

Empirical Study of KMS Impact on Decision Support

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Abstract

This empirical study was carried out to investigate the impact of ICT-based knowledge management systems (KMS) of varying sophistication on decision support in varying decision contexts. The results indicate that the positive impact of KMS sophistication was limited to simple decision contexts only. In simple contexts, the availability of more sophisticated KMS led to more intensive balanced use of the available functions and features which resulted in improved decision quality, confidence and satisfaction. In contrast, greater KMS sophistication made no difference to system usage behaviour and decision performance in complex contexts. Such findings provide much needed empirical support for the proper fit between technology-orientated decision aids and simple decision contexts. Future research is needed to determine suitable solutions for complex contexts.

Keywords: Knowledge Management System (KMS), KMS Sophistication, Decision Context, Context Complexity, Decision Support.

JEL Code Classification: D7, D8

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1. Introduction

A contingency view of information systems has gained widespread recognition and popularity in recent literature (El Sawy 2003). Essentially, this view advocates the need for a proper alignment of the system with the context and personal preferences of users. The advantage of such a view is seen in an opportunity for seamless integration between information systems and business environment.

However, this new viewpoint poses new challenges for researchers and practitioners who need to deal with the change and its theoretical and practical consequences for decision support. The purpose of this paper is to respond to these challenges by empirically identifying the best system-context-user fit. This requires examination of different systems and decision contexts and their impact on decision behaviour and performance of system users.

Knowledge management systems (KMS) are an emerging class of decision aids that target managerial work by focusing on enabling and facilitating creation, sharing, retention and extraction of knowledge needed for decision support. KMS are expected to reduce or eliminate decision biases (Arnott, 2002) and improve users' decision making capabilities. Various social and technical solutions are recommended in terms of this support (Handzic, 2004; 2007). The focus of the current study is on the use of information and communication technology (ICT) as tools to facilitate the management of decision makers' knowledge processes.

Various ICT-based KMS implementations provide differing levels of knowledge support to their users (Sambamurthy and Subramani 2005). In theory, more sophisticated KMS are assumed to provide greater support in locating, extracting, and utilising knowledge. This, in turn, should lead to better decision making by helping users to overcome the negative influence of decision biases and improve their understanding of the decision problem and available solutions. The literature provides considerable theoretical support for suggesting that the potential return from system use can be enormous if KMS are properly designed and implemented (Alavi & Leidner, 2001).

The literature distinguishes between two main approaches regarding the "proper" KMS design. The universalistic view suggests that there is one single best approach which should be adopted in all circumstances. In contrast, the contingency view suggests that no one approach is best under all circumstances. Among notable proponents of the contingency view of KM are Hansen et al. (1999), Snowden (2002) and Becerra et al. (2004). Collectively, they suggest a series of knowledge, task, organisation and environment characteristics as contingency factors that may affect the suitability of alternative KMS solutions. However, there is a general lack of empirical evidence to support this proposition.

Therefore, the purpose of this study is to fill the existing void and contribute to the improved understanding of KMS support in decision contexts. In particular, the study aims to empirically examine the impact of KMS of varying sophistication on decision support in varying decision contexts. It is expected that the improved understanding of the issue will serve as a foundation for better DSS development.

2. Literature Review

This study forms a part of a larger research undertaking aimed at investigating KMS adoption and effectiveness in individual decision making. The current study extends the authors' preliminary work reported elsewhere. In the current study, the focus is on two key factors: KMS sophistication and context complexity and their role in decision support. The following sections provide a brief overview of these concepts.

2.1. KMS Sophistication

The literature offers a number of different conceptualisations of system sophistication. Thus, Cheney and Dickson (1982) characterise system sophistication by three main criteria: technical (hardware, software), organisational (management activities) and system performance. More recently, Pare and Sicotte (2001) define system sophistication in terms of functional, technical and integration sophistication. Functional sophistication refers to system support for different business processes and activities, technical sophistication denotes the extent of specific technologies used in these processes and activities, and integration sophistication reflects the level of internal and external integration of various systems and technologies.

By considering knowledge management from a technology perspective, Handzic (2004) discusses KMS sophistication in terms of the amount and diversity of information and communication technologies and software applications implemented to support knowledge processes. Such a "technological" view of KMS excludes social KM initiatives as integral components of KMS from consideration. Therefore, from the perspective of integration sophistication, KMS in the focus of this study lacks a socio-technical level of integration. According to Handzic (2007), fully integrated socio-technical KMS should comprise various cultural, structural, measurement and leadership enablers of knowledge processes in addition to information and communication technology.

Handzic (2004) distinguishes four main classes of ICT-based KMS depending on their knowledge enabling function. These include knowledge retention, sharing, discovery and generation systems. Knowledge retention systems facilitate capturing and storage, as well as subsequent access to recorded knowledge. Knowledge sharing systems facilitate transfer of knowledge through interaction and collaboration among people. Knowledge discovery systems enable the finding of hidden patterns in data, their interpretation and prediction. Finally, knowledge

generation systems support creativity and research that enable new knowledge development. These four classes of systems support two types of knowledge strategies. In particular, knowledge retention and discovery systems support codification, while knowledge sharing and generation systems support personalisation. With respect to focus, knowledge retention and sharing systems support exploitation of existing knowledge, while knowledge discovery and generation systems support exploration and development of new knowledge.

Each of the above four classes of KMS can be implemented with a wide range of specific technologies (Alavi & Leidner, 2001) and commercial KM software available on the market (Tsui, 2003). Thus, knowledge retention systems may involve various storage and retrieval technologies and business intelligence systems including databases, data warehouses, data marts etc. Knowledge sharing systems may use a variety of communication and collaboration technologies including emails, forums, audio and video conferencing, social networks etc. Knowledge discovery systems may rely on different data and text mining technologies, business analytics tools, visualisation etc. Finally, knowledge generation systems may incorporate a selection of simulation games, online tutorials, virtual experiments etc.

From the perspectives of functional and technical sophistication, the availability of a wider range of KMS functions and features contributes to higher system sophistication. This, in turn, is expected to better address business decision problems and be more beneficial to decision makers. The review of KM frameworks (Heisig, 2009) identified KMS initiatives as critical factors of KM success in more than 50% of the frameworks. A number of other investigations reported KMS system and/or service quality as determinants of KMS adoption and success (Liu et al., 2005; Xu & Quaddus, 2005). Two most recent empirical studies linked IS sophistication to improved performance (Salleh et al., 2010) and revealed that the effectiveness of decision making was influenced by the availability of required technologies (Mohsen et al., 2011). In general, adoption/diffusion and success models, as well as prior empirical research suggest a positive influence of KMS sophistication on decision support.

2.2. Context Complexity

In general, the term “context” denotes “the circumstances that form the setting for an event” (<http://dictionary.com>). Information systems scholars have suggested a variety of informational, operational, organisational, environmental, historical, attentional, behavioural and causal aspects that comprise the system user’s context (Salleh et al., 2010). They have also suggested that the context model should include only contextual elements relevant to satisfy the user’s needs. For the purpose of modeling a decision context, some investigators (Wood, 1986; Campbell, 1988) have taken into account three elements: decision task, decision environment and decision maker. Jointly, the characteristics of these three elements determine the level of decision context complexity.

With respect to decision task, the literature evaluates complexity in terms of the objective properties of the task and the subjective reaction of the individual. Among objective complexity properties, Wood (1986) has introduced component, coordinative and dynamic dimensions of the task. These refer to a number of cues or acts, form and strength of their relationships and change over time. On the other hand, Campbell (1988) has proposed task complexity as a primary psychological experience that may be evoked for reasons other than task, such as anxiety and fear. Investigators have also identified a number of environmental factors that contribute to context complexity. Some of these include time and money constraints, significance, irreversibility and accountability. In general, constraints are recognised as stressors, while others may be related to important status or financial consequences for the decision maker or client. In addition, the literature identifies knowledge, ability and motivation as those individual characteristics that make the decision situation more or less complex. With knowledge and ability comes an opinion about appropriateness of a strategy and likelihood of application.

From the perspective of complexity theory, the difficulty of the decision situation is expected to increase with the objective and/or perceived complexity due to decision task, environment and/or decision maker. This, in turn, is expected to affect individual decision behaviour and subsequent decision performance. The behavioural decision theory proposes a positive relationship between the level of decision context complexity and the level of analytical complexity of decision making strategy. Empirical findings are mixed.

In knowledge management, Snowden (2004) also uses complexity theory as a basis to differentiate between known, complicated, complex and chaotic knowledge domains that determine KM strategies. In addition to knowledge characteristics (explicit/tacit, declarative/procedural), Becerra et al. (2004) suggest a number of other contingency factors that contribute to context complexity and influence KM processes. These include task uncertainty and interdependence, organisation size, business strategy and environmental uncertainty.

In summary, the above review suggests that the context complexity may be an important factor in determining the value of KMS in decision support. However, different studies make different claims regarding the role of context in KMS impacts. One proposition is that the benefits expected from adopting more sophisticated KMS are greater if the decision context is complex rather than simple. An alternative proposition is that the value of such KMS will be lesser in more complex situations due to unknown/chaotic domains. The current study proposes to examine the issue empirically.

2.3. Research Model and Questions

In this study, the authors have relied on different theories and frameworks, as well as past empirical evidence from decision science and knowledge management to

develop a research model presented in Figure 1. This model serves as a theoretical basis for examining the impact of varying KMS sophistication on decision support in varying contexts. The model proposes three interrelated variables: (i) *KMS sophistication* defined in terms of ICT-based systems provided to support different knowledge processes; (ii) *context complexity* representing the overall decision situation faced by decision makers; and (iii) *decision support* reflecting decision makers' system use and performance with KMS.

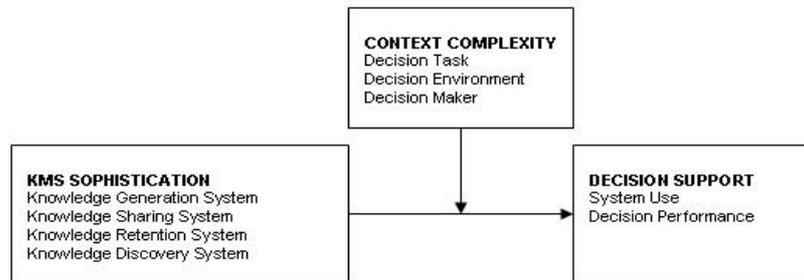


Figure 1: Research Model

From the universalistic point of view, KMS sophistication will have a universally positive impact on decision support. In contrast, the contingency view of KM assumes that KMS sophistication will have a differential impact on decision support in different contexts. On this basis, the following research questions are proposed to be examined:

- (i) Whether system use will vary as a function of KMS sophistication irrespective of context complexity? and
- (ii) Whether increased KMS sophistication will lead to enhanced decision performance irrespective of context complexity?

3. Research Methodology

A field study was conducted among 344 Turkey-based knowledge workers employed in organisations that were purposely selected by the researchers due to their knowledge intensive character and implementation of KMS. Only the organisations implementing and using high technology were selected for the study. The study focused on individual levels of analysis, taking as sample units knowledge workers (respondents) who needed to assess whether or not to use a KMS to support their decision making process.

A survey form was designed to capture the participants' perceptions of their decision context complexity, as well as their opinions about their organisation's KMS sophistication, and to report their own KMS system use and decision performance. All relevant items used to measure the variables included in the research model are provided in the list available in the Appendix.

KMS sophistication was assessed by a mean score on items for business intelligence, business analytics, communication & collaboration, creativity & elearning and other useful KMS features available to them. Context complexity was measured by an average rating score for decision task, decision environment and decision maker items. Two dependent variables for decision support were: system use and decision performance. System use was evaluated in terms of amount, type and focus. The amount of use was measured by an average rating score of four usage items. Two additional indices were obtained from these items to identify type of system use or strategy (codification or personalisation) and knowledge focus (exploitation of existing knowledge or exploration of new knowledge). These indices were calculated as ratios of selected KMS use to total system use. The three usage measures depicted different quantitative and qualitative aspects of individual decision behaviour. Decision performance was evaluated in terms of perceived decision quality, confidence and satisfaction operationalised by respective items rating scores. Decision performance was considered the ultimate indicator of KMS effectiveness in decision support.

In replying to the questionnaire, the respondents ranked their agreement with each given statement relative to negative and positive end-points of a seven-point Likert scale. All the collected and calculated responses were encoded, entered into a computer and were combined into one file. The participants were grouped by KMS (unsophisticated, sophisticated) and context (simple, complex) based on their average scores. Then, their behavioural and performance responses were analysed using both parametric and non-parametric tests. Since there were no differences between them, only parametric results are reported here.

4. Results

Descriptive results (means & standard deviations) for system use measures (amount, type, and focus) and decision performance measures (quality, confidence and satisfaction) by context complexity and KMS sophistication are presented in Table 1 and Table 2 respectively. Results of further analysis of the collected data by a series of parametric tests (One-way ANOVA and T-test) are also reported in the following sections. This analysis found some significant results.

4.1. System Use

With respect to system use, the results of ANOVA indicate a significant overall effect of KMS sophistication on the amount of system use ($F(1,342)=14.78$, $p=0.000$). However, separate analyses by contexts found that the effect of KMS sophistication was limited to simple contexts only. There were significant differences found in the amount of system use between sophisticated and unsophisticated KMS groups in simple contexts (5.16 vs. 4.51, $t=3.410$, $p=0.001$), but not in complex contexts (4.96 vs. 4.65, $t=0.915$, $p=0.366$). Such findings support the contingency view of KM.

Table 1: Descriptive results for system use variables by context and KMS

Dependent Variable	Simple	Context	Complex	Context
	Unsophisticated KMS	Sophisticated KMS	Unsophisticated KMS	Sophisticated KMS
Amount	4.51 (1.570)	5.16 (0.403)	4.65 (1.273)	4.96 (1.260)
Type	0.50 (0.045)	0.50 (0.079)	0.49 (0.073)	0.49 (0.036)
Focus	0.49 (0.064)	0.50 (0.066)	0.50 (0.062)	0.50 (0.040)

In contrast, ANOVA found no significant overall impact of KMS sophistication on either type ($F(1,342)=0.003$, $p=0.958$) or focus ($F(1,342)=2.309$, $p=0.130$) of system use. Further analysis by context found no significant differences in usage type between sophisticated and unsophisticated KMS in simple (0.50 vs. 0.50, $t=0.131$, $p=0.896$) and complex (0.49 vs. 0.49, $t=0.144$, $p=0.887$) contexts. The same was true for usage focus. The subjects' focus on knowledge with a sophisticated system was not different from that with an unsophisticated one in the simple context (0.50 vs. 0.49, $t=1.544$, $p=0.125$) as well as in the complex one (0.50 vs. 0.50, $t=0.185$, $p=0.855$). The results suggest that subjects tended to use similar balanced knowledge codification/personalisation, exploitation/exploration strategies in all circumstances.

4.2. Decision Performance

The results of ANOVA performed on three decision performance measures indicate significant overall effects of KMS sophistication on decision quality ($F(1,342)=7.341$, $p=0.007$), confidence ($F(1,342)=10.140$, $p=0.002$) and satisfaction ($F(1,342)=5.607$, $p=0.018$).

Table 2: Descriptive results for decision performance variables by context and KMS

Dependent Variable	Simple	Context	Complex	Context
	Unsophisticated KMS	Sophisticated KMS	Unsophisticated KMS	Sophisticated KMS
Quality	5.30 (1.511)	5.79 (1.063)	5.33 (1.354)	5.33 (1.089)
Satisfaction	5.34 (1.427)	5.73 (1.112)	5.05 (1.117)	5.23 (1.193)
Confidence	5.24 (1.478)	5.85 (1.044)	5.43 (1.287)	5.27 (1.184)

However, follow-up analyses by contexts revealed that subjects' performance of sophisticated systems was significantly better than that of users of less sophisticated systems only in simple contexts. These subjects had significantly higher mean scores for decision quality (5.79 vs. 5.30, $t=2.687$, $p=0.008$), confidence (5.85 vs. 5.24, $t=3.438$, $p=0.001$) and satisfaction (5.73 vs. 5.34, $t=2.185$, $p=0.031$).

No statistically significant differences were found between sophisticated and unsophisticated system users in complex contexts. The subjects achieved comparative levels of performance across KMS sophistication, when it was evaluated in terms of quality (5.33 vs. 5.33, $t=0.000$, $p=1.000$), confidence (5.27 vs. 5.43, $t=-0.472$, $p=0.640$) and satisfaction (5.23 vs. 5.05, $t=-0.635$, $p=0.529$).

5. Discussion

5.1. Main Findings

In summary, the main findings of this study have provided support for the proposition that the impact of KMS sophistication on decision support is highly contingent upon context complexity. The study has demonstrated that increased KMS sophistication led to more intensive (quantitatively) but equally balanced (qualitatively) system use that provided decision improvement only in simple contexts.

More specifically, in simple contexts, the subjects with more sophisticated systems tended to exhibit greater levels of system use compared to those with less sophisticated KMS, as demonstrated by higher mean values of usage amount. In contrast, the results for usage type and focus revealed subjects' application of similar dual strategies (i.e. codification and personalisation, exploitation and exploration) regardless of the complexity of their decision making situations.

With respect to performance in simple contexts, the study revealed that more intensive use of all the available KMS features and functions resulted in improved decision performance. This was demonstrated by higher levels of user confidence, satisfaction and decision quality. Such results provide limited support for the theoretical expectations suggested by the adoption and success literature (Liu et al., 2005; Xu & Quaddus, 2005).

In contrast, increased KMS sophistication did not make any difference to subjects' decision behaviour in complex decision contexts. This was evidenced in comparable levels of amount, type and focus of system use between users of more and less sophisticated KMS. With respect to performance, the study revealed that increased KMS sophistication did not enhance any aspect of the subjects' decision performance. Subjects exhibited similar levels of decision quality, satisfaction and confidence regardless of their KMS.

One potential reason for the lack of expected better performance with more sophisticated KMS in complex contexts could be the lack of users' adaptive behaviour. The subjects in this study appeared to have adopted the universalistic approach to KM as demonstrated by their application of similar dual strategies in all situations. The contingency perspective (Khalifa et al., 2008) suggests the need for a greater qualitative shift towards exploration and personalisation in order to better deal with increasing complexity.

Another potential reason for the lack of significant decision improvement from more sophisticated KMS in complex contexts may be the diminishing value of technology and the increasing importance of the human factor in unordered decision domains with more uncertain or novel problems. In general, technology is considered more suitable for "reuse" economics (Hansen et al., 1999), as it can allow fast and reliable reuse of explicit knowledge. It is also more suitable for

ordered task domains where patterns are knowable. There, KMS can facilitate the analysis and lead to more appropriate responses in accordance with the interpretation of that analysis (Snowden, 2002).

5.2. Implications, Limitations and Future Research

Knowledge of the factors that influence the use and effectiveness of KMS in decision support have implications for the design of such systems. Because the KMS system supports and extends decision making capability, a thorough understanding of the underlying processes is required to provide constructive guidance for the design and implementation of such systems. To this end, the current study contributes empirical evidence of the contingency view of KM, by identifying the moderating effect of context in the KMS sophistication impact on decision support.

However, the present study is not without limitations. These should be taken into consideration when interpreting its findings. First, the KMS system that was studied lacked full socio-technical integration sophistication that could account for non-significant results in complex contexts. Furthermore, the lack of true experimental design, unequal groups, subjective measures and parametric statistical tests may limit the validity of the study findings. In addition, the behaviour of Turkey-based participants may not generalise to other geographical and cultural settings.

Therefore, further studies need to be carried out to address the above limitations and establish validity and generalisability of the current findings. Furthermore, the instrument to assess context is not well documented in literature. In future, criteria other than complexity applied in this study may be used to classify different contexts. Finally, this study focused on the relationship between KMS sophistication and individual system use and performance. Future research needs to extend the present investigation to examine the impact of system sophistication on organisational performance.

6. Conclusions

The findings of this study make a significant contribution to DSS and KM research by showing the nature of the impact that KMS sophistication has on decision support. More specifically, the study establishes that the value of sophisticated KMS for decision support depends upon context complexity. Such findings contradict the universalistic view of KM and favour the contingency view. The findings imply that organisations that implement more sophisticated ICT-based KMS can generate greater system use and consequently may expect higher performance gains in limited contexts (i.e. simpler, known or knowable decision circumstances). In other situations (i.e. complex, unknown or chaotic decision circumstances) organisations may require different (perhaps socially orientated) approaches. Finally, given the contradictory and limited nature of current findings

there is a need for cautious interpretation and further investigation. Several possible directions are recommended for future research.

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Appendix: List of research variables and measures

CONTEXT COMPLEXITY
<i>Decision Task</i>
Most decision problems that I solve are complicated/complex
In my organisation, I encounter a lot of problems with uncertain/changing causal links
In my organisation, many of my decision tasks are rather ambiguous/unclear
My decision problems are often novel/unfamiliar/unknown to me
Most of my decisions are irreversible and can not be easily corrected
<i>Decision Environment</i>
I have limited time & money to spend on making my decisions
My decisions have significant personal & organisational consequences
I am solely accountable for all my decisions
Most of my decisions are irreversible and can not be easily corrected
<i>Decision Maker</i>
I have the necessary knowledge and skills to perform my decision tasks
I am able to solve decision problems that I encounter
My motivation to do well is high
I learn quickly from experience
KMS SOPHISTICATION
In my organisation, KMS has sophisticated business intelligence components (e.g. repositories, database/warehouse/mart, document management, reporting system, dashboard, OLAP, SQL)
My organisation's KMS incorporates intelligent business analytics tools (e.g. data mining, text mining, visualisation, graphics, modelling, forecasting, DSS, statistical tools)
KMS in my organisation comprises excellent systems for communication & collaboration (e.g. internet, extranet, intranet, audio/video conferencing, groupware, online forums, email)
In my organisation, KMS includes advanced e-learning and creativity support features (e.g. mentoring, expert-led discussions, webinars, virtual classes, simulations, games, brainstorming, mapping)
There are other high-quality KMS features in my organisation (please specify):
DECISION SUPPORT
<i>System Use</i>
I use KMS to access captured internal/external knowledge and gather intelligence
I use KMS to uncover and interpret hidden patterns in data and extract new knowledge
I use KMS to exchange ideas and share knowledge with my colleagues and experts
I use KMS to close gaps in my own knowledge and look for new innovative ideas
<i>Decision Performance</i>
<i>Confidence:</i>
I am more confident in the quality of my decisions
<i>Satisfaction:</i>
I am more satisfied with the process/outcome of my decision making
<i>Quality:</i>
My efficiency/effectiveness of decision making has improved