

# The influence of Information linkage on User Acceptance of a Knowledge Management System (KMS) in Small to Mid-size Enterprises (SME)

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## Abstract

*A concern relevant to the viability of a Knowledge Management System (KMS) implementation may well be: at what point is there adequate information packets and links among them to achieve value to the user? A closely associated statement may wonder if the size of a company or the number of knowledge workers in the company may or may not be sufficient to generate enough links. This paper uses a realist research approach to study how the mechanism of adding links among stored packets of information in a KMS, impacts the outcome of user acceptance. The paper's context will specifically analyze KMS in Small to Mid-sized Enterprises (SMEs) and attempt to determine whether there is a measurable point (tipping point) where the extent of links is such that the user community will value and accept the system.*

## 1. Introduction

Corporations are faced with tradeoffs everyday in the process of deciding where best to invest their capital. Information System (IS) departments serve a critical role in advising the company on the best means to use IS and Information Technology (IT) to achieve its strategies while limiting capital, time and risks. A Knowledge Management System (KMS) is one IS solution that may be considered important to a company's strategy. Implementing a KMS is generally a large and complex undertaking. As such, there are risks and uncertainties with budget and success. It is important for IS departments to have an awareness of the critical success factors that will affect new system acceptance. Key factors which influence the acceptance of a KMS have been identified in the literature: management leadership and support, culture, information technology, strategy

and purpose, measurement, organizational infrastructure, processes and activities, motivational aids, resources, training, human resource management, and process and activity [27]. This last factor was composed of several questions relevant to the nature of this study's research question. These questions relate to: the classifying and storing of knowledge, the finding of required knowledge, and the application of the knowledge to the organizations products and services. Another critical factor, richness of knowledge [4], is associated with linkages and context. The extent of linkages is quantifiable and may be useful as a predictor of user acceptance of a KMS. The quality of those links is an area for future research, but will not be addressed in this paper. Although no study appears to have looked at the differential ranking of critical success factors based on company size, I believe it may be safe to assume there are factors which will be affected. In particular, any factors associated with the creation, input and linking of knowledge in the KMS, are likely to be influenced by the number of personnel available to perform those functions. The more people available to do so will certainly increase the amount entered.

A Small to Midsize Enterprise (SME), with less capitalization than large companies, may have even more to risk in taking on a large IS project such as the implementation of a KMS. Knowledge of key success factors, especially quantifiable ones, may greatly improve their ability to make informed decisions on whether to move forward with a KMS project. SMEs are a critical part of the U.S. economy: 96 percent of all companies in the U.S. [16] and approximately 75 percent of new employment [22]. This research will strive to provide information that may be valuable to those SMEs facing a decision on whether to move forward with implementing a KMS.

The research question of this paper is: Does the extent of knowledge and its linkage in a SME's KMS affect the acceptance of the system by the using

community? The value in this research is in providing a mechanism for the business community to use in evaluating the feasibility of moving forward with the implementation of a KMS. A company which knows the volume and linkage necessary to produce a successful KMS implementation, can then understand the cost and effort necessary to achieve this tipping point. This research may also prove valuable to those involved in the design of future KMS: to create a more effective interface to allow users to make links and improve the quality of those links.

## 2. Background

Knowledge Management (KM) was a hot topic thru the 1990's and continues to be so today. [24] believes comparisons with previous management fads show us that KM is clearly not a fad, but something that has great value to business. In a very cursory literature search using the ProQuest literature search engine and looking only for scholarly journals, the following results were obtained and are reported in table 1.

Table 1.

| Year | KM only | KM + SME | SME only |
|------|---------|----------|----------|
| 2000 | 99      | 1        | 22       |
| 2004 | 558     | 2        | 93       |

Table 1 shows that: 1) KM is an active field and has grown by 463 percent since 2000, 2) The use of "SME" to describe small to mid-sized businesses seems to be in common use and related research has grown by 323 percent, although it does not appear to be a busy area of research, and 3) that very few researchers seem to appreciate the value KM may bring to SME growth and success, and the impact on national economic success. A SME's organizational knowledge is limited relative to larger organizations and when an employee leaves, they potentially leave with a relatively larger share of the organizational knowledge. Thus it should be an imminent concern to SMEs to find a means to capture knowledge and protect itself from loss of valuable knowledge, especially in those SMEs with extensive knowledge based work. Good examples of such SMEs would be Fabless Semiconductor Design companies and Biotech companies. There are other advantages that a SME can realize from an effective KMS: reduction of repetitive solutions to the same problem, reduction of redundancy in knowledge based activities, make knowledge available quickly and easily, and increase employee satisfaction by enabling greater personal development and empowerment. The key advantage,

however, is to obtain a strategic advantage over competitors [12]. Knowledge-based resources may be essential to providing a sustainable competitive advantage because of the difficulty competitors have in duplicating it [14].

There are two types of knowledge that IT systems have to be able to support in some fashion. Explicit knowledge, is generally in written form and can be read, distributed, stored and manipulated in many ways for advantage (knowledge base, data warehouses, DSS, portals, etc). The second form of knowledge, Tacit knowledge, encompasses perspectives, know-how, expertise and context-specific skills and is not easily put in writing [25]. Therefore it requires entirely different systems to assist in its creation and dissemination. IT tools helpful with the creation and transfer of Tacit knowledge are those that encourage dialog: links to experts, portals, E-mail, groupware, intranets, internets, and videoconferencing [19]. Both types of knowledge require effective linking to context and other knowledge to be of high value to the using community. Jennex and Olfman [10] point out that a strategy needs to be in place to ensure the integrity of linkages: adequate resources for creating and updating, security to ensure validity and accuracy, encouragement of users to make a part of daily activity, and to monitor changes to the KMS itself.

## 3. Model

This paper is concerned with answering the research question: Does the extent of knowledge and its linkage in a SME's KMS affect the acceptance of the system by the using community? To guide the research in answering this question, a causal process based theory composed of the following hypotheses has been generated:

*Proposition 1:* As the pool of knowledge workers grows in a company, the number of submitted information packets will increase.

*Proposition 2:* As the number of information packets increase, the amount of linking among information packets will increase.

*Proposition 3:* An increase in the linking of information packets results in more usefulness and acceptance by the user community.

*Proposition 4:* A higher acceptance by the user community will generate more inputs of knowledge and linkages of that knowledge.

These hypotheses are addressed in the model described below.

The realist research approach attempts to prove how a mechanism mediates an action to achieve outcomes: all within a given context [18]. For purposes of this paper, we will define the Action as the input of information, the Mechanism as the linking of that input information, and the Outcome as the acceptance of the KMS by a majority of the users (see figure 1). The Context for this model will be the SME and KMS environment. The paper will define a KMS as that IS system which stores and provides links among information, articles, media, URLs, context, and expert contacts. Since the context of this research is that of a KMS used within a SME, the KMS studied will be custom off the shelf software, readily available and reasonably priced. It is not expected that many SMEs would incur the expense of designing and developing their own KMS. SMEs are defined as companies with less than 500 employees (SBA, 2004).

### 3.1. Action

This paper defines the action as the input of new information packets to a KMS which is influenced by hypothesis 1. As the headcount of a SME increases, and in more particular the knowledge worker headcount, there will be more employees available to generate and input information packets. Examples of this information may be articles, specifications, procedures, project plans, blogs, emails, forum threads, media, expert contacts, websites software, and other. There are a number of spurious variables which may influence the frequency and extent of contributions by the knowledge workers. Some of these variables may be: training, simple user interface, KMS support staff skill set, resources, HW/SW standardization (all uploads are readable and useable by all on the network), incentives, culture (social and corporate), and a good enterprise wide data dictionary [9,10]. This study will not address these spurious variables. They all influence the "action" of entering new information. The model above is interested only in how the mechanism influences the information entered and not on what influences the input of that information.

### 3.2. Mechanism

The mechanism in this model is the creation of linkages among the various packets of information input to the KMS and is influenced by hypothesis 2. Robert Metcalf, one of the founders of the internet, developed a theorem which stated that value of a network increases in proportion to the square of the

nodes [20]. This theorem relates to hypothesis 2 in that as more information packets are entered in the system there will be a far greater opportunity to create links among them. The creation of linkages among information packets and context develops the richness of knowledge accessible to the users. There are several intervening variables or alternate mechanisms that may be relevant: training, KMS software ease of use, maintenance of knowledge (update cycle), company resources, incentives to create and maintain links, management involvement, industry, ratio of knowledge workers in company, and security (avoidance of nuisance links and destruction of links). It is hoped that the stratified random sample methodology explained below will allow an analysis to separate out the effect of these variables on the mechanism of concern in this paper.

### 3.3. Outcome

In this model, the outcome will be represented by the acceptance of the KMS and is influenced by hypothesis 3. Hypothesis 3 represents the increased value to the user community as information packets are linked in various contexts. Robert Metcalf's law also plays a role in support of this statement: as the links increase as a power of two relative to the information packets contributed, the value of that network increases proportionally. In other words, as information packages are contributed, there is a greater chance for links and thus context and value to the user community. Hypothesis 4 also occurs at this stage in the model and represents a cycle of positive reinforcement: as the value of the information in the system increases, so will the willingness to contribute more information packages and links [17]. Wikipedia provides evidence in support of this statement: Since its founding in 2001, the English language edition has grown exponentially to over 750,000 articles with extensive links among them [26]. Since the articles and links in Wikipedia are entirely user community developed, its growth has only occurred because the community found enough value in it to commit personal time in adding to it. The acceptance will be measured by the extent of usage (the accessing of the system) and stated perception of and attitude towards the system's value [2]. Potential moderating variables may be culture (social and corporate) and incentives. It is hoped that the stratified random sample methodology explained below will allow an analysis to separate out the effect of these variables on the mechanism of concern in this paper.

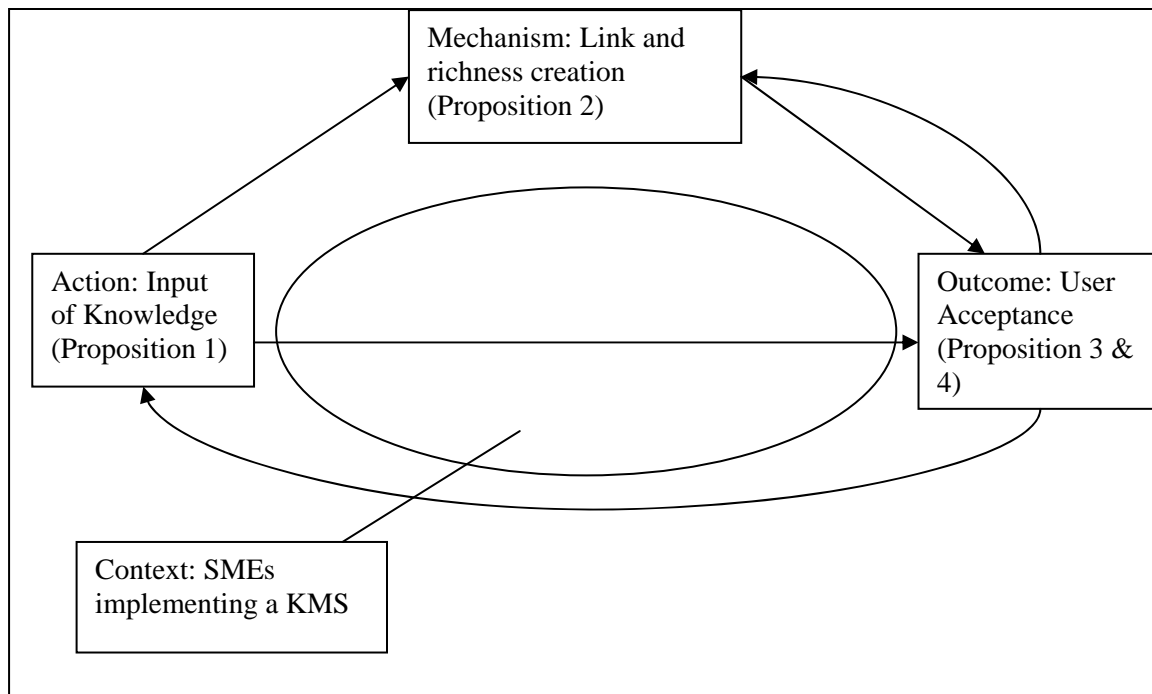


Figure 1. A model of the impact of information linkage on KMS user acceptance

### 3.4. Context

The context surrounding this model is the use of a KMS in a SME environment. Other contexts that are not part of this study, but may provide useful as collaborating evidence (triangulation) to support the understanding of the mechanism may be found in:

- Internet forums (number of hits, number of submissions, satisfaction index, and advertising revenue).
- Interorganizational KMS (connections with information from many external sources may overcome issues associated with having a small number of people in a company).
- Wikipedia (history of growth: submission, links, and new users)

## 4. Methodology

This research paper is interested in answering the question: Does the extent of knowledge and its linkage in a SME's KMS affect the acceptance of the system by the using community? To explore this question, a model was developed to examine the details of what can be considered a single critical success factor: one associated with the process of using links to improve context and richness of input knowledge and thus create greater value for the user community. Other authors [21, 5, 13, and 27] have

taken a much broader view and have attempted to uncover multiple critical success factors for a KMS. Wong and Aspinwall [27] provide a summarization of the research on critical success factors associated with KMS and arrived at 11 factors: management leadership and support, culture, information technology, strategy and purpose, measurement, organizational infrastructure, processes and activities, motivational aids, resources, training and education, and human resource management. The information in the Wong and Aspinwall [27] study was collected via a survey composed of questions scored on a 6-point Likert scale; to avoid a central tendency error. The survey instrument has great value for collecting a broad base of information as was necessary for the analysis done in the above studies. Although collecting data through a survey instrument provides valuable data on attitudes, values beliefs, motives, and intentions, it is also affected by the respondent's memory, knowledge, experience, motivation and personality [18]. This study, however, is interested in behavioral actions rather than attitudes, values beliefs, motives, and intentions. The analysis to be performed by this study, is a very specific look at one critical success factor (process and activity), and follows in the post-positivist mode. The quantitative variables representing behavioral actions used in this analysis will be extracted from reports and log files.

The source of data for this study will be obtained from SMEs who had purchased and implemented document management/Knowledge

Management SW. The list of companies to be used in the study will be obtained by contacting two of the larger more successful providers of document management/Knowledge Management SW. They will be explained the purpose and value of the study and hopefully agree to provide a listing of the companies they have provided their software to. The list will be narrowed to only U.S. companies and those which fit the Small Business Administration's definition of a SME: 500 or less personnel. The list will be randomized and 500 selected for contact by mail and phone follow up. Contact will be made at the CEO level due to the nature of data requested (log files). Out of the 500 companies contacted, expectations are that about 75 (15%) will provide the data requested. The survey experience of Wong and Aspinwall [27] produced an 8.7 percent useable response rate. An explanation for their low response rate was that many of the SMEs they contacted did not have a KMS. This study, however, starts with a listing of companies that had purchased a KMS and thus the higher rate of involvement is expected.

The companies that respond to this request, will all be provided with a detailed set of instructions on what and how to extract the data from their system. The instructions will be designed to ensure a complete set of data and also to maintain anonymity of employees. These companies have all installed their knowledge management software using either one of the two companies previously mentioned. The software developed by these companies comes with reports and ad hoc capabilities to easily extract the log files and the data necessary for this study.

## 5. Variables

The variables and data source represented in this paper's model are all provided in Table 2 below. The key ones to be used to test for the Mediation effect are: Number of knowledge articles, Number of links among Knowledge articles, and Frequency of access by users. The other variables that will be tested for effects are: company size (number of employees), variety of knowledge articles, and the number of links per article, and industry. Although these variables are not key to the model, it may prove valuable in the understanding of the model to be able to isolate and consider the influence of these. Company size may have a direct influence on the number of articles published simply because there is more opportunity with more people. A high variety of article types (various media: video, pdf, audio, presentation, project files, etc.) may establish richness of context and thus influence user acceptance and increased usage of the system. An increase in the average links per article may also

establish richness of context and influence usage of the KMS. Some industries are more knowledge intensive and there may be a greater need for proliferation and use of new knowledge. Thus, the tipping point where users find value may occur at a much lower level of articles and links.

## 6. Analysis

Regression analysis will be used to test the core of the model: the effect of adding articles and the mediational effect of adding links on usage of the KMS. Although [1] point out that ANOVA has been used to test a mediational hypothesis, they suggest that a better way is to use regression models. This paper has chosen to follow the regression methodology as proposed by these authors:

To test for mediation, one should estimate the three following regression equations: first, regressing the mediator on the independent variable; second, regressing the dependent variable on the independent variable; and third, regressing the dependent variable on both the independent variable and on the mediator. Separate coefficients for each equation should be estimated and tested. There is no need for hierarchical or stepwise regression or the computation of any partial or semi-partial correlations.

If the model is found statistically significant, then additional analysis will be performed to test the additional variables and the effect of the feedback created by user acceptance and increased use of the KMS in the creation of new articles and links. This adjusted model would have greater complexity and appear to be a candidate for Structured Equation modeling (SEM). However, SEM is designed to evaluate models with latent variables and the model as defined does not include them. Therefore, to test this more complex model, regression analysis will once again be employed.

Direct manipulation of the model's variables is not possible, therefore a large sample size is necessary to control for the effects of industry, size, and richness. The expected sample size of  $\geq 75$  is deemed adequate for the number of variables and the analysis methodology used in the study's stated model. [15] as cited by [18] indicates that a good rule of thumb is 15 observations per variable included in a quantitative analysis. [8] suggest that a good rule of thumb is 10 observations per each variable in a regression model.

Table 2: Analysis Variables and Sources

| Variable Description                     | Code    | Proposition | Source             | Type                   |
|--|---------|-------------|--------------------|------------------------|
| Frequency of access by users             | Freq    | 3           | Log file of usage  | Dependent              |
| Number of knowledge articles             | Article | 1           | Log files          | Independent            |
| Number of links among knowledge articles | Links   | 2           | Log files          | Independent (Mediator) |
| Types of knowledge articles (Richness)   | Arich   | 2           | Log files          | Fishing                |
| Link Richness per article                | Lrich   | 2           | Log files          | Fishing                |
| Number of Personnel                      | Pers    |             | Executive response | Control                |
| Industry                                 | SIC     |             | SIC                | Control                |

Table 3: Results TBD

| Regression                           | Indep. Var.      | Dep. Var. | F (R <sup>2</sup> ) | Coeff (T-alue) |
|--------------------------------------|------------------|-----------|---------------------|----------------|
| <b>Model Core</b>                    |                  |           |                     |                |
| Article → Freq                       | Article          | Freq      |                     |                |
| Article → Links                      | Article          | Links     |                     |                |
| Article & Links → Freq               | Article, Links   | Freq      |                     |                |
| <b>Feedback Loops</b>                |                  |           |                     |                |
| Freq → Links                         | Freq             | Links     |                     |                |
| Freq → Articles                      | Freq             | Article   |                     |                |
| <b>Possible Moderating Variables</b> |                  |           |                     |                |
| Lrich → Links                        | Lrich            | Links     |                     |                |
| Arich, Pers, SIC → Article           | Arich, Pers, SIC | Article   |                     |                |

Table 3 provides the structure for summarizing the results of the regression analysis. The top half of the table provides the results necessary to understand the mediational effects of linking. The bottom half of the table includes analysis associated with the additional of control and fishing variables.

## 7. Future Research

- *Longitudinal Study:* The results of this study look at the submission of media and its linking controlled for the number of employees. Comparisons can be made based on the relative number of employees and use of the system between companies. Is there an interaction between employee numbers and satisfaction with the KMS? A longitudinal study of these companies would provide additional validation. One could analyze the effect of company growth or downsizing on the perceived satisfaction with the KMS. It would also prove useful in understanding if there is a point where enough media and links have been established in the KMS that even if there is a vast reduction in personnel,

the KMS would still be perceived positively. In other words, is there a critical mass of articles and links that must be achieved to enjoy customer satisfaction and once achieved that satisfaction remains.

- *Interpretive Case study:* Additional validation and understanding of the article submission and linking could be provided by performing an Interpretive Case Study on a selected company. This would further our understanding of this process by obtaining a clearer understanding of the structural characteristics of a company that may affect the practices of article submission and creating linkages.
- *Intentions to add articles and links versus actual behavior from log files:* The model from [3] could be used to represent the front end for this model. It accounts for the intention and behaviors related to sharing explicit and tacit information. However, the analysis was performed on data collected only from Korean Companies and the model only reached to “intention” – and not actual use of the KMS. It would be interesting to replicate their study with data collected from the

above SMEs and run a PLS for their model tied into the model of this paper.

- *Simulation:* Simulation is a powerful tool that may be used to gain understanding and predictive abilities about a complex phenomenon. Using the knowledge gained from the above studies would provide insight into the most appropriate components, their values, ranges, and related frequencies. This information, along with the models above to provide an understanding of the relationships among these components, would allow a simulation to be constructed that may provide additional insight into how structure, motivators, organizational climate, and actual behaviors work together to produce satisfaction in a KMS. This simulation could provide tremendous value to practitioners in sizing up their company to make the best possible decision on where to invest in preparing an organization for a KMS implementation or to rectify one that is struggling.

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