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ABSTRACT

Knowledge management systems (KMS) are an important component of implementing successful knowledge management initiatives in organizations. In order for such systems to achieve their intended benefit, it is important that the knowledge workers both contribute knowledge to the systems, and that they reuse knowledge which has been contributed by others. It has previously been shown that there is often reluctance on the part of employees to participate in both of these activities. This study explores the effect of the usefulness of a knowledge management system and incentives on intention to contribute and reuse knowledge, controlling for tolerance of ambiguity. The results of a pilot laboratory study measuring the effects of usefulness and incentives on intention to contribute and reuse knowledge are presented in this paper.

Keywords

Knowledge management, reuse, contribution, incentives, usefulness

INTRODUCTION

Knowledge management systems are becoming increasingly commonplace in organizations. Given the importance of intellectual assets in modern businesses, companies have invested heavily in information technology to manage knowledge. The primary purpose of most knowledge management systems is to facilitate the transfer of knowledge between those who have it and those who don't (Markus 2001). The transfer of knowledge may be understood to have two broad stages. In the first stage, the person having the knowledge creates a knowledge object and puts it in a repository and in the second stage, another person who needs the knowledge retrieves it from the repository (Alavi and Leidner, 2001). Indeed, this type of knowledge management system is rather commonplace especially in large organizations (Grover and Davenport, 2001). For instance, seventy percent of large organizations (employing 10,000 or more employees) have investment in knowledge repositories. In 2002, companies spent approximately $2.7 billion in knowledge management software designed to capture, store and retrieve knowledge objects (Weiss, Capozzi and Prusak, 2004). Despite the increased corporate dollars and attention, the evidence on the success of knowledge management systems is at best mixed. Obviously, the primary determinants of success of knowledge management systems are (i) getting people to contribute their knowledge to the knowledge repository and (ii) getting people to reuse knowledge from the repositories. Issues relating to knowledge contribution and reuse have received a lot of attention in recent years. For instance, high level knowledge management practitioners ranked "how to best motivate individuals to contribute their knowledge to knowledge management systems" as the fourth most important issue in knowledge management (King, Marks and McCoy, 2002). Likewise, one of the challenges for knowledge management system implementation is how best to motivate people to reuse knowledge from knowledge management systems.

Prior research indicates that system characteristics, quality of knowledge objects, and the knowledge sharing culture in an organization are critical in determining whether a knowledge management system effort is likely to be successful or not. Indeed, extant research suggests that organizational support, supervisory control, support of top management, etc. shape how well knowledge is contributed and reused in an organization (Constant, Kiesler, and Sproull, 1994; Jarvenpaa and Staples, 2000; Kankanhalli, Tan and Wei, March 2005). Given that increasing knowledge contribution and increasing reuse are the

major goals in implementing knowledge management systems, the purpose of this paper is to examine how incentives and usefulness of knowledge management systems impact individuals' intention to contribute knowledge objects to a knowledge management system and reuse knowledge from a knowledge management system. In this paper, we define usefulness of a knowledge management system as the likelihood of finding a valuable knowledge object in the system.

The remainder of the paper is organized as follows: The next section provides a brief background of prior research in usefulness and incentives in the context of knowledge management systems. Research hypotheses and the experimental design are delineated in the third section. The fourth section presents the data, results and analyses. The paper concludes with a summary, limitations and directions for future research.

PRIOR RESEARCH

In order for knowledge management systems to be successful, it is important that individuals within an organization both 1) contribute knowledge to the knowledge repository, and 2) search for and use knowledge that others have contributed to the repository. In each of these steps, namely contribution and reuse, individuals weigh the potential benefits against their potential costs in deciding whether or not to participate in either. Costs which may prevent someone from participating in knowledge contribution include time and effort involved in codifying knowledge (Goodman and Darr, 1998; Kankanhalli, Tan and Wei, March 2005; Markus, 2001), and perceived loss of power due to sharing of knowledge which makes individuals valuable to an organization (Davenport and Prusak 1998). Benefits which may come from knowledge contribution stem from knowledge being used in such a way that it benefits those who contribute it (Markus, 2001) or some incentive an individual may receive for contributing (Ba, Stallaert and Whinston, 2001; Wasko and Faraj, 2000). The Linux operating system represents an example of a project to which people's contribution of knowledge is influenced by the benefit they receive from the software itself. Developers who contribute code to the Linux project are themselves users of the operating system and therefore receive some benefit from their contributions. Knowledge reuse is also influenced by similar factors. Individuals are unlikely to reuse knowledge if they perceive that the time and effort of searching for and retrieving valuable knowledge are very high (Davenport and Prusak, 1998), or if they perceive that using a knowledge repository is difficult (Goodman and Darr, 2001; Kankanhalli, Tan and Wei, September 2005). It has also been observed that individuals can be reluctant to use knowledge if it comes from outside of their immediate work group. This is commonly referred to as the Not Invented Here syndrome (Katz and Allen 1982). However, if it is likely that the search process will yield knowledge which has value to an individual, and will help them improve the quality or reduce the time involved in producing a given product, individuals are likely to participate in the process of knowledge reuse.

The effect of usefulness on knowledge contribution and reuse

Individuals seeking knowledge from a repository often do so to resolve a particular issue (Davenport and Prusak, 1998). These individuals are likely to benefit from the repository if they find a knowledge object which is relevant to the issue at hand. However, it is not always the case that these individuals will find what they are looking for in these repositories (Markus, 2001). Clearly, if individuals believe that a knowledge repository is not useful, that is if the repository is not likely to deliver a knowledge object from which they may benefit, then individuals will not be likely to use the repository. This is supported by the Technology Acceptance Model, which shows that individuals are more likely to use a given technology if they perceive it to be useful (Davis, 1989).

Likewise, individuals who contribute to knowledge repositories often do so because of some benefit they receive. Reciprocity, reputation, and altruism are all possible benefits that may come from contributing knowledge to a repository (Davenport and Prusak, 1998). One of the primary reasons individuals contribute to repositories is because they want to use the repository for themselves and know that in order for the repository to work everyone must contribute. In some cases, contribution of knowledge objects may lead to improved reputation, pay raise and promotion. Altruistic individuals may contribute simply because it makes them feel good to know that others are being helped by their knowledge (Davenport and Prusak, 1998). Regardless of the initial motivation to contribute, if the knowledge management system does not consistently return information of use to co-workers, such a system will be used less and less which in turn will adversely impact the motivation of the contributors to contribute.

The effect of incentives on knowledge contribution and reuse

Contributing knowledge to a repository involves costs on the part of the contributor. Unless these costs are offset by some benefit that is received from contributing, there will be no contribution. These costs can be offset as mentioned by benefits such as reciprocity, reputation, and altruism. However, these intangible benefits may not be enough to offset the costs completely. In this case, incentives can help to make up for the costs associated with creating knowledge (Markus, 2001).

The direct effect of incentives on intention to contribute has been studied in previous literature. Three recent studies using survey methodology showed varying effects of incentives on intention to contribute. (Kankanhalli, Tan and Wei, March 2005) studied the effects of organizational rewards on intention to contribute using survey methodology and found a significant direct effect. (Ko, Kirsch, and King, 2005) studied the effects of extrinsic rewards on intention to contribute and reported finding no significant direct effect. (Bock, Zmud and Kim, 2005) studied the effects of anticipated extrinsic rewards on intention to contribute and reported that extrinsic benefits have a negative impact on intention to contribute. Despite mixed results, the predominant expectation, at least in most cases, is that incentive to contribute is likely to lead to greater contribution.[1]

As with knowledge contribution, there are also costs associated with knowledge reuse, particularly time involved in locating a valuable knowledge object and matching it to a given task. These costs can be offset if individuals find a valuable knowledge object because the given object will help to reduce the time involved in completing a project. However, individuals in search of objects face the risk that such an object may not be found. Therefore, it may be necessary to encourage individuals to search for relevant knowledge objects by using incentives. The direct effect of incentives on intentions to reuse knowledge has not been as well studied as the effects of incentives for contribution. A literature search yielded only one recent study which explored the effect of incentives on intention to reuse. This study used survey methodology and measured the interaction of incentives with task tacitness and task interdependence and reported that incentives have a positive effect on intention to reuse when task interdependence is high (Kankanhalli, Tan and Wei, September 2005).

The purpose of this study is to further explore, in a controlled setting, the effect of usefulness of a knowledge management system and the effect of incentives on the intent to contribute and reuse knowledge objects. The experimental design and related hypotheses are provided in the next section.

EXPERIMENTAL DESIGN AND RESEARCH HYPOTHESES

Experimental Design

Participants and the Dependent Variable(s)

Participants consisted of students enrolled in a large southwestern state university. All participants were presented with a scenario in which the incentive levels and usefulness levels were manipulated. In the scenario, each participant was placed in the role of a consultant for a nationally renowned consulting firm. The scenario provided an explanation of a knowledge management system and the reasons for which individuals use knowledge management systems. From that followed questions about whether the participants would use the system to solve problems they encountered as consultants. The participants were required to read the case carefully and then indicate on a seven point scale their intent to (i) contribute knowledge to the knowledge management system and (ii) reuse knowledge from the knowledge management system. These two variables were the dependent variables.

Independent variables

Recall that the purpose of the study is to examine the effect of usefulness and incentives on knowledge contribution and reuse. Consequently, two levels of usefulness and three levels of incentives were administered via case variations to the participants. That is, six versions of the case were prepared and each student completed one version. Each version consisted of the usefulness of the knowledge management system as either high or low. That is, individuals were told that the likelihood of finding a relevant knowledge object in the system was either high or low. In this study, usefulness is defined as the likelihood of retrieving a relevant knowledge object from the knowledge management system. Each version also consisted of one of the three incentive levels (i) incentive to contribute (ii) incentive to reuse and (iii) no incentive to contribute or reuse (control). The incentive levels were not quantified, i.e. individuals were not told how large the incentive would be. They were only told that they would receive (i) a bonus for contributing knowledge objects, (ii) a bonus for both contributing and reusing knowledge objects, (iii) a bonus only for completing the project in the required time. Thus, the experiment was a fully crossed 2X3 factorial design.

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[1] In the Siemen's ShareNet case incentive to contribute led to increased contributions. Similar results were found in other KM implementations too.

Tolerance of Ambiguity

Tolerance of ambiguity can be defined as the extent to which an individual perceives an ambiguous situation as desirable (Budner, 1962). An ambiguous situation is one which cannot be adequately structured or categorized by an individual (Budner, 1962). Individuals with low tolerance to ambiguity will experience stress when placed in a situation in which they are expected to solve an unstructured problem. These two types react to multiple cues very differently. For instance, ambiguity tolerant individuals are able to process multiple cues efficiently in arriving at a decision while intolerant individuals either react negatively to ambiguous situations or ignore the cue that causes ambiguity to simplify the decision making scenario. Because knowledge problems are typically unstructured problems with high degrees of ambiguity, the manner in which these problems will be dealt with may vary depending on an individual's tolerance of ambiguity. As the use of knowledge management systems is a step in dealing with such problems, an individual's propensity to use the systems may also vary depending on their tolerance of ambiguity. Therefore, we believe that ambiguity tolerant individuals and ambiguity intolerant individuals will react differently to multiple cues on usefulness and incentives. Consequently, we required individuals to complete a short Tolerance of Ambiguity questionnaire (McDonald, 1970).

Hypotheses:

Based on the above discussions, we propose the following hypotheses:

Knowledge Contribution

H1 (Usefulness Hypothesis): Usefulness of the knowledge management system is positively related to intent to contribute. That is, participants who receive the high usefulness case will indicate greater intent to contribute as compared to participants who receive the low usefulness case.

H2 (Incentive Hypothesis): Incentive to contribute is positively related to intent to contribute. That is participants who receive the "incentive to contribute" case will indicate greater intent to contribute as compared to participants who receive the other two cases.

Knowledge Reuse

H3 (Usefulness Hypothesis): Usefulness of the knowledge management system is positively related to intent to reuse. That is, participants who receive the high usefulness case will indicate greater intent to reuse as compared to participants who receive the low usefulness case.

H4 (Incentive Hypothesis): Incentive to reuse is positively related to intent to re-use. That is participants who receive the "incentive to re-use" case will indicate greater intent to re-use as compared to participants who receive the other two cases.

DATA, RESULTS AND ANALYSES

Data and Partition

As mentioned earlier, a questionnaire containing a case was administered to 200 students in a large southwestern state university. After accounting for missing information and incomplete responses, 196 usable responses were used for further analyses. Since our expectation was that high tolerant and low tolerant individuals are likely to respond to the treatments differently, we split the sample into two groups based upon TOA scores. Individuals scoring above the TOA median were classified as "high tolerant" and individuals scoring below the median were classified as "low tolerant." As TOA is a relative scale, and the interest of TOA in this study is in measuring the differences of behavior of individuals who score relatively high versus relatively low on this scale, we believe the median split is an appropriate way to observe this difference. This is consistent with other studies which have been done on the effects of tolerance of ambiguity and other cognitive characteristics on other observed behavior (Doktor and Hamilton, 1973; Gul, 1984; Wright and Davidson, 2000),

Analyses

Given that the experiment was conducted as a 2X3 fully crossed factorial design, the appropriate analysis was an ANOVA. For each group, that is high and low tolerant, two ANOVA runs were conducted. The dependent variables were intent to contribute and intent to re-use. The independent factors were (a) the level of usefulness (high or low) and (b) the incentive scheme (incentive to contribute or re-use, or no incentive). The results are provided below.

Results and discussion

Low Tolerance – Knowledge Contribution

The ANOVA results for the low tolerance group are summarized in table 1. This table shows the results of the F-tests for the effects of usefulness, incentives and the interaction between usefulness and incentives on both intent to contribute and intent to re-use. The effects for each test are clearly marked in the first column. The dependent variable for each test is clearly marked in the second column. The ANOVA result on the low tolerance group indicated that incentive level was a significant determinant of an individual's intent to contribute (p=0.001). Thus, hypothesis 2 was supported. However, the usefulness was not (p=0.436). Therefore, hypothesis 1 was not supported. The interaction effect was not significant (p=0.655). Table 2 shows the means for the main effects which were found to be significant. The means for intention to contribute across varying levels of incentive are shown in the top section of Table 2. Marginal means indicated that both incentive to contribute and incentive to re-use produced significant desired result – that is, people intended to contribute significantly more. Surprisingly, incentive for re-use produced greater intent to contribute – even higher than what the incentive for contribution produced.

Low Tolerance – Knowledge Re-use

Results indicated that only usefulness was a significant determinant of intent to re-use (p=0.003). Thus hypothesis 3 was supported but hypothesis 4 was not (p=0.755). There was no significant interaction effect (p=0.315). Table 2 shows the mean intent to re-use across varying levels of usefulness. Marginal means indicated the intent to re-use was significantly higher when usefulness was HIGH as compared to when usefulness was LOW. This indicates that perhaps the best way to encourage people to re-use knowledge objects is to ensure that they find useful knowledge objects. Incentives are not likely to impact an individuals' intent to search and re-use the system when usefulness of knowledge objects is low.

Source	Dependent Variable	df	F	Significant
Usefulness	Re-use	1	9.447	0.003
	Contribution	1	0.613	0.436
Incentive	Re-use	2	0.282	0.755
	Contribution	2	7.032	0.001
Usefulness*Incentive	Re-use	2	1.174	0.314
	Contribution	2	0.425	0.655

Table 1. Low Tolerance ANOVA

Dependent Variable	Factor	Mean
	Incentive	
Contribution (main effect)	None	4.061**
	Contribution	5.036*
	Re-use	5.589*
	Usefulness	
Re-use (main effect)	High	5.620***
	Low	4.592***

Items marked * and ** are significantly different from each other at 0.05 level

Items marked *** are significantly different from each other 0.05 level

Table 2. Low Tolerance Marginal Means

High Tolerance – Knowledge Contribution

The findings for the high tolerance group are different from the findings for the low tolerant group. These results are

summarized in table 1, which is structured in the same manner as Table 1. The test of between-subjects effects indicated that both usefulness (p=0.182) and incentives (p=0.187) for the high tolerant group did not have a significant effect on intention to contribute. Thus, hypotheses 1 and 2 are not supported. However, the usefulness – incentive interaction was significant (p=0.057). Table 4 shows the mean intent to contribute across varying levels of incentive for both high and low usefulness. Marginal means indicated that when usefulness is HIGH, incentive to contribute produces desired results – that is, individuals intend to contribute significantly higher. However, when usefulness is LOW, incentive to contribute does not produce desired results, but incentive to re-use does. That is, individuals are willing to contribute if they feel that their co-workers are encouraged (and therefore more likely) to use knowledge objects. In the table, the means marked (b) show intent to contribute is higher when incentives for re-use exist under low usefulness. The means marked (a) show that intention to contribute when offered incentives to contribute is significantly higher at high usefulness than at low usefulness.

High Tolerance – Knowledge Re-use

The test of between-subjects effects indicated that usefulness of the system was a major factor in determining intent to re-use knowledge from the knowledge management system. Estimated means indicated that when the usefulness of the knowledge objects was HIGH, the mean intent to re-use was significantly higher (p<0.0001) as compared to when the usefulness of the knowledge objects was LOW. This result is shown in Table 3. Thus hypothesis 3 was supported. The incentive mechanism was not significant (p=0.609). Thus, hypothesis 4 is not supported.

In addition, the analysis also revealed a significant usefulness – incentive interaction (p=0.023). Marginal means indicate that when usefulness of knowledge objects is HIGH, incentive to contribute and incentive to re-use do not result in increased knowledge re-use intent as compared to the control of no incentive. However, when the usefulness is LOW, people simply respond to the incentive to re-use (and not to incentive to contribute). This result is shown in Table 4 by the means marked (b). This underlines the main effect finding that usefulness is perhaps more important in determining knowledge re-use than incentives.

Source	Dependent Variable	df	F	Significant
Usefulness	Re-use	1	13.098	0.000
	Contribution	1	1.808	0.182
Incentive	Re-use	2	0.499	0.609
	Contribution	2	1.710	0.187
Usefulness*Incentive	Re-use	2	3.941	0.023
	Contribution	2	2.949	0.057

Table 3. High Tolerance ANOVA

The purpose of this study is to examine the effects of usefulness and incentives on individuals' intentions to contribute to and re-use knowledge in knowledge management systems. The results of this study provide some insight into how individuals respond to different incentives at different levels of usefulness of a knowledge management system. These results may be important to organizations hoping to increase the level of use of knowledge management systems by offering incentives to employees. Overall, the results indicate that usefulness is more important than incentives in determining whether or not individuals choose to re-use knowledge objects. Only when usefulness is low, and only among individuals who have a high tolerance of ambiguity, do incentives have an effect on intention to re-use knowledge.

Limitations of this study include the use of undergraduate students as subjects for the study. While in many studies the use of undergraduate students is criticized due to lack of generalizability, we propose that this limitation does not greatly reduce the generalizability of these results, especially with respect to the results on knowledge re-use. This is due to the fact that the intended users of knowledge management systems for knowledge re-use are often recent graduates who do not have a great deal of experience and have a need for knowledge that has been contributed by others. A second limitation is the use of intention to contribute and re-use as indicators for whether or not individuals would chose to contribute or re-use knowledge. It is possible that responses to questions regarding intent to contribute or re-use may not accurately reflect whether or not an individual will or will not actually re-use. A future study may involve conducting an experiment that observes actual behavior rather than intended behavior. Other limitations may involve different perceptions of usefulness from the indications of whether or not the probability of finding a relevant knowledge object is high. It is assumed that indicating that a system has a high probability of delivering a relevant knowledge object will lead to high usefulness, but there could be some variation between the two.

Usefulness	Dependent Variable	Incentive	Mean
High	Re-use	None	5.786
		Contribution	5.882
		Re-use	5.389
	Usefulness (high) main effect		**5.686***
	Contribution	None	4.786
		Contribution	5.706(a)
		Re-use	4.778
Low	Re-use	None	4.750(c)
		Contribution	4.333
		Re-use	5.375(c)
	Usefulness (low) main effect		**4.819***
	Contribution	None	4.167(b)
		Contribution	4.571(a)
		Re-use	5.313(b)

Items marked *are significantly different from each other 0.05 level

Items marked (a) are significantly different from each other 0.05 level

Items marked (b)are significantly different from each other 0.05 level

Items marked (c) are significantly different from each other 0.05 level

Table 4. High Tolerance Marginal Means

The results of this study are unique in that there have been no prior experimental studies which have explored the effects of incentives on knowledge re-use. As knowledge management systems do not actually provide any benefit to an organization until knowledge is re-used, we believe that studies which contribute to the understanding of knowledge re-use require more attention. The interaction effects between usefulness and incentives are also an aspect of this study which are unique. These results yield interesting insight into the dynamics between usefulness of a knowledge management system and incentives. The results show that incentives for reuse may only be important during the beginning phases of implementation when the knowledge management system is not perceived as being useful, whereas incentives for contribution may continue to be important even after the system has been in place for some time. This may be important for practitioners who are attempting to structure incentive systems after implementing a knowledge management system.

There are some surprising results which may have important implications for future studies on knowledge management systems. For instance, the finding that incentives for re-use produced greater intent to contribute is an interesting one. This implies that individuals do not only think about how incentives will affect them when deciding to contribute, but they also think about how incentives affect their co-workers. It seems that when employees believe that their co-workers will be more likely to re-use objects due to an existing incentive, then they will be more likely to contribute something. The differing effects of incentives on intention to re-use on individuals who have high tolerance of ambiguity versus those who have low tolerance of ambiguity (at low usefulness) is also an interesting result. It seems that individuals who have high tolerance of ambiguity can be encourage by incentives to re-use knowledge, whereas those with low tolerance of ambiguity cannot. As these individuals experience different levels of stress when placed in situations where they are expected to solve unstructured problems, this introduces the possibility that the level of stress under which a person is placed may possibly be a factor that affects intention to re-use knowledge. This also may be an important finding for practitioners in determining whether or not incentives would be effective in their organization. Some organizations, due to the type of work that they perform, may be more likely to hire individuals who have a high or low tolerance of ambiguity. Thus, incentives may be more effective in some organizations than in others.

As with any information system, the implementation of a knowledge management system involves more than simply putting the system in place. Organizations must be sure that the organizational environment is such that the system will be effective. Many organizations are currently putting incentives in place without fully understanding how effective these incentive systems are. This study provides insight into the circumstances under which incentives may or may not be effective. As

such, we believe it is an important contribution to the literature on knowledge sharing.

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