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Evaluating Knowledge Quality in Knowledge Management Systems

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Abstract: Knowledge management (KM) involves strategies and processes for identifying, capturing, and leveraging knowledge to enhance competitiveness. Quality management (QM) has its roots in manufacturing and services to accomplish efficiency and customer satisfaction. This paper seeks to explore the relationship between knowledge management and quality management. The paper also aims to address the reality that for organizational maturity, knowledge management will have to be harnessed and this knowledge management will need to have requisite quality for it to be effective.
The main purpose of this paper is to address the nature of knowledge quality, describe its elements and their attributes, and create a valid and reliable instrument to measure the relative importance of the elements and their attributes. A framework is proposed that uses a hierarchical approach to address the dependence relationships of knowledge quality with its elements of intrinsic, contextual and actionable knowledge quality. Each of these elements has their own attributes. Based on the relationships, business managers can judge the need to improve and determine which element to provide the most effective direction towards knowledge quality improvement in knowledge management systems.

Keywords: Knowledge, Knowledge Quality, Statistics, Knowledge Management, Analytical Hierarchical Process

1 Introduction

Knowledge management (KM) has assumed a key position in today's business environment. Quality management (QM) is a business competence that increases a firm's efficiency and capability. KM and QM fundamentally share the same goal improving performance at all levels of the organization. As firms operate in a highly competitive environment, knowledge and its quality are critical to surviving and prospering in these circumstances ([36]; [3]). A high level of knowledge quality helps firms do work better, develop novel and useful products or services, reduce costs, and increase sales. It escalates problem-solving capability, raise process efficiency, and improve performance.

Knowledge quality, however, remains a vaguely defined concept because of its abundance and variability ([38]). Although knowledge is an important resource, its effective use will depend, to a large extent, on its quality ([40]). As such, research on knowledge quality should grow in scope and prominence.

This article explores integrating knowledge management (KM) concepts, strategies, and practices and quality management (QM) approach into a framework and operational model that address the needs of business managers implementing KM. The article presents a hierarchical model to explore the concept of knowledge quality in dimensions such as intrinsic knowledge quality, contextual knowledge quality, and actionable knowledge quality. This paper begins by outlining the research concept, presenting the relevant literature, which builds up to the formation of the methodology employed by the authors, and concludes with final assertions and managerial implications.

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2 Review of Literature

2.1 Knowledge and Knowledge Management Systems

Knowledge is an elusive concept. Knowledge can be viewed as representation of the world; or it can be conceptualized as a product of the interaction between individual cognition and reality (Lin et al 2002). There are many differentiators of knowledge such as tacit vs. explicit ([35]), descriptive vs. procedural ([19]), local vs. global ([37]), and declarative vs. procedural ([31]). Defining and understanding knowledge is a rather broad and open-ended pursuit. We can narrow it considerably in defining and understanding knowledge as it pertains to knowledge management (KM) in organizations rather than tackling the entire realm of epistemology.

Our effort in KM need to make knowledge viable for an organization to use, reuse, and manage it as a tangible resource, and apply it toward specific actions. But, without the abilities to acquire, represent, store, retrieve, and apply knowledge in a way that positively affects the operation of organizations, we are not engaging in knowledge management. This knowledge foundation can be converted into IT-based systems and form a basis for IT-centric knowledge management initiatives ([7]). [47] described IT systems as the hygiene factors of knowledge management.

By taking this perspective, we define the granularity of knowledge in terms of the knowledge-information-data (KID) hierarchy. The KID hierarchy regards data as simple facts that would become information when combined into meaningful structures. Information subsequently becomes knowledge as human perspective is added and the information being put into a context. This distinction between data, information, and knowledge can be conveniently used in defining issues regarding knowledge quality in knowledge management systems.

[11] view organizations as bundles of knowledge assets. The organizational capability to learn, create and maintain knowledge, as well as the conditions under which such capabilities are developed, has been deemed critical to the operational and strategic health of organizations.

Organizational knowledge is commonly understood as intellectual capital encompassing both knowledge of individuals employed by the organization and group knowledge that is embedded in the organizational policies, procedures and protocols. Both the individual and group knowledge have two basic forms: those that can be easily codified and transmitted in formal, systematic language and shared asynchronously and that can be better managed by the IT centric KM. While the other type of knowledge described as the human perspective in the KID hierarchy is more personal and subjective in quality and experiential and intuitive in nature thus is difficult to transmit and share using an IT based system.

Knowledge management is a broad and multi-faceted topic involving socio-cultural, organizational, behavioral, and technical dimensions ([4]). [24] defined knowledge management as a mechanism that involves the acquisition, explicating and communicating of mission specific professional expertise in a manner that is focused and relevant to an organizational participants who receive the communications. Lee and Yang (2000) also defined knowledge management as the deliberately designed organizational processes that govern the creation, dissemination, growth, and leveraging of knowledge to fulfill organizational objectives. In real terms knowledge management in organizations is beyond the KID hierarchy. Knowledge management is an integrated, systematic approach to identifying, managing, and sharing all of an enterprise's information assets, including databases, documents, policies, and procedures, as well as previously unarticulated expertise and experience held by individual workers. A quality knowledge management system needs to consider both these dimensions. Knowledge management systems (KMS) are becoming increasingly important to organizations both for their strategic potential and as a crucial resource ([2]; [50]). Consequently several organizations have established these systems in order to leverage the combined knowledge of individual employees their intellectual capital and disseminate this amalgam to promote organizational learning in order to increase decision making effectiveness and ultimately competitive positioning. Organizations are increasingly adopting the resource-based view of knowledge which holds that the accumulation of their employee's knowledge is a primary assets and a resource to be managed like other organizational asset ([40]).

Thus, KMS is a systematic and organizationally specified process for acquiring, organizing, and communicating knowledge of employees (both in articulated and unarticulated forms) to other employees who can make use of it to be more effective and productive in their work ([3]). KMS is about supporting individual and organization performance. A successful KMS is one that helps identify, optimize, and extend individual's and organization's ability to act effectively. KMS encompasses a broad range of tools, technologies, and practices intended to make better use of a firm's intellectual resources ([12]).

[40]) point out that the role of a KMS is to: (1) provide access to the sources of knowledge rather than the knowledge itself; (2) provide a link among sources of knowledge to create a wider breadth and depth of knowledge flows; (3) enhance intellectual capital by supporting the development of individual and organizational competencies; (4) provide effective search and retrieval mechanisms for locating relevant information; (5) gather, store and transfer knowledge; and (6) help in user assimilation of information.

A growing range of organizations are focusing attention on KMS. In short, KMS treats knowledge as an asset and manages it in a systematic way to achieve the goal of enhancement of organizational performance and competitiveness. ([28]).

If this knowledge has to be treated like any other asset in organizations, the biggest challenge for business managers is to define quality measures for this knowledge in the KMS. The quality principles that support knowledge management include a focus on process, employee involvement, continuous learning and improvement, measurement and standardization. Wherever quality principles can be applied, knowledge management can become a fertile ground to grow effectively.

2.2 Quality and Quality Management Systems

There are different meanings of the term quality. We judge quality by making comparisons, based on our own experiences, but defining it in terms that convey the same meaning to others can be difficult. There are a number of definitions in use, each of which is valid when used in a certain context. Quality may be defined as ”fitness for use”, ”fitness for purpose”, ”conformance to requirements”. Each of these statements represents a facet of quality. It is therefore the context that defines the statement in which the term quality is used ([20]).

No organization today-whether in the industrial, service, or private sectors-can hope to sustain financial health without embedding the principles and tools of quality into its day to day thinking and operations. Organizations today need to manage quality to be competitive in the market. Organizations need to establish means to set up on a permanent basis, install, or create quality management system.

Quality management (QM) has its roots in manufacturing and services to accomplish efficiency and customer satisfaction. QM defined as an approach to management, has a set of mutually reinforcing principles, each of which is supported by a set of general practices and specific techniques ([13]). QM has been shown to be particularly useful for the improvement of an organization’s performance ([1]; [9]; [18]; [23]; [33]; [42]).

[43] are pioneers to examine the practices of QM. Their QM instrument identifies critical factors of QM. Based on these critical factors [34] show that QM includes practices for improvement that affect both the firm’s internal environment and its relationship with its environment. Likewise, it includes practices focused on both the technical and social parts of the firm. These factors include top management support, quality reporting (which includes quality information/knowledge availability and quality information/knowledge usage), employee training, employee involvement, product design, supplier quality, process management, and the role of the quality department. Amongst all these factors the one unifying concept is the exchange of knowledge that takes place within the firm and between the firm and the external environment.

As [14]), suggest that business excellence cannot be achieved if the knowledge the enterprise depends on is defective (inaccurate, missing, duplicate, untimely, or biased or misleading in its presentation). Making decisions or taking actions on the basis of poor quality knowledge causes process failure and, if not controlled, can ultimately lead to enterprise failure.

2.3 Quality of Knowledge Management Systems

As [30] suggest that the fundamental objectives of knowledge management and quality management are the same-create more organizational knowledge so that improvement can occur. It follows that a successful organization should not only manage the quality of products and practices effectively but also master and apply knowledge management ([17]; [51]). [45] suggest that some quality management practices directly impact the knowledge management systems. Also, some studies suggest that quality management practices create knowledge and that knowledge leads to organizational performance ([10]; [30]).

However, although QM and knowledge management have recently received increasing scholarly attention, the majority of researchers treat QM and knowledge management as two entirely separate fields and independent systems of management ([16]; [45]; [46]; [51]). In spite of the importance of knowledge management within the firm, few empirical studies examine its relationship with QM. The main studies connecting QM with KM include those linking KM with idea generation from QM ([32]), integrating the frameworks of QM practices and KM processes ([**?**]), incorporating a KM learning model into QM ([10]), the total quality knowledge management system ([48]), relating QM practices and knowledge transfer ([34]), examining knowledge and QM from an R and D perspective ([21]J), exploring the role of KM in Six Sigma project management ([6]), and investigating data mining and quality control ([5]; [15]). Currently, research on the quantitative impact of QM practices on organizational KM process is rare.

KMS quality refers to accessibility and ease of use ([8]). The former means that one can access and search the related knowledge to meet one’s needs anywhere and anytime. The latter means that one can easily input and retrieve the data in

the KMS system ([25]). If the KMS quality is adequate and meets the employee's needs, the extra effort required to find and use knowledge will be reduced. In addition, if organizational members can find valuable and useful knowledge using KMS, they are more likely to have positive attitudes toward knowledge sharing. In this situation, quality of knowledge content and perceived usefulness of knowledge sharing is the main considerations ([**?**]).

[8] study provides some useful insights that suggest organizations cannot assume that KMS alone will solve their concerns regarding knowledge sharing. KMS is just a tool to support organizational knowledge processes, especially for explicit knowledge. On the other hand, organizational knowledge is implicit, context-dependent, difficult to imitate, and noncodified. Therefore, organizations should focus on cultivating employee capability and a sharing culture, rather than putting emphasis on information technology.

[40] suggest that there is general agreement that the success a knowledge system is dependent on its quality. Their study has considered the knowledge quality dimensions at different levels of granularity; the knowledge item and the retainer level (knowledge retainers refer to the stores of knowledge within the KMS, while the knowledge items refer to the specific units of knowledge in the retainers), the ontology level (syntactic, semantic, social and pragmatic quality that glues together the all the knowledge process) and the knowledge usage level (are the task coordination and credibility important to the success of the KMS regardless of the quality of the knowledge in the system). Each quality dimension has been identified, defined at the appropriate level of granularity and an appropriate way of measuring the quality dimensions has been proposed.

2.4 Evaluation of Quality in KMS

From the literature reviewed what emerges is the following:

1. Knowledge is a part of the KID hierarchy. So in order to study the quality of KMS it is important to study data quality and information quality.
2. Organizational knowledge has two forms one that can be easily codified that is managed by the IT centric KM and the other is the experience and intuition of individuals and groups. A quality KMS needs to consider both these dimensions.
3. Quality management in organizations focus on exchange of knowledge that takes place within the firm and between the firm and the external environment.
4. Both QM and KM both are involved in improvement of an organization's performance. But the biggest challenge for business managers is to define quality measures for knowledge in the KMS.
5. Knowledge quality has different levels of granularity at the item and retainer level; the ontology level and the usage level.

3 Methodology and Data Analysis

As has been summarized above, knowledge quality has different levels of granularity. The item and retainer level of granularity contributes to the inherent knowledge quality. The ontological level concerned with syntax, semantics, socialism and pragmatism sets the context for knowledge quality. The usage level provides a task orientation and is related to actionable knowledge quality. Further, these levels of granularity are complex and depend upon their respective attributes as has been identified by [40]. It is important to consider the role of these attributes so as to arrive at some conclusive evidence about the significance of these attributes and the levels of granularity to knowledge quality. Hence knowledge quality comprised of a chain of hierarchy of a few attributes, each attribute contributing towards the final analysis of understanding the degree of knowledge quality. Analytical hierarchy process (AHP) was selected to guide us in choosing the right degree of knowledge quality. The AHP technique ([41]) allows model a complex problem like knowledge quality in a hierarchical structure showing the relationships of the goal, criteria, and the attributes. AHP employs both quantitative and qualitative approaches to solve complex problems. Qualitatively, a complex problem is decomposed into a hierarchical structure. Quantitatively, it adopts pair-wise comparisons to rate the elements. Further, AHP employs redundant comparisons to ensure the validity of judgments. It also provides a measure of inconsistency for discarding inconsistent judgments ([26]). The AHP method includes three steps: the first step involves constructing the hierarchy; second, calculating weights of elements at each level of hierarchy; and finally, computing the weight of each decision alternative. AHP is used here to guide the organizations in determining the degree of knowledge quality while considering the major factors. The factors were derived from the literature research and interviews with business managers. To apply AHP, twelve business managers were involved. The profile of the business managers are presented in Table 1.

Table 1: Profile of Business Managers

Years of Experience	Number of Business Managers	Industry Sector	Number of Business Managers
>25 years	6	IT/ITES	3
20 25 years	4	KPO	7
16 20 years	2	Consulting	2

Based on the interactions with the business managers and applying the AHP the following steps were carried out.

Step I: Structuring the hierarchy of levels and attributes

For this study a KMS quality model that aims at providing a solution to these above issues have been proposed. The model is formalized and structured as a hierarchy, which enables navigation between the different levels of KMS quality. Furthermore, by combining this hierarchical structure with AHP, the model has been applied to quantitatively assess KMS quality in organization's focus in KMS initiatives and practice. The model integrates the contribution of similar work and models.

The model restructures into a unified hierarchy the granularity of [40] to elicit attributes of knowledge quality. The study illuminates three dimensions inherent knowledge quality, contextual knowledge quality, and actionable knowledge quality and classifies the elements proposed by [39]. The three different knowledge qualities are conceptually separated, but are used interactively at work. The three dimensions combine to create an overall construct of knowledge quality. Inherent knowledge quality refers to the extent to which knowledge has quality in its own right (i.e. accurate, reliable, or believable). This is the foundational attribute of knowledge quality. Even though knowledge is based on personal beliefs and insights, they should be within a reasonable range for others to accept. Knowledge is context-specific and contexts play a large role in how knowledge is understood. Different contexts (i.e. paradigms, goals, roles, time, space, and culture) evaluate quality in a different manner. Different contexts even need different knowledge management processes. Contextual knowledge quality refers to the extent to which knowledge considered within the context of the task (i.e. relevant or value-added). The notion of knowledge quality depends on the actual use and reuse of knowledge. Knowledge is not created for its own sake, but should be converted into action to manifest its usefulness and profitability. Knowledge is about action and must be used to some end. Actionable knowledge quality refers to the extent to which knowledge is expandable, adaptable, or easily applied to tasks. The hierarchical model with the different levels and their attributes is presented below in Figure 1:

Step II: Data collection by pair-wise comparison of the elements

Using the nine-point scale as suggested by [41], relative importance of business managers for the factors at the same level with respect to factors of their preceding level is recorded. The scale for relative importance is given in Table 2.

Step III: Calculating the relative weights of factors

The weight, which is the priority of an attribute with respect to its preceding attribute, is calculated. The judgments are synthesized using the geometric mean approach as suggested by [41]. Table 3 gives the details of the local weights of the attributes.

Table 2: Table of Scale of Importance for AHP

Intensity of Importance	Definition	Explanations
1	Equal importance	Two activities contribute equally to the objectives
2-3	Weak Moderate importance	Experience and judgement slightly favor one activity over another
4-5	Moderate plus- Strong importance	Experience and judgement strongly favor one activity over another
6-7	Strong plus- Very strong importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8-9	Very, very strong Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

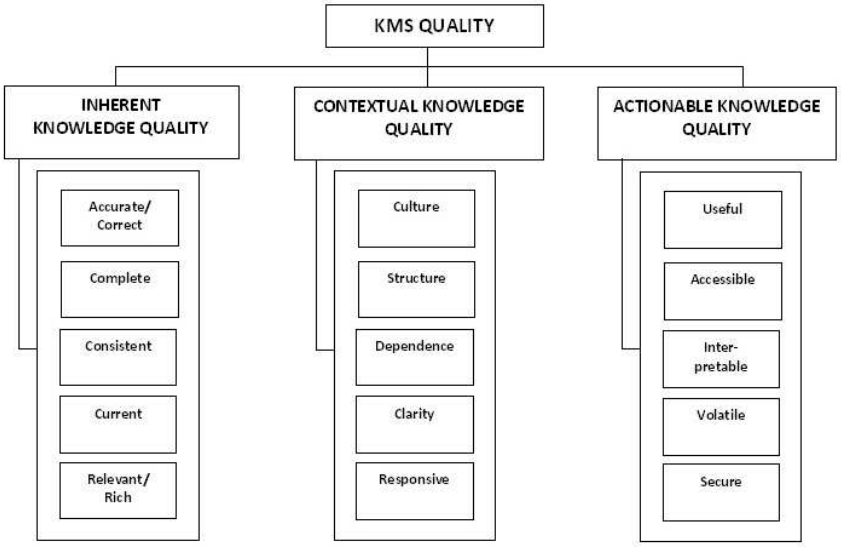

Fig. 1: Hierarchical Structure of Knowledge Quality

Table 3: Weights of Knowledge Quality Attributes derived from AHP ProcessP

Level 1 Factors	Weights	Level 2 Sub-factors	Weights
Inherent Knowledge Quality (0.50)	0.33	Accurate/Correct	0.26
		Complete	0.43
		Consistent	0.06
		Current	0.16
		Relevant/Rich	0.09
Contextual Knowledge Quality (0.12)	0.12	Culture	0.05
		Structure	0.09
		Dependence	0.15
		Clarity	0.49
		Responsive	0.23
Actionable Knowledge Quality (0.55)	0.55	Useful	0.27
		Accessible	0.15
		Interpretable	0.07
		Volatile	0.48
		Secure	0.03

4 Results and Discussion

Results of AHP process can be analyzed for two purposes. Firstly, to help in choosing the degree of knowledge quality; and secondly, to prioritize the attributes of the knowledge quality framework.

Choosing the degree of knowledge quality

The results from the AHP process in terms of the syntheses of observations taken from twelve business managers with respect to the goal of knowledge quality are shown in Table 3.

The results show that actionable knowledge quality (0.55) influences knowledge quality much more than inherent knowledge quality (0.50) and contextual knowledge quality (0.12). Hence, in organizations wanting to implement KMS, managers have to ensure actionable knowledge quality followed by inherent knowledge quality. The degree of influence of contextual knowledge quality seems insignificant.

Prioritization of attributes of knowledge quality

The AHP process has also led to prioritizing the attributes that belong to the three granular levels of knowledge quality. Table 3 gives the weights of the five attributes of each level.

Among the three levels of knowledge quality, actionable knowledge quality emerges as the most important attribute (weight of 0.55) in knowledge quality followed by inherent knowledge quality (weight of 0.33), and lastly, contextual knowledge quality (0.12). It may be inferred that managers considering knowledge quality in their organizations are concerned about the actionable knowledge quality. Another interpretation of this could be that managers consider task orientation when it comes to knowledge processes of sharing, storing and disseminating. They are not swayed by context.

To analyze the importance of attributes of the knowledge quality levels, weights of these attributes that give the relative importance with respect to their parent level are given in Table 3. Volatility emerges as the most important attribute (weight of 0.48) for actionable knowledge quality followed by usefulness (weight of 0.27). It shows that managers lay high importance on volatility while considering knowledge quality in KMS. From Table 3, in the contextual knowledge quality level, clarity assumes higher importance than responsiveness. Completeness represents higher (0.43) to inherent knowledge quality as compared to accuracy and correctness (0.26).

Managerial implications for knowledge quality

It is observed that in highly knowledge intensive organizations that were part of this study such as IT/ITES, KPOs and consulting, knowledge quality is of concern in their formal and informal knowledge management systems. All these organizations need quality knowledge that can be used and reused by them for existence, thus actionable knowledge quality seemed most important to the business manager. There are serious concerns of knowledge leakage (volatility) in these organizations business managers need to ensure a constant supply of knowledge in organization is maintained and any knowledge that is available needs to be preserved for ensuring knowledge quality in the knowledge management system. Significantly the usefulness of such knowledge also plays a role in knowledge quality in organizations. Available and useful knowledge also need to be accessible. It becomes important that organizations maintain a knowledge map that is current and updated to provide a picture of the available, useful and accessible knowledge. The results of AHP also suggest the same.

However, it is pertinent to mention here that inherent knowledge quality also has a significant role in maintaining knowledge quality. To further reinforce the dictum little knowledge is dangerous, knowledge in organizations will have to be complete, accurate and current. Thus, it is important that organizations carry out knowledge audits to ensure completeness, accuracy and currency along with a knowledge cleaning process.

Care needs to be taken while implementing a knowledge management system. There are contextual risks involved which may act as barriers to knowledge quality. It is important for business managers to provide clarity of goal to the knowledge management process to set the context for any knowledge management system. The message of responsiveness and dependence needs to be clearly defined through regular team interactions.

5 Conclusion

With the rapidly growing need to manage knowledge in such competitive environment, organizations will not only have to implement formal knowledge management systems but also ensure quality in the knowledge that circulates in the organization. Business managers will have to proactively take steps to provide necessary knowledge quality. In these turbulent times where employee turnovers are extremely high retention of knowledge in organization is of paramount importance. Inherent, contextual and the actionable knowledge quality contribute in varying importance to the overall goal of knowledge quality. Analytical hierarchy process (AHP) is used in this study so as to arrive at the goal of the study. Actionable knowledge quality emerges as the most important area of concentration for business managers to ensure knowledge quality in the knowledge management system.

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