMS. As additional KMS success factors gain empirical support, new scales can be added to the survey instrument so that organizations can actively pursue increasingly competitive advantages and higher levels of KMS success. Given the study's results, there is at least compelling enough evidence to suggest that using the proposed model is a good place to start.

The open-ended questions used in the survey instrument allowed respondents the chance to comment on the specific KMS examined within the specific context of this study; however, the insight provided by their answers was nevertheless informative to the discussion of KMS success factors. For instance, issues such as stability and maturity of the emerging technologies and protocols need to be carefully examined in order to meet the user's needs and expectations. The study's results also show that officers would like to share techniques, tactics, and practices with other agencies. However, the current single-tier web-base architecture (password requirement) of the NRDFI does not provide enough security. To resolve this issue and other flaws with the NRDFI, DC3 and CTANS are working closely with law enforcement personnel to develop a more advanced collaboration component for the NRDFI.

Additional problems were indentified with the repository system that limited the researcher's ability to fully present it to the targeted users. For example, the system included numerous design flaws that impaired its effectiveness. The NRDFI was programmed using Firefox version 2 Web Browser. Internet Explorer version 6 was the only web browser available at the conference for users to test the NRDFI. Because of the disparity between the two web browsers, some respondents reported problems with partial searching as well as understanding the results executed by the system. A new and improved version of the NRDFI is due for release soon. However, the improved version must be carefully designed to function properly and more importantly meet the needs, technical constraints, and context in which the targeted users actually operate the system.

Limitations and Directions for Future Research

Several factors limited the analyses conducted in this research. The primary limitation in this study was the low sample size and response rate to evaluate the research model. Many law enforcement officers expressed interest in accessing the NRDFI; however, only 10 who actually interacted with the beta version of the NRDFI provided feedback for the survey instrument (out of 70 who received e-mail invitations to do so). A larger number of respondents may well have improved the power of the significance testing and provided more accurate estimates of scale reliability and validity, as well as more accurately represented the demographic diversity of the law enforcement officers. Furthermore, with approximately 7% of the targeted population (all male) responding, one cannot summarily ignore the possibility of sample bias.

The study's sample was limited to users in a specific law enforcement community using a particular type of system for volitional usage activities such as collaboration and sharing knowledge. The obtained sample size was also well short of the minimum 67 required for conducting multiple regression analysis (Sopher, 2008). Furthermore, the suggested minimum sample size for multiple regression analysis and discriminant analysis is 100 respondents (Coakes and Steed, 1997). Assuming the problems associated with the low sample size also did not result in violations of the basic assumptions underlying the parametic tests conducted (and one cannot ignore the possibility that this was so), the main implication for future research is to test this instrument with a larger sample size to see if more definitive results can be obtained that allow for more critical commentary on the underlying constructs and relationships. As such, future replications of the research model are needed for generalizing the proposed system use construct and its effects on usage behavior for other systems and in other organizational contexts

Second, the operationalization of the constructs included in the model was primarily drawn from relevant KMS literature. These measurement scales were validated previously and articulated such that they allowed replication for future research. The number of non-significant findings obtained in this study, barring the aforementioned problems of sample size, may imply some fundamental shortcomings in these scales for measuring KMS success. At the very least, this possibility reinforces the importance of instrument re-evaluation (as discussed by Straub, 1989) to ensure the scales themselves are not somehow at fault.

This research also bears some concerns for generalizability that would be true of any study of a single KMS within a small subject population in a specific organization. In addition, KMS adoption and usage issues are likely to evolve over a period of time; this study was conducted during a snapshot in time early in the adoption phase of this particular KMS. Therefore, the results may not generalize to all other situations or during other phases of KMS implementation. Because the success factors identified during this research were evaluated by members of the law enforcement community, it is also possible that this research may be only relevant to the law enforcement community.

It is widely accepted within the KMS literature that not all success factors will exert the same influence on related outcomes; some will exert a stronger influence than others within and across an event of interest (Bulter, Heavin, & O'Donovan, 2007). While the organizational dimensions may remain the same, the specific adoption determinants might vary with technology or user groups. Because of this, there may be some dynamic that a KMS introduces that is not compatible with the design of the survey instrument. Validity estimates require the assessment of measurement properties over a variety of samples in similar and different contexts (Wu & Wang, 2006). Hence, samples from different cultures should be gathered to evaluate and confirm the model.

As the problems addressed in this research are corrected, and the NRDFI continues to mature using new information technology, the system itself should be evaluated again to examine its new capabilities and features. The lessons learned from this research certainly suggest follow-on analysis should be considered for the latest version or versions of the NRDFI. A more complete longitudinal study of user and organizational patterns that encompass the totality of a KMS over its development, implementation and adoption should also be pursued. Ideally, such a study could be extended to the entire population of law enforcement KMS users, thus providing a more representative measure of KMS success factors. Given the pivotal role of information technology in acquiring knowledge and the importance of knowledge to organizations, further studies of KMS success factors is warranted. With KMSs providing potential opportunities for maintaining competitive advantages, many opportunities remain for meaningful research in KMS literature. Academicians may further extend the findings from this stream of research in order to further improve the success rates of various types of KMS.

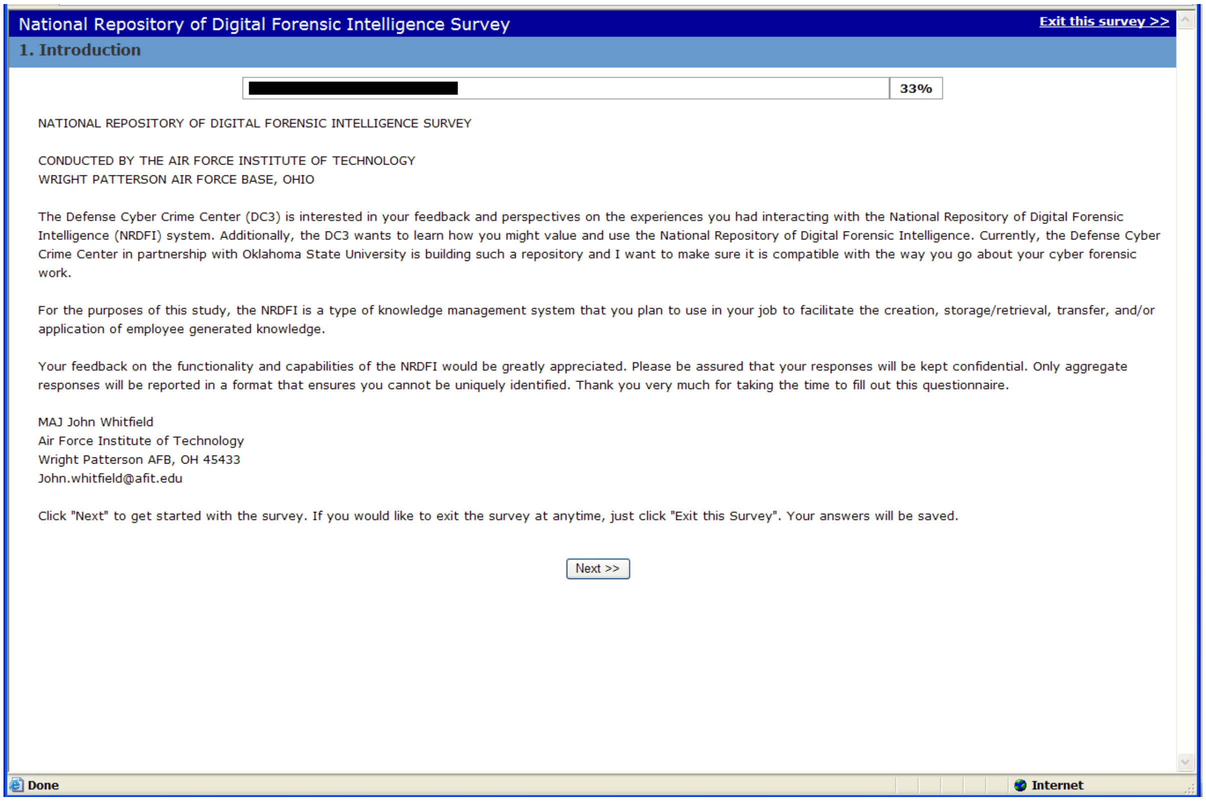
Conclusion

It is evident from this study that the use of knowledge management systems, such as the NRDFI, can have a significant impact on law enforcement. The participants in this study strongly voiced their eagerness for the development of the NRDFI. Based on the limited findings of this study, the NRDFI was generally perceived as a useful and valuable asset for the performance of digital forensic tasks. These preliminary results also indicate that the NRDFI can potentially lead to increased productivity by reducing the amount of effort spent for data search. However, additional development efforts are required for redesign of the interface to enable law enforcement officers to be more readily able to interact with and understand the application of the NRDFI and address some of the usability problems uncovered by this research.

More generically, the main focus of this study was to design a more comprehensive research model regarding the successful implementation of a KMS in an organization. The proposed theoretical constructs and the research model were empirically examined in a context of real-world organizational KMS implementation at the time of initial adoption. The evidence provided from the law enforcement participants in this study indicate that the key to the successful deployment of a KMS draws on a range of closely related factors that operate at all organizational levels and functions. There is, not just one KMS "silver bullet" that is critical for the successful implementation of KMSs in organizations. It is important that any organization, to say the least of the law enforcement communities studied during the course of this research, recognize these factors and take appropriate efforts towards overcoming them if they are going to implement a successful KMS.

Appendix A: Survey Instrument

Figure A. 1 Survey Introduction Screen



National Repository of Digital Forensic Intelligence Survey

Exit this survey >>

1. Introduction

33%

NATIONAL REPOSITORY OF DIGITAL FORENSIC INTELLIGENCE SURVEY

CONDUCTED BY THE AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT PATTERSON AIR FORCE BASE, OHIO

The Defense Cyber Crime Center (DC3) is interested in your feedback and perspectives on the experiences you had interacting with the National Repository of Digital Forensic Intelligence (NRDFI) system. Additionally, the DC3 wants to learn how you might value and use the National Repository of Digital Forensic Intelligence. Currently, the Defense Cyber Crime Center in partnership with Oklahoma State University is building such a repository and I want to make sure it is compatible with the way you go about your cyber forensic work.

For the purposes of this study, the NRDFI is a type of knowledge management system that you plan to use in your job to facilitate the creation, storage/retrieval, transfer, and/or application of employee generated knowledge.

Your feedback on the functionality and capabilities of the NRDFI would be greatly appreciated. Please be assured that your responses will be kept confidential. Only aggregate responses will be reported in a format that ensures you cannot be uniquely identified. Thank you very much for taking the time to fill out this questionnaire.

MAJ John Whitfield
Air Force Institute of Technology
Wright Patterson AFB, OH 45433
John.whitfield@afit.edu

Click "Next" to get started with the survey. If you would like to exit the survey at anytime, just click "Exit this Survey". Your answers will be saved.

Next >>

Done

Internet

The survey instrument appears on the pages that follow (Figure A.2).

Figure A.2. Survey Instrument

2. NRDFI Survey

1. Please indicate your agreement with the questions below.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
The NRDFI is reliable.	○	○	○	○	○	○	○
The NRDFI contains few software errors (for example, glitches & bugs).	○	○	○	○	○	○	○
The response time of the NRDFI is acceptable.	○	○	○	○	○	○	○
Using the NRDFI is easy, even after only a brief time of familiarization.	○	○	○	○	○	○	○

2. NRDFI's knowledge quality.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
The NRDFI's knowledge content is the precise information I need.	○	○	○	○	○	○	○
Knowledge content provided by the NRDFI is helpful in resolving the digital forensic challenges I encounter.	○	○	○	○	○	○	○
The knowledge content in the NRDFI is relevant to what I need/do.	○	○	○	○	○	○	○
The information provided by the NRDFI is understandable.	○	○	○	○	○	○	○

3. Using the NRDFI is a(n)________idea.

	Extremly Bad	Quite Bad	Slightly Bad	Neither	Slightly Good	Quite Good	Extremely Good
*	○	○	○	○	○	○	○

4. NRDFI's simplicity of use.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I find the NRDFI easy to use.	○	○	○	○	○	○	○
I find it easy to get the NRDFI to do what I want it to do.	○	○	○	○	○	○	○
Interaction with the NRDFI does not require a lot of mental effort.	○	○	○	○	○	○	○
The NRDFI is clear and understandable.	○	○	○	○	○	○	○

Figure A.2. Survey Instrument Continued

5. Using the NRDFI:

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
...will enable me to accomplish job related tasks more quickly.	○	○	○	○	○	○	○
...in my job will increase my productivity.	○	○	○	○	○	○	○
...will make it easier to do my job.	○	○	○	○	○	○	○

6. I _______ the idea of using the NRDFI.

	Strongly Dislike	Dislike	Slightly Dislike	Don't Care About	Slightly Like	Like	Strongly Like
*	○	○	○	○	○	○	○

7. Intention to use the NRDFI

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I intend to use the NRDFI for communicating with others in the context of my work.	○	○	○	○	○	○	○
Using the NRDFI is a good idea.	○	○	○	○	○	○	○
I intend to use the NRDFI to obtain and retrieve information essential to my job.	○	○	○	○	○	○	○
I expect that I will use the NRDFI quite extensively in the future.	○	○	○	○	○	○	○

8. Rate the following statements.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
My colleagues think I should contribute to the NRDFI.	○	○	○	○	○	○	○
My boss thinks I should contribute to the NRDFI.	○	○	○	○	○	○	○

9. Using the NRDFI would be _______.

	Extremely Unpleasant	Quite Unpleasant	Slightly Unpleasant	Neutral	Slightly Pleasant	Quite Pleasant	Extremely Pleasant
*	○	○	○	○	○	○	○

Figure A.2. Survey Instrument Continued

10. In my organization:

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
...the benefits of sharing knowledge outweigh the costs.	○	○	○	○	○	○	○
...employees are encouraged to ask others for assistance when needed.	○	○	○	○	○	○	○
...high levels of participation are expected in transferring knowledge.	○	○	○	○	○	○	○
...overall organizational objectives are clearly stated.	○	○	○	○	○	○	○
...employees understand the importance of knowledge for organizational success.	○	○	○	○	○	○	○
...knowledge is shared with other organizations.	○	○	○	○	○	○	○

11. Rate the following statements:

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
Use of the NRDFI will become a part of my normal routine.	○	○	○	○	○	○	○
I will continue to use the NRDFI to search and explore for alternatives.	○	○	○	○	○	○	○
I will use the NRDFI to help me solve problems.	○	○	○	○	○	○	○
I will use the NRDFI to help share digital forensic information with other individuals working in law enforcement.	○	○	○	○	○	○	○
I will use the NRDFI to communicate knowledge and information with my colleagues.	○	○	○	○	○	○	○

12. Using the NRDFI would be a(n) _______ idea.

	Extremely Foolish	Quite Foolish	Slightly Foolish	Neither	Slightly Wise	Quite Wise	Exremely Wise
*	○	○	○	○	○	○	○

13. Please provide any additional suggestions for improving the functionality and usability of this system.

Figure A.2. Survey Instrument Continued

3. Demographic Information

The following questions ask for information about yourself. This information is for demographic purposes only. No attempt will be made to link your responses directly back to you.

14. Select the choice that best describes your current job title/position.

- ◯ Management (President/Director/Owner/Chairman/Department Head, etc.)
- ◯ Information Systems/Information Technology Manager
- ◯ Knowledge Management
- ◯ Forensic Examiner
- ◯ Consultant
- ◯ Educator
- ◯ User of NRDFI
- ◯ Other (please specify)

15. Do you have forensics responsibilities in your job?

- ◯ Yes
- ◯ No

16. How many years of forensics experience do you have? (Please skip this question if you answered "NO" to question 15)

17. How many years of law enforcement experience do you have?

18. How long have you been assigned to your current work unit?

Years

19. What is your gender?

- ◯ Male
- ◯ Female

20. What is your age?

- ◯ Under 20
- ◯ 20-35
- ◯ 36-50
- ◯ 51-65
- ◯ Over 65

21. What is your highest level of education?

- ◯ High School or Less
- ◯ Some College
- ◯ Associate/Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate Degree

You have now viewed all of the survey questions.
Once you are satisfied with your answers, click "Done" to submit your survey.

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Vita

Major John F. Whitfield, Jr. graduated from Goldsboro High School in Goldsboro, North Carolina in June 1991. He enlisted in the Army in 1991 and attended basic training at Fort Jackson, SC. He spent the next two and half years in the North Carolina Army National Guard as a switch board operator in the Signal Corps.

In July 1995, Major Whitfield earned a Bachelor of Science degree in Electronics and Computer Technology, graduating with Summa Cum Laude honors. He was commissioned as a commission as a signal corps officer that same year through the AROTC Detachment at North Carolina Agricultural and Technical State University. His first assignment as a commissioned officer was at Fort Bragg, NC. There he spent the next four years as a platoon leader, executive officer, and a battalion signal officer. Since that time, Major Whitfield has served in a variety of roles including, C4I joint system operations officer at MacDill AFB, FL and Corps G6 Operations Officer and company commander at Fort Bragg, NC. During his second tour at Fort Bragg, NC, he spent 6 months deployed to Afghanistan with the XVIII Airborne Corps Headquarters supporting Operation Enduring Freedom and 12 months deployed as a company commander to Iraq supporting Operation Iraqi Freedom. In August 2006, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology to pursue a MS degree in Information Resource Management. Upon graduating, he will be assigned to the Africa Command at Stuttgart, Germany as a knowledge management officer.

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14. ABSTRACT Knowledge has been viewed as a critical component for organizations. Consequently, organizations implement Knowledge Management Systems (KMSs) to seek competitive advantages but encounter mixed results. This research draws on previous information system and knowledge management system success related literature and selects eight factors that are believed to be critical for the successful implementation of a KMS. These factors were derived through a literature search of current KMS success related literature. The purpose of this study is to identify factors that could have a clear influence on the development and implementation of KMSs. The study presents the empirical examination of a theoretical model of KMS success for predicting system use by law enforcement officers. The research findings were accomplished through a validated questionnaire that surveyed 10 law enforcement officers from various agencies. These results contribute to the literature by empirically supporting the hypothesized relationships between identified success factors and KMS success. Though limited in sample size, this research can serve as a foundation for future studies, which can help identify other factors critical for KMS success. The comprehensive model can be used to undertake further research and thus add value to knowledge management system based literature. In addition to its theoretical contributions, this study also presents important practical implications through the identification of specific infrastructural capabilities leading to KMS success.			
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