Relationships between factors for evaluating Knowledge Sharing Portals

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Abstract—**The purpose of this case study is to better understand the relationships between three key factors namely Usability, Availability and Relevance. One of the primary goal of this case study is to analyze the data collected from the database technology professionals(Knowledge Seekers), who access a series of database technology articles in the knowledge sharing portal to enhance their skills. This study also analyse the data from the database technology experts for validation, and perform the correlation between the evaluation results of Knowledge Providers and Knowledge Seekers. In addition, this study illustrates how to measure these factors, and identify the correlation between these three factors, using both Knowledge Providers and Knowledge Seekers. Findings indicate that both knowledge seekers and knowledge providers responded favourably to most of the usability measures. They have also responded favourably to the other two measures of Availability and Relevance. In addition, this paper tries to identify the correlation between the feedback data collected from Knowledge Seekers and Knowledge Providers. This study also describes an evaluation methodology involving both Knowledge Seekers and Knowledge Providers, with an emphasis on the key evaluation factors, as an effective approach to evaluate the knowledge sharing portal.**

Keyword-Knowledge Management Systems (KMS), Ranking, Rating, Usability, Availability, Relevance, Knowledge Sharing Portal, Evaluation, Correlation

I. INTRODUCTION

Though today's organizations build infrastructure, context and learning cycles in the form of knowledge sharing portals, there are no proven measurement processes in place, to assess the effectiveness of the knowledge sharing portal, either to enhance the portal itself or the knowledge assets in the portal, or to archive the unused or irrelevant knowledge assets. The required metrics can be collected through an evaluation methodology, such as Goal Question Metrics, Weighted Balanced Score Card, and/or Hybrid methodology. In this study, we examine the use of a Knowledge Sharing portal for providing technical knowledge to the database administrators, with respect to its usage and the effectiveness. Each topic in the knowledge sharing portal provides the related information in the database administration field which will be useful for the day to day operations of the Database Administrators. In addition, because the topics were developed for providing additional tips or best practices which are beyond the text book, we are interested in the impact of the additional knowledge on other aspects of the traditional class, and training including lectures. A review of the literature identifies three primary factors, namely Usability, Availability and Relevance related to how the knowledge seekers use the knowledge sharing portal. We shall first describe the Knowledge Sharing Portal, components of the KMS and Quality Factors, which are critical for conducting an evaluation exercise for measuring the strengths and weakness of the existing KM system and its components. Secondly, we shall describe the process of building a metric database using the multi-dimensional metric model, for capturing the measures and metrics for the three prime factors, which are collected through evaluation methods. All the knowledge seekers were given a web based evaluation sheet to feed in their scores, using the balanced score card method. The relationship between these three factors, were studied in detail using the correlation. The weights are assigned for each evaluation category, which is ranked and rated for the portal, using the weighted average mean method.

II. KNOWLEDGE SHARING PORTAL

Considering the fundamental capabilities of the KMS and the typical KMS infrastructure topology, we have identified a suitable KMS framework shown in Figure 1, which represents all the key components that make up the KMS, and in particular is focused on the needed quality factors. Knowledge Sharing Portal works as an integration tool to provide easy, unified and integrated access to an organization's own resources. Most knowledge portals have 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 the systems and would be structured in such a way that the location and retrieval of such information would be quick and easy. A Knowledge Portal helps as an access tool for other information sources to provide internal and external information which is beyond their own organization's resources, but which can be made available

to its staff. It also serves as a communication tool to enable individuals, teams and communities of practice to share and discuss ideas and knowledge. For this case study, we have taken Usability, Availability and Relevance as the important quality factors apart from other supporting ones. The KM System and /or Knowledge Sharing Portal Effectiveness Measurement Cycle diagram is shown in Figure 2.
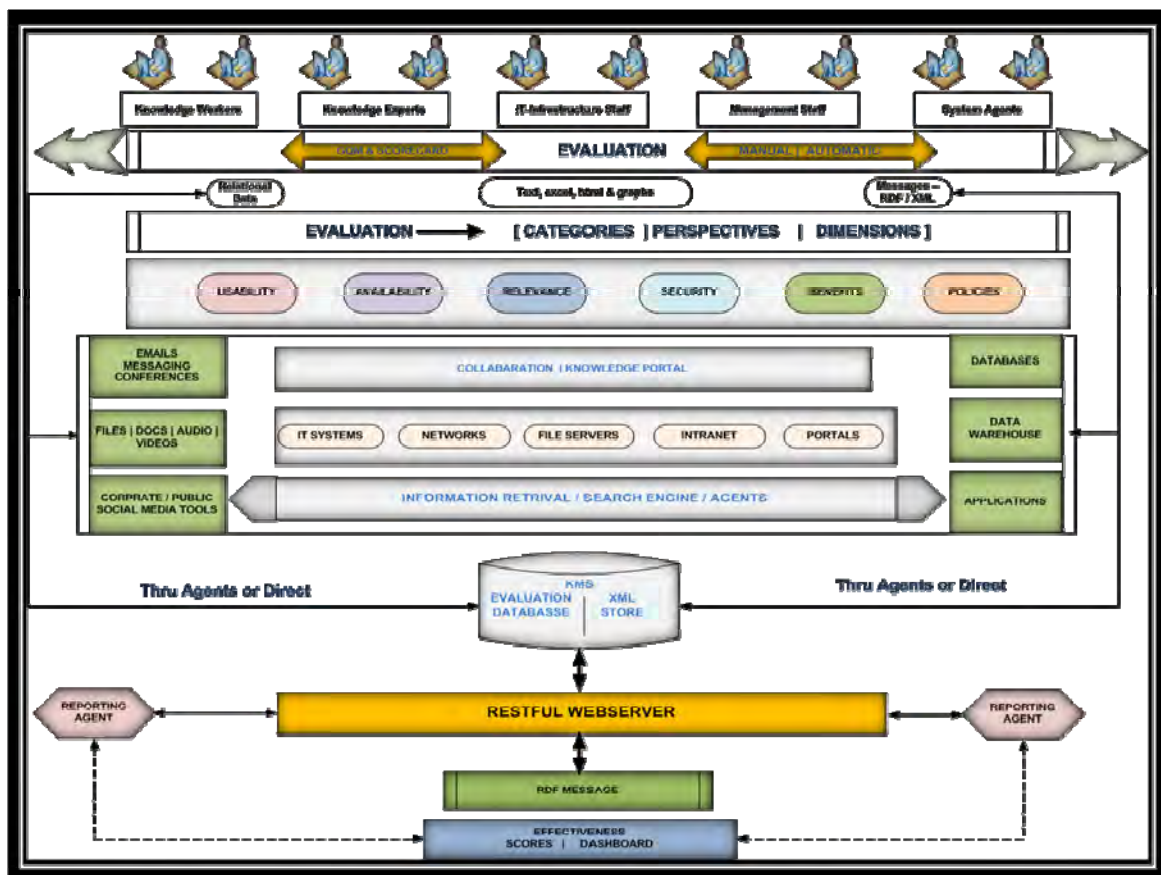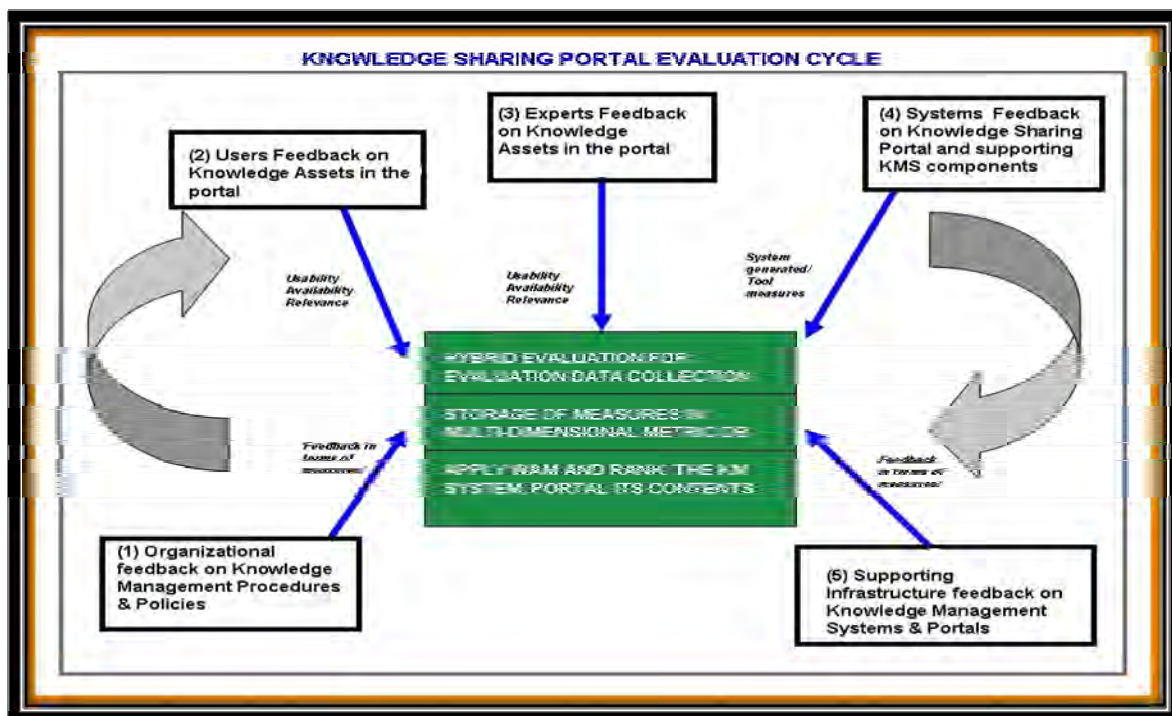

Fig 1. KM System Framework

Fig 2. KM Measurement Stages and Cycle

III. DATA COLLECTION METHOD

There are factors and measures which play a critical role in producing the desired outcomes in the KM Systems evaluation. So, KM dimensions also called as categories or view-points should be extensively correlated to many factors influencing the results as much as possible. The Knowledge management quality factors enable organizations to strongly indicate what they consider to be important. There are many forces within an organization and KM Systems, affecting people's learning, sharing, and efficiency, so, it is important to consider the secondary factors as well (Quality Sub Factors) based on the multi-dimensional metric model. For this case study, we have taken Usability, Availability and Relevance as the key Quality Factors as these metric indicate the usefulness of the knowledge sharing portal. If we want to know which of the knowledge transfer portals or tools are the most effective for sharing practices, we must measure the level of transfer activity and ask users and experts how it has helped them achieve business or technology objectives. The features often discussed, concerning the overall quality of the Knowledge Sharing Portals are availability, relevance and usability. In our metric model design and development these quality factors are considered as dimensions. Output metrics measure characteristics at the project or task level, such as the effectiveness of the lessons learned, for future operations. By applying the basic knowledge measurement process in a few organizations and knowledge sharing portals, we have identified the key parameters and associated measures. For a given subject present in the Knowledge Sharing or Management Portal, the web based evaluation questionnaire will be given to the users. The results obtained from the evaluation sheet will be stored in a metric database which can be queried to provide the outcomes such as the ones below:

- OverallUsabilityRating,
- OverallAvailabilityRating
- OverallRelevanceRating

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. This section discusses the KM measures considered by us for this case study. The selected measures which are generated manually or through the system should be stored in any available database, and later they will be retrieved for ranking and rating, using the Weighted Average Mean Method.

A. Usability Measures

The Usability of the knowledge sharing portal, needs to have undergone proper usability evaluation, and must follow a user-centered design to encourage sharing and collaboration. The Knowledge Sharing Portal must provide all the key knowledge assets based on the subject of interest and should only provide the relevant topics. This means that the evaluation of the Availability and Relevance of the portal and its components is as important as that of Usability of the portal. 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 following are some of the key attributes for measuring the Usability of the portal and the existing knowledge assets in the portal:

- UserRatingOnUsability
- ExpertRatingOnUsability

TABLE 1. USABILITY QUESTIONS

No.	Question
1	Are the contents in the portal, consistent in terms of the subject language?
2	Does this knowledge minimize your memory load?
3	Is the design asthetic, visually pleasing and satisfying with respect to the layout, document format, etc?
4	Does the portal convey knowledge in an easy and lucid manner?
5	Does the portal provide an easy navigation through the document?
6	Does the portal provide useful and/or additional tips for exploring the information?
7	Is the information organized hierarchially for the topic shared in the portal?
8	How do you rate the ease of use of this portal?
9	Rate the Usability for the portal and its contents

B. Availability Measures

In the context of 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:

- UserRatingOnAvailability

- ExpertRatingOnAvailability

TABLE 2. AVAILABILITY QUESTIONS

No.	Question
1	Is the information contained dynamic?
2	Does the portal provide relevant and unique links for further references?
3	Did you find the information, you were looking for?
4	Are unique headings or information kept in separate paragraphs highlighted, for quick access?
5	Does the portal provide search options ?
6	Does the portal provide the updated information to the users?
7	Does the portal provide 'the user feedback feature' to add or improve the content?
8	Are there any additional links or references given in the content?
9	Rate the Availability for the portal and its contents.

C. Relevance Measures

In the context of KMS, the knowledge assets present in the portal should be relevant to the knowledge seekers.

The following are some measures which describe the relevance of the knowledge asset:

- OverallRelevanceRating

- UserRatingOnRelevance and ExpertRatingOnRelevance

TABLE 3. RELEVANCE QUESTIONS

No.	Question
1	Is the information contained, precise and to the point, not deviating from the subject?
2	Is the topic or page title, precise and does it describe the content in a nutshell?
3	Do you feel that you have learned more by visiting this portal?
4	Do you feel that the links or references given in the content are relevant ?
5	Are you able to apply the knowledge, that you have learned from the portal in your daily work?
6	Are the illustrations or examples relevant to the contents displayed?
7	Are there enough scenarios and/or examples related to the concepts for better understanding?
8	Are the related topics or sub navigation links grouped in a common category for your subject area?
9	How do you rate the Relevance for the portal and its contents?

D. Other Supporting Measures

There are other supporting measures, which are important along with the three key measures. There are three other important supporting measures we have considered for this case study, which are, Management Support for Knowledge Management, Quality of Supporting Infrastructure used for Knowledge Management and the System Statistics/measures used for the KM Portal and KM Systems. Some of the sample questions (5 out of 27) are listed below in TABLE 4.There are indirect measures such as KMS supporting infrastructure and System measures, which are listed in TABLE 5 and 6.

TABLE 4. MANAGEMENT QUESTIONS

No.	Question
1	Does the company establish quality policies for Knowledge Sharing and Management?
2	Is the working environment conducive to encourage the knowledge sharing efforts?
3	Is there any motivational factor, such as spot award or recognition in the company, for the one who takes the knowledge sharing initiative?
4	Is there any Knowledge Sharing initiative or activity mentioned in the organizations'/groups' vision, mission and objectives?
5	Is there any importance given for Knowledge Sharing as part of the employee induction or orientation process?

TABLE 5. INFRASTRUCTURE MEASURES

No.	Question
1	Number of interfaces/channels for the knowledge repository
2	Number of databases & EDMS connected from the knowledge portal
3	Number of channels for automatic knowledge updates
4	Number of departments/data sources linked with KMS
5	Number of Video Conferencing/Live Meetings and Recordings
6	Features for Securing and Storing the knowledge assets
7	Number of departments/data sources linked/interconnected for the search
8	Types of Documents searched using search facilities
9	Types and Number of Linkages with Social Media Tools

TABLE 6. SYSTEM MEASURES

No.	Measure
1	# of relevant hits or documents for the search
2	# of New Visits
3	# of Times spent on the page
4	# of Pageviews
5	# of Visits
6	# of New Vistors/users accessed
7	# of Unique Pageviews
8	# of Total Unique Searches
9	# of downloads and uploads
12	# of New Best practices or Technical Articles
14	# of New Users or consumers of the portal
15	# of active community members of the portal
16	# of new posts/technology updates in the portal
17	# of Questions and Answers in Q & A/Discussion
19	# of Editors on Q & A Forum in the portal
20	# of Open and Closed Discussion Threads
21	# of Documents Available
23	# of New Links
24	# of positive/negative comments on the discussion thread
25	# of new messages sent/posted thread
26	# of rejections, correction and approvals

IV. KM METRIC DATABASE

The databases used in the existing infrastructure can be considered for storing the metrics and measurements. As the volume of data and amount of transactions used for the KMS measurement is 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. If the models and databases are systematically developed to be flexible, effective, and scalable,   surely the data can be explored using the mining technique or the Weighted Average Mean Method. The metric database can be created using any industry specific database systems. There are four KEY steps in implementing the multi-dimensional metric database:

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. Store the collected measures in the data objects

The metric database for our evaluation experiment, has been implemented using Microsoft Sqlserver 2008, and contains the metrics collected through manual feeds and also through customized programs based on the inputs from user, expert and system.
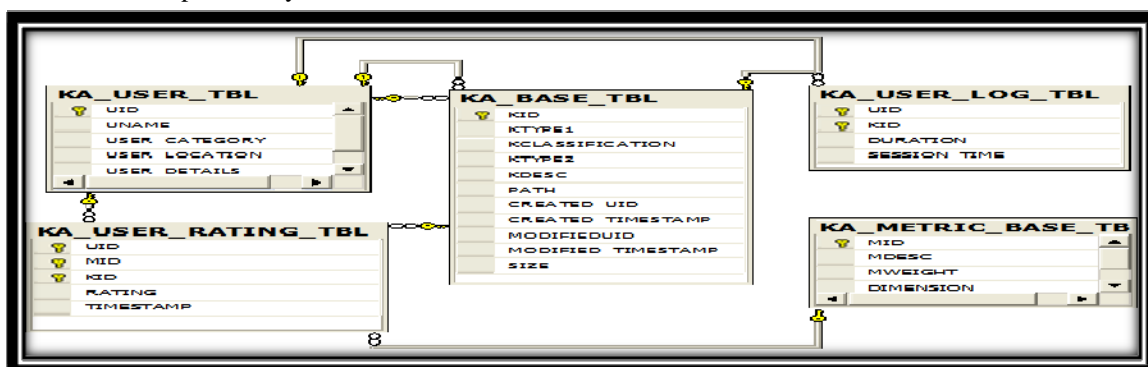

Fig 3. KM Metric Database ER Diagram

As can be seen from the database ER diagram in Figure - 3, the metric database should be designed to be flexible to hold any dimension and metric as per the rating from the user (normal user or expert user). The database consists of five key tables. The KA_BASE_TBL which is the base table that 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 holds the attributes like the metric id (MID), Metric Description (MDESC), metric weight (MWEIGHT) and the corresponding quality factor (DIMENSION).

V. THE EXPERIEMENT – PORTAL EVALUATION

The evaluation should be treated as ''a process that employs participants who are representative of the target population to evaluate the degree to which the knowledge sharing portal meets specific usability, availability and relevance criteria''. This is an important consideration for this study, because the users we surveyed, frequently uses the knowledge portals. For this case study, 15% of the employees were selected from 3000 employees who work for the Database Administration and Support department of a few IT companies, who provide Database and Systems support services. The feedback offered by the participants is valuable because, the knowledge sharing portal stores and represents the topics, which are beyond the traditional training or book material. More than 450 database professionals were informed about our survey, but only 270 database professionals were able to complete and submit the online evaluation sheet on time.

The database professionals usually acquire their basic skills through class room training courses in the Database Administration area. Responses to all the questions found in Tables 1, 2 and 3, were based on a five-point Likert scale, and ranged from strongly disagree to strongly agree. The subject matter experts or Knowledge Providers in the database administration area also participated in our survey after going through the knowledge sharing portal. Both Knowledge Seekers and Knowledge Providers (Subject Matter Experts) responded to 27 questions in the online survey associated with the knowledge sharing portal. The following are the three research hypotheses developed for this evaluation process.

Hypothesis 1: The knowledge sharing portal usability (WU) is directly proportional to the extent of knowledge sharing portal availability.

Hypothesis 2: The knowledge sharing portal usability (WU) is directly proportional to the extent of knowledge sharing portal relevance.

Hypothesis 3: The knowledge sharing portal Availability (WA) is directly proportional to the extent of knowledge sharing portal relevance (WR).

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
- Professionals with moderate or intermediate Database Administration skills in using Oracle and MS-SQL Servers with less or no experience

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

- Expert knowledge in database administration
- Willingness to review and provide ranking of the knowledge asset in a constructive way
- Professionals with the right qualification and real time Database Administration experience of more than 5 years in using Oracle and MS-SQL Server

The following sample table (Table-7) lists out the average scores of 10 users. All the three columns contain the captured rating which contains the aggregated value from the questionnaire from 251 users which are stored in the metric database.

TABLE 7. EVALUATION FROM KNOWLEDGE SEEEKERS

KUSERID	Usability Score	Availability Score	Relevance Score
1	3.50	3.39	3.45
2	3.67	3.56	3.44
3	3.44	3.33	4.33
4	3.72	3.50	3.72
5	3.00	3.00	3.00
6	3.67	3.67	3.78
7	2.78	2.44	2.67
8	4.11	4.33	3.78
9	3.72	3.50	3.72
10	2.78	2.67	2.56

The relationship and linear regression charts are shown in Figures 4, 5 and Figure 6.
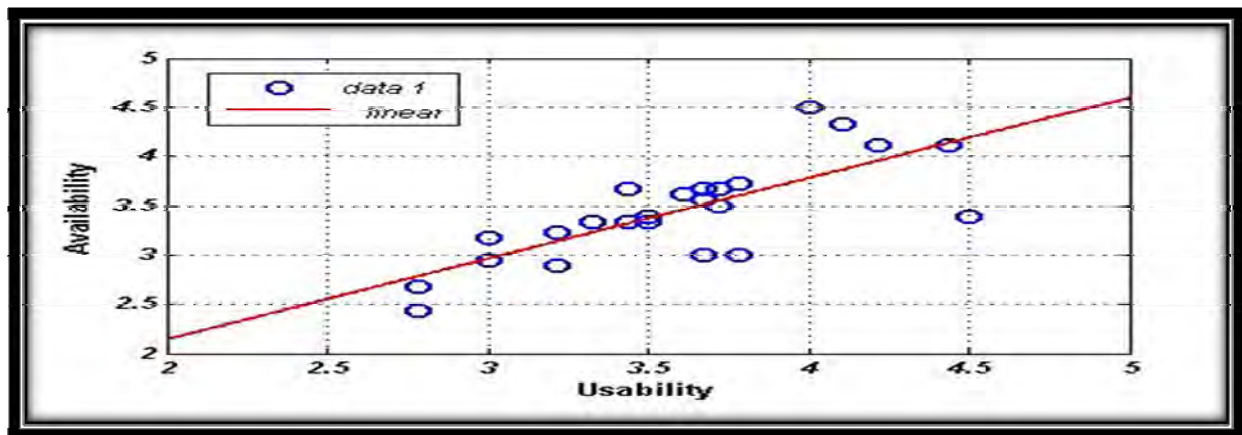
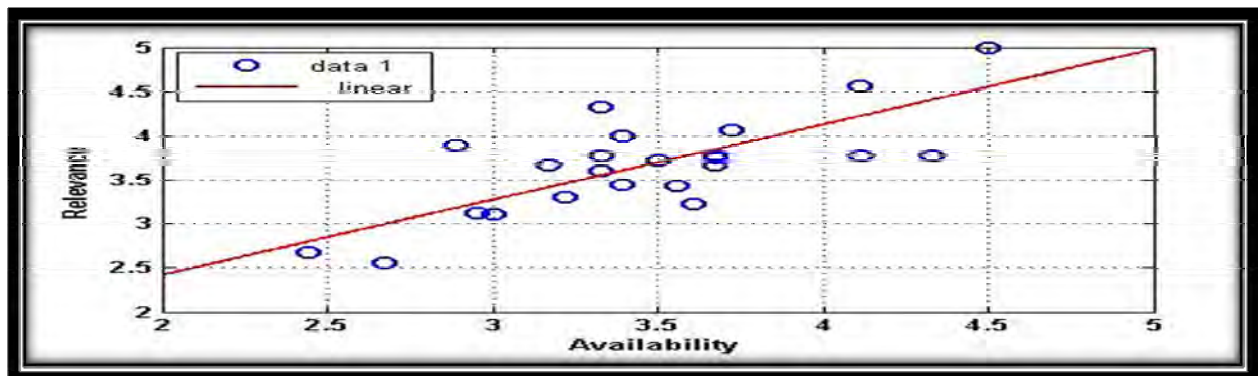Fig 4. Relationship between Usability and Availability

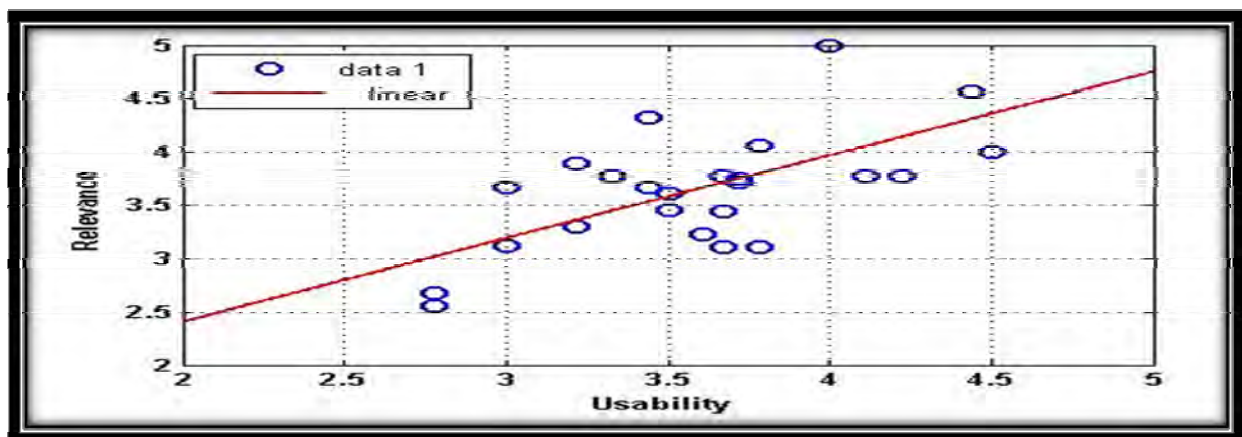Fig 5. Relationship between Availability and Relevance

Fig 6. Relationship between Usability and Relevance

For this experiment, we have primarily considered the Correlation and Weighted Average Mean method. A correlation is a number between -1 and +1 that measures the degree of association between two variables (call them X and Y). For this case study, X is Usability and Y is Availability for the UA relationship. Similarly X and Y values are used for the other relationships. A positive value for the correlation implies a positive association (large values of X tend to be associated with large values of Y and small values of X tend to be associated with small values of Y).A negative value for the correlation implies a negative or inverse association (large values of X tend to be associated with small values of Y and vice versa).

The weighted mean is similar to an arithmetic mean (the most common type of average). The weights can be specified for the measures or metrics collected based on the user or implementer or the evaluation needs. The KMS measures can be weighted either equally or unequally, based on the evaluation or ranking criteria, in our case, we considered four different aspects of the knowledge sharing, and assigned equal weights as the measures are equally important to provide the right ranking for every quality factor.

TABLE 8 P VALUE FROM K-SEEKERS' VIEW

RELATIONSHIP	CORRELATION COEFFICIENT	P VALUE
UA	0.719	SIGNIFICANT
UR	0.712	SIGNIFICANT
AR	0.693	SIGNIFICANT

Table 8 indicates the correlation coefficient for the three key relationships UA, UR and AR. From Table 8 it is clear that there exists a positive correlation between the three factors since the P Values are significant. Equal weights have been given to these three factors and Table 9 contains the weights and captured ratings from the metric database.

TABLE 9. WEIGHTAGE TABLE FOR USER SCORES

KM Evaluation Measure	Weight (90%)	Captured Rating (from Metric DB)	Weighted Calculation
UsabilityScore	33.33%	3.64	1.21
AvailabilityScore	33.33%	3.50	1.16
RelevanceScore	33.33%	3.70	1.23
	100%	Total Score	3.60
KM Dimension Score (90%)			3.24

For an effective and successful KM system, the organization must have multiple support factors such as Environment, Infrastructure, Domain Knowledge and participant's thrust for knowledge sharing, apart from user's feedback. Therefore, hence, for the evaluation purpose, we have also considered non-weighted measures and added 10% to our overall calculation. The metrics for non-weighted measures are shown in Table 10. The capture rating was an average score based on the questions and automated measures mentioned in Table 4, 5 and 6 in the data collection method.

TABLE 10. NON WEIGHTED MEASURES

KM Non Weighted Measure/Metric (10%)	Captured Rating (from Metric DB)
NW_M1 Supporting KM Infrastructure	3
NW_M2 Management Support	4
NW_M3 System Measures	4
Total Non Weight Value	11
Average	2.2
10 % of Non Weighted Dimension Group Score	0.22

TABLE 11. RATING FROM THE USERS' VIEW

Allocation	Type	Derived Score
90%	Weighted Dimension Group	3.24
10%	Non Weighted Dimension Group	0.22
Overall KM System Score		3.56

TABLE 12. GUIDELINES TABLE FOR RANKING

Rank	Category	Rating
1	Outstanding	5
2	Extremely Effective	4
3	Effective	3
4	Below Effective	2
5	Not Effective	1

By referring to tables 10 and 11, and the guideline table 12 for ranking and rating, it is clear that the evaluated Knowledge sharing portal is effective, as the overall evaluation rating of above 3 has been obtained from both the users' and experts' view.

VI. CONCLUSION

Most of the knowledge sharing portal users gives equal importance to Availability and Relevance Questions apart from the Usability of the portal. Findings indicate that both knowledge seekers and knowledge providers responded favourably to Availability and Relevance in conjunction with Usability. In addition, we have identified that, ranking and rating of the knowledge sharing portal's usability is directly proportional to the effectiveness of the three parameters Usability, Availability and Relevance, as there exists, a positive correlation

between the evaluation samples. The suggested evaluation approach, developed metrics and portal rating could also be helpful to archive the unused or irrelevant knowledge assets exists in the portal, and also to enhance the portals whose effectiveness ranking was below average. For an effective evaluation of the knowledge sharing portal, we recommend consideration of both the users' and experts' feedback, and other factors and measures corresponding to Usability, Availability and Relevance. In addition to this, other non-weighted measures suggested in this paper, such as the system's statistics, supporting infrastructure for the knowledge management system and organization's knowledge sharing culture and processes.

REFERENCES

[1] Diwakar Krishnamurthy, Jerry Rolia, and Min Xu1(2011), "WAM – The Weighted Average Method for Predicting the Performance ofSystems with Bursts of Customer Sessions, University of Calgary, Calgary, AB, Canada, IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, 0098-5589/11
[2] Jiawei Han, Yizhou Sun, Xifeng Yan, Philip S. Yu(2010), "Mining Knowledge from Databases: An Information Network Analysis Approach", SIGMOD'10, June 6–11, 2010, Indianapolis, Indiana, USA.
[3] Sergio Consoli, Keneth Darby-Dowman, "Heuristic approaches for the quartet method of hierarchial clustering", IEEE Transactions on Knowledge & Data Engineering, Vol 22 #10, 2010
[4] Behrang ZadJabbari, Pornpit Wongthongtham, Farookh Khadeer Hussain(2010),"Ontology based Approach in Knowledge Sharing Measurement", Communications of the IBIMA Volume 11", 2009
[5] Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundation and research issues. Management Information Systems Quarterly, 25(1), 107-134.
[6] Jennex, M. E., & Olfman, L. (2006). A model of knowledge management success. International Journal of Knowledge Management, 2(3), 51-68.
[7] Kankanhalli, A., & Tan, B. C. Y. (2005). Knowledge management metrics: A review and directions for future research. International Journal of Knowledge Management, 1(2).
[8] Kaplan, R. S., & Norton, D. P. (1996). Translating strategy into action - The Balanced Scorecard. Boston, MA: Harvard Business School Press.
[9] Ellis, B. (1966). Basic concepts of measurement. Cambridge, UK: Cambridge University Press.
[10] Fenessy, G. (2002). Understanding and selecting knowledge management systems for a health information provider. In Proceedings of the 35th Hawaii International Conference on System Sciences.
[11] Jennex, M. E. and L. Olfman, L. (2003). A Knowledge Management Success Model: An Extension of DeLone and McLean's IS Success Model. Ninth Americas Conference on Information Systems.
[12] V. R. Basili and D. M. Weiss (1984). A Methodology for Collecting Valid Software Engineering Data, IEEE Transactions on Software Engineering, vol. 10(3), pp. 728-738.
[13] Venkata S Dayanandan, Angelina Geeteha(2011), "Adaptation of Goal Question Metric Technique For Evaluation of Knowledge Management Systems", Review of Knowledge Management Journal, Volume 1, Jan-June 2011, ISSN:2231-5845
[14] Venkata S Dayanandan, Angelina Geeteha, Mohammed Hussain(2011), "Measurement Process and Multi-dimensional Model For Evaluating Knowledge Management Systems", International Conference on Research and Innovation in Information Systems, International Islamic University, Malaysia (IIUM) and Universiti Teknologi Malaysia(UTM), Indexed by IEEE & SCOPUS, November 2011
[15] D.Venkata Subramanian, Angelina Geetha(2012), "Evaluation Strategy for Ranking and Rating of Knowledge Sharing Portal Usability", International Journal of Computer Science, Volume 9, Issue 1, January 2012 – ISSN (Online): 1694-0814

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