Evaluation Strategy for Ranking and Rating of Knowledge Sharing Portal Usability

D.Venkata Subramanian, Angelina Geetha

Department Of Computer Science and Engineering
B.S. Abdur Rahman University, Chennai, India

Abstract

Knowledge Sharing portals are the primary gateways for users to access all the information they need for their activity with adequate safety, security and in the best quality. The usability of a Knowledge Sharing Portal plays an important role in every organization and higher learning institutions, as it helps to increase the user satisfaction, reuse of knowledge assets, consistency of information and simplification of the maintenance process, regardless of the context, order or type of users. The primary goal of this paper is to propose a strategy for the ranking and rating of usability of the KM system. In this proposed work, we first describe the ways to design and develop the quality factors, using a multi-dimensional metric model for measuring usability along with other supporting factors. Secondly we have shown the ways to apply the Weighted Average Mean (WAM) on the usability factor and other relevant factors for evaluation. Using the weights and values generated in the metric database, the usability of the KM system can be ranked and rated both manually and automatically.

Keywords: *Multi-dimensional Metric Model, Knowledge Sharing Portal, Ranking, Rating, Usability Evaluation, WAM*

1. INTRODUCTION

Knowledge Management (KM) provides an innovative methodology for knowledge creation, storage, dissemination and sharing. Many companies and institutions are utilizing KM systems, especially the Knowledge Sharing Portal as the main method of collaboration for increasing, knowledge sharing with their workers. The usability evaluation of the KM portal is one of the crucial steps, if an organization wants to change the structure of the portal. The evaluation methodology also helps to identify the frequently used as well as effective documents with higher usability and at the same time, identify least recently used contents or inactive contents for archiving them for better storage utilization. The feedback from users helps to identify areas where access mechanisms, structure, labeling and depth of content need to be improved to meet the user's needs. Considering the intangible nature of the knowledge asset, complexity and dynamics of building the KMS infrastructure, one of the possible approaches is to determine the strengths and weaknesses of the existing KM portal and its components, such as contents through usability evaluation. Speed of information change and new ways of collaboration and enhanced user interfaces have started to take place, at every organization for knowledge sharing and management. Willingness and accurate inputs from the knowledge seekers or providers will decrease, if the feedback is requested many times from the system or through a manual process. So it is important to enhance or develop a suitable strategy for usability evaluation of the Knowledge Sharing Portal to reduce the number of user feedbacks and at the same time extract the maximum results from a metric database.

Based on many research works, it has been identified that there is no proven reliable model and metric database, to estimate and report the usability of the Knowledge portal. To overcome this challenge, we have developed the multi-dimensional metric model [3] and the widely used statistical technique WAM to rank and rate the system-generated and user measures, which are stored in the metric database. This paper first describes the comprehensive Knowledge Management Systems framework [2], usability of the KM portal, and the prediction process of using multiple dimensions. Secondly, the paper describes the process of evaluating usability through experiments and approaches for building a metric database using the multi-dimensional metric model for capturing the measures and metrics. The WAM will be applied against the results to rank and rate the effectiveness of the KM portal.

2. KM PORTAL AND USABILITY

A Knowledge Management (KM) system is a collective term that is used to describe the creation of knowledge repositories, with their respective interface components, improvement of knowledge access and sharing as well as communication through collaboration, enhancing the knowledge environment and managing knowledge as an asset for an organization. Considering the fundamental capabilities of the KMS and typical KMS infrastructure topology, we have identified a suitable KMS framework [2] which is mentioned in the figure (Figure 1) below. This framework represents all the components which make up the KMS, and in particular focuses on the needed quality factors. For our research work, we have taken Usability as an important quality factor, and other supporting factors such as Availability, Functionality and

Efficiency, for evaluating the effectiveness of the Knowledge Sharing Portal, in totality.

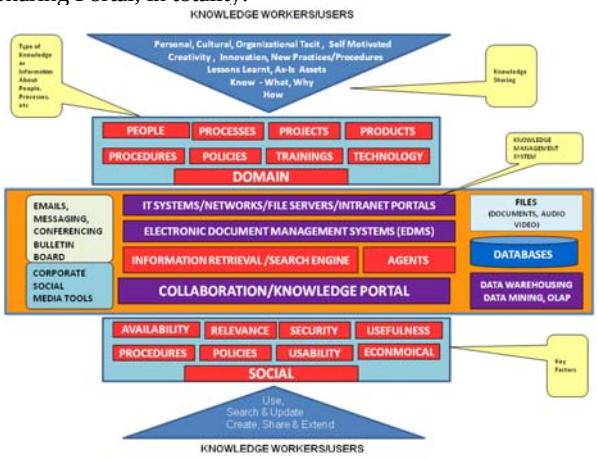

Figure 1. KMS Framework

The Knowledge Portal works as an integration tool to provide easy, unified and integrated access to an organization's own resources. Most knowledge portals have existing, but diverse systems for collecting and accessing important information from all the different systems or groups. An effective knowledge portal would provide a single point of access to all of the systems and would be structured in such a way that the location and retrieval of such information would be quick and easy. Knowledge Portal helps as an access tool for other information sources to provide internal and external information, which are beyond their own organization's resources and which can be made available to staff. The Knowledge Portal also serves as a communication tool to enable individuals, teams and communities of practice to share and discuss ideas and knowledge.

The International Organization for Standardization (ISO) defines the Usability of a product as "the extent to which the product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."

For our evaluation, we consider the following key parameters for evaluating the usability of a KM System

- Learnability, User Efficacy, User Efficiency
- Searchability, Memorability, Operability
- Communicativeness, Accessibility
- User satisfaction and Expert Ranking

3. EVALUATION PROCESS

Based on our earlier research work, we had proposed a hybrid method of using the Goal Question Metric (GQM) and Balanced Score Card to collect the required measures for performing an evaluation [2]. As illustrated in Figure 2, the basic KM System prediction process consist of the selection of the quality dimensions and their classification in to subjective or objective and then applying the hybrid method for data collection. The selected measures which are generated manually or through the system are stored in any available database and later retrieved for ranking and rating using the WAM Method. The factors whose effects need to be quantified are called primary quality factors. The features often discussed concerning the overall quality of the knowledge management system are capability, availability, reliability, usability, maintainability and completeness. In our metric model design and development, these quality factors are considered as dimensions.

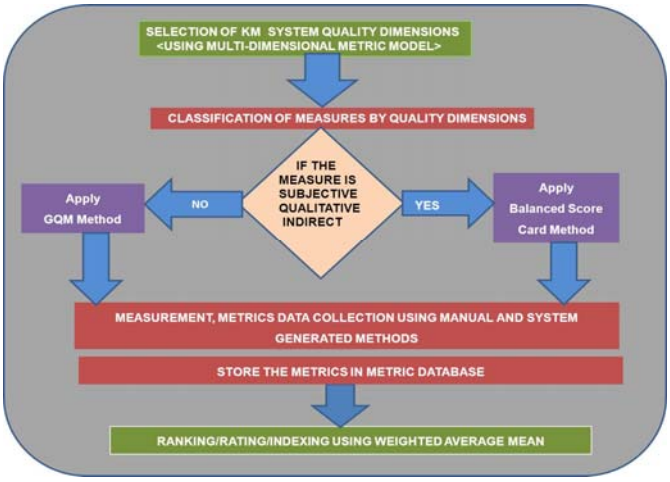

Figure 2: Hybrid Evaluation Approach

We categorized the factors in two groups such as primary and secondary and evaluators can choose the factors based on the evaluation consideration and outcomes. Continuous Inputs for the KMS Measurement process can be done through standard system programs or tools to monitor the usefulness and responsiveness of supporting technology or the framework or components used for the KMS. They give an indirect indication of knowledge sharing and reuse by highlighting which knowledge assets are the most popular ones and which components are mostly accessed and used by the knowledge workers. The system generated factors may also indicate usability problems and supporting policies for the KMS by introducing the agents which collect these measures. Some of the standard ones are page visits, number of community members and size of the document or file system.

The output metrics can be calculated or derived based on the objective and subjective feedback analysis from the knowledge sharing portal or the whole knowledge infrastructure. Most of these output measures can be calculated manually or through online user survey or forced feedback system of the usage of the knowledge portal. Some of these measures can be calculated using system level statistics and also by developing some background agents or web services. For our evaluation we have considered the most popular usability review checklist supplied by Xerox Corporation and usability evaluation questionnaires can be decided based on the usability requirements set by the evaluator of the KM portal.

4. METRIC DATABASE

The metric database Entity Relationship (ER) diagram is shown in the figure (Figure 4) below, it was created to hold the user and expert feedback of the considered dimensions(4) and measures for evaluating the KM portal usability The databases used in the existing infrastructure can be considered for storing the metrics and measurements. As the volume of data and the amount of transactions used for the KMS measurement are less, there is no need for a dedicated or high performance database and the existing database used for infrastructure maintenance or application database can be used to store the schema and data.

The metric database can be created using any industry specific database systems, using the following steps:
1. Gather the evaluation factors for assessment.
2. Decide the Quality Factor and Sub Factors
3. Create Data Objects such as Tables or Classes or XML to hold the Quality Factor/Entities and Attributes/measures.
4. Upon collecting the measures, store them in the data objects

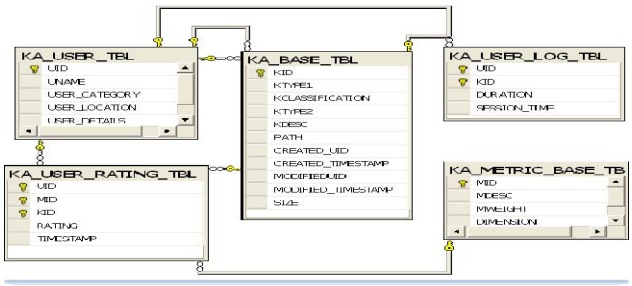

Figure 4: Metric Database E-R Diagram

As you see from the above Entity Relationship E-R diagram, our metric database has been designed in such a way as to be flexible to hold any dimension and metric as per the rating from the user (normal user or expert user or from the system).

The database consists of five key tables, namely

- The KA_BASE_TBL which is the base table which contains the knowledge asset created/modified in the knowledge portal or repository.
- The KA_USER_TBL holds the information about the user name, user type and their details.
- The KA_USER_RATING table holds the user feedback on the given measure.
- The KA_METRIC_BASE_TBL which is our key table that holds attributes, like the metric id (MID), metric Description (MDESC), metric weight (MWEIGHT) and quality DIMENSION.

5. DIMENSIONS AND MEASURES

The following section discusses the measures and metrics corresponding to some of the prime quality factors, which will be given weights in the 80% category. The diagram below represents the four key dimensions considered for the evaluation of the KM systems. The needed dimensions and attributes can be added as per the evaluation or prediction. For evaluating the usability of the knowledge management system, one needs to consider Usability as the primary dimension and the other dimensions such as Efficiency, Availability, Functionality, etc as secondary.

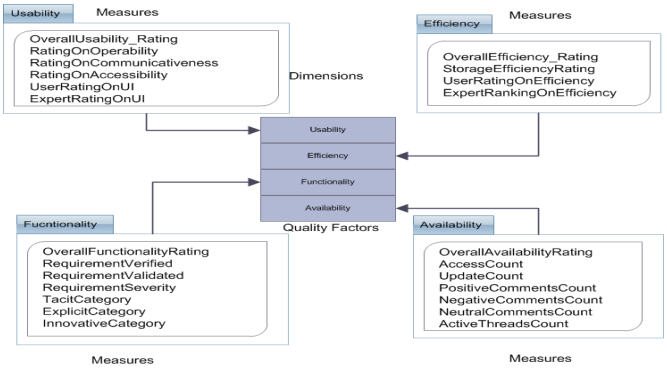

Figure 5: Four dimensional evaluation model

5.1 Usabilty Measures

The knowledge component should be easily understandable, learnable, and applicable. Usability attributes are the features and characteristics of the software/product/sites that influence the effectiveness, efficiency and satisfaction with which users can achieve specified goals. The usability entity can have the following attributes:

- OverallUsability_Rating
- RatingOnLearnability
- RatingOnUserEfficacy
- RatingOnUserEfficiency
- RatingOnSearchability
- RatingOnMemorability
- RatingOnOperability
- RatingOnCommunicativeness
- RatingOnAccessibility
- UserSatisfactionRatingOnUI
- ExpertSatisfactionRatingOnUI

5.2 Functionality Measures

The functionality of the KMS can be considered as an entity object in the metric model and its expected behavior will be captured as the requirements or attributes of an entity object

- OverallFunctionalityRating
- RequirementVerified
- RequirementValidated
- RequirementSeverity
- TacitCategory
- ExplicitCategory
- InnovativeCategory

5.3 Availability Measures

In the context of the KMS, Knowledge Availability is whether (or how often) a given knowledge asset is available for use by its intended users. The following are some of the key attributes for measuring the Availability of the knowledge asset:

- OverallFunctionalityRating
- RequirementVerified
- RequirementValidated
- RequirementSeverity
- TacitCategory
- ExplicitCategory
- InnovativeCategory

5.4 Efficiency Measures

The knowledge portal should state the quickest solution with the least resource requirements. The following describes the efficiency of the KMS components and their contents:

- OverallEfficiencyRating
- StorageEfficiencyRating
- UserRatingOnEfficiency
- ExpertRankingOnEfficiency

6. WEIGHTED MEAN

The weighted mean is similar to an arithmetic mean (the most common type of average), where instead of each of the data points contributing equally to the final average, some data points contribute more than others. The weights can be specified for the measures or metrics collected, based on the user or implementer or evaluation needs. For example, training organizations gives higher weightage to the quality of the training material, certifications obtained by the participants and also the employability of the participants after completing the training which indicated its effectiveness. Consulting companies usually gives weights on the problems solved by the consultant or technical expert and the number of best practices implemented by the technical or domain consultant on a given domain or technical issue. In higher learning institutions like universities and engineering colleges, the relevance of the knowledge asset based on the syllabus or curriculum gets more weight as it reflects the standard. Additional weights can be given to the academic institutions, if the knowledge asset on a specific subject encourages students to do projects or submit research papers or obtain higher scores in the exams in the subjects taught and presented in the knowledge portal or repository. The non-critical or supportive measures, which indirectly contribute to measurement of the KM System, will be considered as non-weighted measures for our evaluation. 95:5 has been adapted for our ranking and rating using the weighted average mean, in these formulas, 90 indicates 95% of the allocation for critical KMS measures and 5 indicates 5% of the allocation for non-weighted measures. We have considered the following as the non-weighted measures, and the evaluator can decide the rule and keep the measures in the weighted or non-weighted category.

- KM Infrastructure & Management Support
- Participant's Subject or Domain Knowledge
- Participants' Thrust for Knowledge Collaboration

7. USERS AND ENVIRONMENT

For evaluating the usability of the KM portal documents, the metric must indicate the usability parameters of the KM portal and/or its components and need to involve Knowledge Seekers, Providers, Web Portal Designer, Developer and Domain expert on the evaluation subject and typical novice and expert web users. The participants were selected from multiple departments of top two engineering colleges with moderate and frequent usage of knowledge portals and knowledge repositories. Initially 450 candidates were selected, but only 270 candidates, with similar profiles, were actually used in the experiment.

The main aspects of the normal user profiles of the participants were similar in the following ways:

- Computing knowledge and knowledge of using collaborative tools such as corporate or organization knowledge portal or knowledge systems
- >= 22 years of age and < 27 years of age, with English as their learning language for all the engineering subjects.

The main aspects of the expert user profiles of the participants used were similar in the following ways:

- Teaching or Training skills
- Expert knowledge in the subject area
- Willingness to review and provide ranking of the knowledge asset in a constructive way
- <= 69 years of age and > 27 years of age with apt qualification and teaching experience in the engineering subjects

The users evaluated six knowledge sharing portals for the purpose of usability evaluation. One of the categories is technology forum/support site for IT tools and database related support; another category is engineering colleges and the third category is training firms. The data obtained for this experiment pertained to the usability of the computer science related subjects and respective user interfaces provided in the knowledge sharing portal.

8. RANKING AND RATING

Though we have considered Usability as a primary dimension, we have also considered other dimensions as important which should be evaluated in conjunction with the usability of the Knowledge Sharing Portal. The knowledge assets and the portal should be available and part of functionality and efficiency requirement of the KM Infrastructure. The table 1 shows how the evaluation percentage is distributed among multiple dimensions.

TABLE 1. DISTRIBUTION TABLE FOR EVALUATION

KM Quality Dimension For Evaluation	Allocated Evaluation Percentage
Usability	80%
Functionality	5%
Availability	5%
Efficiency	5%
Others	5%
	100%

The following table 2 shows how the evaluation percentage (80%) is distributed among multiple usability measures and the captured rating received from the metric database and weighted calculation for the usability dimension.

TABLE 2. WEIGHTAGE TABLE FOR USABLITY

KM Usability Measure	Weight (80%)	Captured Rating (from Metric DB)	Weighted Calculation
RatingOnLearnability	10%	3.5	0.35
RatingOnUserEfficacy	10%	3.9	0.39
RatingOnUserEfficiency	10%	3.7	0.37
RatingOnSearchability	10%	4.4	0.44
RatingOnMemorability	10%	4.1	0.41
RatingOnOperability	10%	3.6	0.36
RatingOnCommunicativeness	10%	4.2	0.42
RatingOnAccessibility	10%	3.8	0.38
UserSatisfactionRatingOnUI	10%	3.7	0.37
ExpertSatisfactionRatingOnUI	10%	4.5	0.45
	100%	**Total Score**	**3.94**
		KM Dimension Score	**3.152**

The secondary tables (table 3 to 6) listed below show how the evaluation percentage (15%) is distributed among other dimensions such as functionality, availability and efficiency.

TABLE 3. WEIGHTAGE TABLE FOR FUNCTIONALITY

KM Functionality Measure	Weight (5%)	Captured Rating(from Metric DB)	Weighted Calculation
OverallFunctionalityRating	20%	3.5	0.7
RequirementVerified	10%	3.2	0.32
RequirementValidated	10%	3.6	0.36
RequirementSeverity	10%	2.1	0.21
TacitCategory	10%	4.1	0.41
ExplicitCategory	10%	2.4	0.24
InnovativeCategory	30%	3.1	0.93
	100%	**Total Score**	**3.17**
		KM Dimension Score	**0.1585**

TABLE 4. WEIGHTAGE TABLE FOR AVAILABILITY

KM Availability Measure	Weight (5%)	Captured Rating(from Metric DB)	Weighted Calculation
OverallAvailablityRating	20%	3.2	0.64
AccessCount	10%	3.9	0.39
UpdateCount	10%	3.2	0.32
PositiveCommentsCount	10%	4.2	0.42
NegativeCommentsCount	10%	1	0.1
NeutralCommentsCount	10%	3.7	0.37
ActiveThreadsCount	30%	4.1	1.23
	100%	**Total Score**	**3.27**
		KM Dimension Score	**0.1635**

TABLE 5. WEIGHTAGE TABLE FOR EFFICIENCY DIMENSION

KM Efficiency Measure/Metric	Weight (5%)	Captured Rating(from Metric DB)	Weighted Calculation
OverallEfficiency_Rating	20%	3.9	0.78
StorageEfficiencyRating	20%	3.5	0.7
UserRatingOnEfficiency	30%	4.1	1.23
ExpertRankingOnEfficiency	30%	3.6	1.08
	100%	**Total Score**	**3.79**
		KM Dimension Score	**0.1895**

The table 7 shows the overall summary weightage for the weighted dimension group and non-weighted dimension group.

TABLE 6. NON-WEIGHTED MEASURES

KM Non Weighted Measure/Metric (5%)	Captured Rating(from Metric DB)
Supporting KM Infrastructure	3
Management Support	2
Condusive Environment	1
Particpant's Subject or Domain Knowledge	2
Participants Thrust for Knowledge Collabration	3
Total Non Weight Value	11
Average	2.2
5 % of Non Weighted Dimension Group Score	0.11

TABLE 7. SUMMARY WEIGHTAGE TABLE

Allocation	Type	Derived Score
90%	Weighted Dimension Group	3.6635
10%	Non Weighted Dimension Group	0.11
	Overall KM System Usability Score	**3.7735**

TABLE 8. RANKING AND RATING TABLE

Rank	Category	Rating
1	Outstanding	5
2	Extremely Usable	4
3	Usable	3
4	Somewhat Usable	2
5	Not Usable	1

Table 6 indicates the non-functionality measures such as overhead measures for the remaining 5% evaluation. The negative values/rating will be subtracted from the score. The ranking and rating was done based on the data collected from the knowledge portals. The captured ratings are aggregated values, which are stored in the database through system feed, user and expert feed. The ranking and rating values for all the six portals considered are listed below table 9.

TABLE 9: USABILITY RATING OF KM PORTALS

Knowledge Sharing Portal	Usability Score
Portal-1	4.214
Portal-2	2.489
Portal-3	4.561
Portal-4	3.654
Portal-5	3.773
Portal-6	2.542

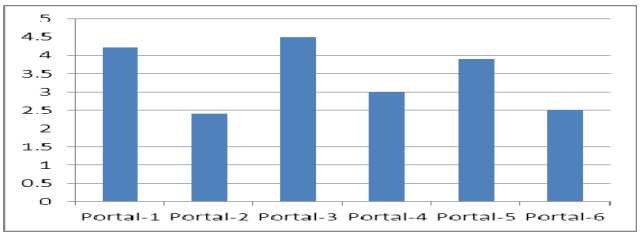

Figure 6: Usability Ranking Of KM Portals

The chart shown in Figure 6, represents the ranking and rating of the KM portals evaluated as part of the experiment.

9. CONCLUSIONS

By referring to table 8 and the guideline table 9 for ranking and rating, it is clear that the evaluated KM system usability is effective as the system got the overall evaluation rating of 3.7735. In this research work, we have attempted to use the metric database and a proven statistical technique, the Weighted Average Mean, to validate the effectiveness of the knowledge sharing in Knowledge Management systems using Ranking and Rating and proved that the combination of the Metric Database with a statistical technique such as the WAM could be useful to predict the usefulness and effectiveness of the Knowledge Sharing Portal and can help to identify issues, challenges and gaps in the existing KM infrastructure and could help to improve the user-satisfaction of the Knowledge Sharing Portal. For our experiment, we have taken only a four dimensional metric model and database, to validate the usability which may not be adequate enough to measure the overall usability of the Knowledge Management Systems, as the usability measurement is heterogeneous. So there are multiple research avenues to enhance the proposed dimensional model as well as the structure of the metric databases to use multi-dimensional data cubes instead of tables to gather additional usability factors and measures. The proposed strategy is simple to use and provides a lot of flexibility for evaluators to decide the usability dimensions of a KM system and store them in the database system for reporting, ranking and rating as per the allocation of weights. In order to compare the proposed strategy, an appropriate hypothesis can be set to validate the significance of the results obtained from the KM metric database. Further research can be conducted on mining methods along with ontologies for getting highly reliable, dependent and multifarious relationship of the usability factors and their attributes.

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First Author D. Venkata Subramanian completed his Bachelor of Engineering in Computer Science and Engineering in 1992 from Bharathidasan University, India and his Master Of Science in Computer Systems Engineering from Northeastern university, Boston, USA in 2002. Venkata has worked in industries in India, Malaysia, Singapore & U.S.A for about 18 years and got certifications in IBM Db2, MDM Infosphere and ITIL V2. Venkata is presently providing consulting and training in the areas of Databases and Systems, and in parallel doing his Ph.D (part-time) in Knowledge Management, at B.S Abdur Rahman University, Tamilnadu, India.

Second Author Angelina Geetha completed her Masters In Engineering Degree and Ph.D in Computer Science from Anna University. Angelina is presently working as a Professor and Head in Computer Science and Engineering department at B.S Abdur Rahman University, Chennai, Tamilnadu India. Angelina has worked for more than a decade in academic institutions and guided several Ph.D students in knowledge management, data warehousing, data mining and web mining.