KSFaci: Facilitating Knowledge Sharing Using Profiler and Recommender Agent

Nurfadhlina Bt Mohd Sharef [1], Mohd. Hasan b. Selamat[2], Md. Nasir bin Sulaiman[1] , Wan Nurhayati Wan Ab. Rahman[2,]

[1]*Department of Computer Science,*
[2]*Department of Information System,*
Faculty of Computer Science and Information Technology,
University Putra Malaysia (UPM), Serdang, 43400 UPM Serdang
Selangor Darul Ehsan, Malaysia

Abstract

Knowledge sharing is one of the modern knowledge management initiatives, where a more user-centered system has replaced the traditional management of knowledge as asset. This article aims to collect user satisfaction to prove whether user profiling and recommendation is significant in knowledge sharing facilitation framework. A four-factor evaluation metric to measure the overall performance of the agent based system is used. The evaluation metric consists of three types of analysis, which are overlap analysis, weighted responds analysis and responds analysis. The four-factor metric covers the efficiency of user profile built by the agent, the relevance of recommendation, the staff directory and the document repository. The main discussion is on the setting of the experiment and the results of KSFaci performance in the proposed experiment setting. It is concluded that user profiling and recommendation plays a role in knowledge sharing system framework.

Keywords:
User Satisfaction, Agent-based Knowledge Sharing System

1.0   INTRODUCTION

Knowledge Sharing Facilitator (KSFaci) was inspired by the "lack of understanding of the benefits derived from knowledge sharing" and the "technology inadequacies" due to the fact that "knowledge is held in too many formats and repositories" [5]. KSFaci is an agent-based system which main focus is to provide personalization and intelligent assistance towards users. KSFaci becomes the facilitator for knowledge sharing by offering intelligent recommendation of similar members based on their interest similarity in the user profile as describe by Sharef, M. N. et. al, [10].

This article addresses the concern of evaluation metric for agent-based system designed for knowledge sharing facilitation.

An experiment is setup setting based on the proposed four-factor evaluation metric is discussed. The metric is specially designed to verify the significant of the Profiler and Recommender agent and the algorithms used, and to get user satisfaction on the overall framework in KSFaci. The success of KSFaci is evaluated through user satisfaction survey which covers (i) profiling ability (ii) recommendation preciseness (iii) staff directory, and (iv) document repository.

The contributions of the article are three-fold. First, this research identifies components for agent-based knowledge sharing system. Second, find suitable approach for profiling and recommendation to be used in knowledge sharing system. . An agent-based system, which model knowledge sharing facilitation is designed and implemented. Third provide reasonable background for applying existing measures of agent-based knowledge sharing system success and prove whether user profiling and recommendation are significant in knowledge sharing system framework through user satisfaction experiment.

The article is divided into seven parts. The first part introduce on KSFaci while the second part discuss on related research. The third part describes KSFaci design followed by the evaluation metric used to analyze the experiment data in section four. The fifth part details the questions in the user satisfaction questionnaire. The sixth part discus the experiment results while the last part concludes the article.

2.0   RELATED RESEARCH

There are a number of information systems success research including user information satisfaction, task-technology fit, user involvement, and participation. Among the popular ones are DeLone and McLean Model of IS Success, The Technology Acceptance

Model (TAM) and the Garrity and Sanders Model of IS Success.

DeLone and McLean model comprised of six multi-level constructs: Information Quality, System Quality, User Satisfaction, System Use, Individual Impact, and Organizational Impact. Garrity and Sanders extended DeLone and McLean model which identifies four sub-dimensions of User Satisfaction: Interface Satisfaction, Decision Support Satisfaction, Task Support Satisfaction and Quality of Work Life Satisfaction. Other components include in Garrity and Sander's model are System Use, Individual Impact, Organizational Impact and Behavioral Intention to use the website. The Technology Acceptance Model asserts that Ease of Use and Perceived Usefulness are primary determinants of System Use. Zviran et al [13] suggested that user satisfaction evaluation should cover content, accuracy, format, ease of use and timeliness of the website.

In KSFaci experiment, user satisfaction is collected through questionnaire which covers task support satisfaction, decision support satisfaction, and individual impact. The data collected from the experiment are analyzed by looking at user reaction in the survey as suggested by Selamat M., H. and Mahbubur, M., R., [9] and Mostert *et. al* [8].

3.0   KSFACI DESIGN

Figure 1 shows the main components in KSFaci. Personalization and Recommendation are the main role in agent-based knowledge sharing facilitation since it provides a more user-centered application to the users [10], [11]. Researches in knowledge sharing are growing towards providing more focus on people, not to the technology [1], [3], [4], [12]. The user profiles are used to recommend and filter relevant members towards users; based on their interest similarity. Knowledge reuse is enabled through a knowledge

repository where users can deposit their documents to be shared by others. Both knowledge reuse and recommendation services are the initiators to knowledge network, which would expand knowledge sharing initiatives.

According to Lee and Hwang [7] agent-based system consists of several agents that play their roles to achieve the system's goal. KSFaci consists of two agents namely Profiler and Recommender. The Profiler main task is to monitor users' navigational behavior and build user profile accordingly. The Recommender then identifies the user's most preferred interest based on the usage frequency. Next, the Recommender matches and recommends for knowledge network. Figure 2 shows KSFaci framework.

KSFaci framework is then implemented in web server setting where twenty users are invited to use the system. The weighted response analysis is implemented through an online quantitative survey. Users answer the questionnaire by giving scores using a 5-point Likert scale based on their satisfaction. The result is then calculated and analyzed using a satisfaction scale. Users are also required to give score on the recommendation significance. The overlap analysis collect the number of overlaps between users' selected most preferred interest with agent-suggested most preferred interest.
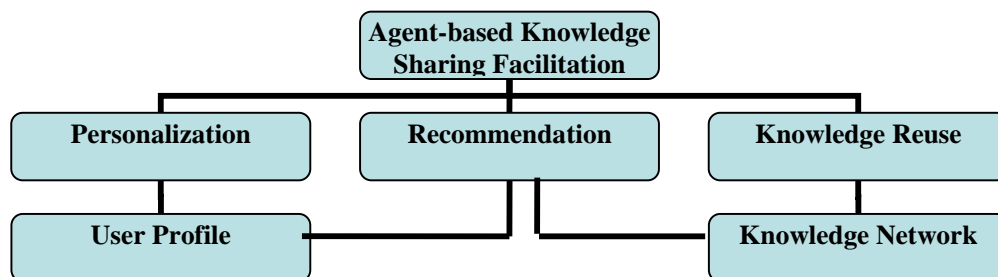

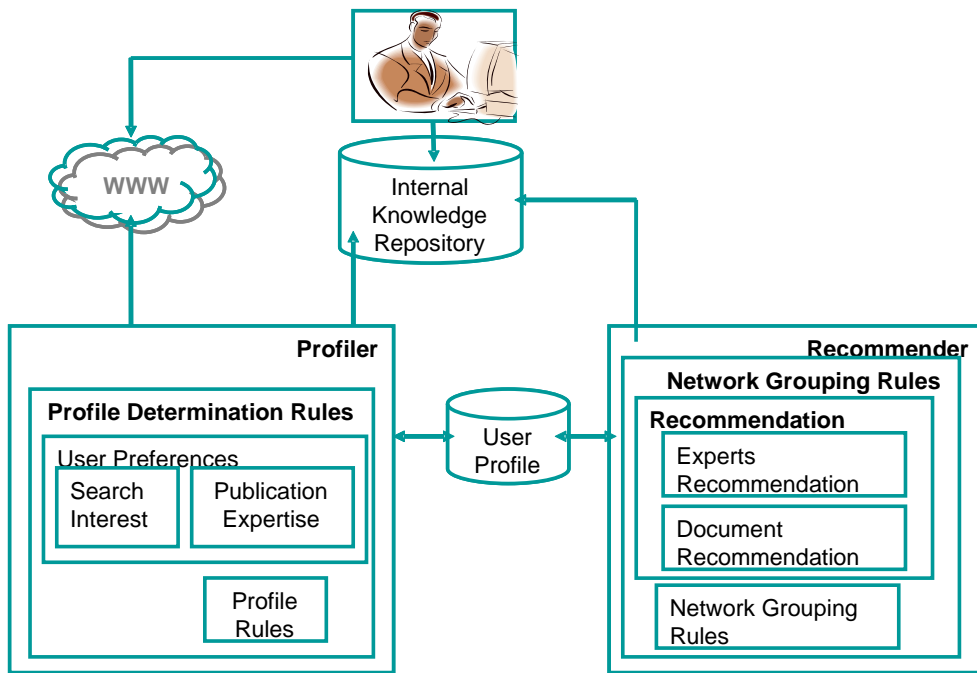*Figure 1: Components in Knowledge Sharing Facilitation by KSFaci*
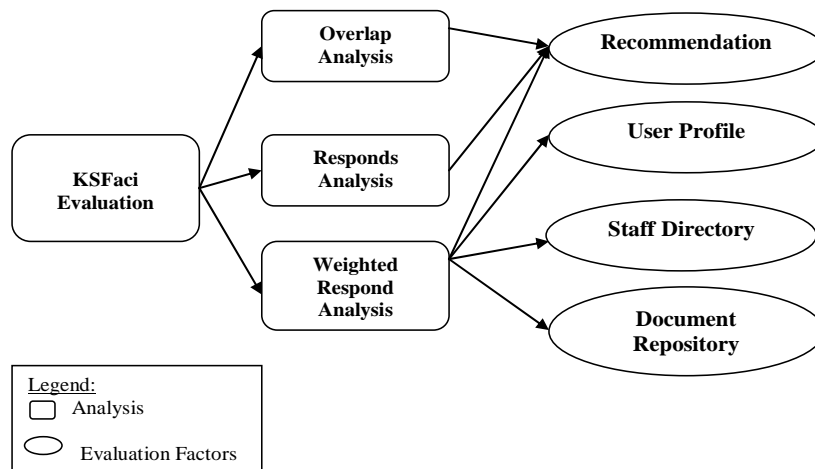
Figure 2: KSFaci Framework

Figure 3: KSFaci evaluation metrics

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4.0   KSFACI EVALUATION METRIC

A four-factor evaluation metrics was created based on the components in knowledge sharing adopted in KSFaci design [10] in order to analyze user satisfaction towards KSFaci. The factors covered in the user satisfaction survey are (i) profiling ability (ii) recommendation preciseness (iii) staff directory, and (iv) document repository. The questionnaire covers task support satisfaction, decision support satisfaction, and individual impact.

Three approaches have been adopted for the result analysis purpose which are overlap analysis, respond analysis and weighted respond analysis. Figure 3 illustrates the four-factor evaluation metrics for KSFaci. The overlap analysis and respond analysis are used to evaluate the recommendation service while weighted respond analysis is used in analyzing feedbacks captured through the questionnaire. The questionnaire contains questions asking users on their satisfaction towards the four evaluation metrics.

User satisfaction scores are collected through a quantitative online survey based on the user's usage on the system. A 5-point Likert scale which consists of five adjectives ranging from 'Strongly Agree', 'Agree', 'Not Sure', 'Disagree' and 'Strongly Disagree' are used to let users give scores to the metrics. The evaluation of user reactions relative to each of the adjective is expressed using a five interval scale. The scaling of five intervals is quantified by assigning numeric numbers (Figure 3).

Reaction of an individual user to any one of the four contributing factors can be computed as the average of responses to all of the scale adjectives affecting that factor [8], [9]. User satisfaction is defined as the sum of a user's weighted reaction to a set of criteria (Bailey and Pearson, 1983). However, in KSFaci study, it is assumed that all the four factors contribute equally in developing the user satisfaction. As such, an equal weighing factor for each of these is assumed unity. Thus, the user satisfaction is calculated using the following equation (Eq. 1):

$$Sm_i = \sum_{j=1}^{4} \frac{1}{4} R_{m_i j} \qquad \dots \text{(Eq. 1)}$$

where

z is the number of criteria to be rated
j is a specific criteria to be rated by user i
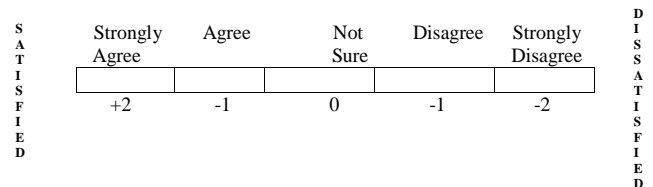is the average rating on all dimensions of criteria j by user i

Figure 3: Rating Scale to Measure User Satisfaction

The resulting value for Sm_i will fall in the interval [-1:+1] and can be interpreted by using the scale as suggested by Monstert *et. al.* [8] as shown in Table 1.

Table 1: Satisfaction scale used for questionnaire results

Score	Satisfaction Scale
0.68 to 1.00	Maximally Satisfied
0.34 to 0.67	Quite Satisfied
0.01 to 0.33	Slightly Satisfied
0.0	Neither Satisfied or Dissatisfied
-0.01 to -0.33	Slightly Dissatisfied
-0.34 to -0.67	Quite Dissatisfied
-0.68 to -1.00	Maximally Dissatisfied

Despite the questionnaire, the respond analysis and overlap analysis are used to evaluate the recommendation service. Respond analysis is used to calculate the number of 'Agree' respond by user captured in the recommendation page. Users are asked state whether they agree or disagree on the recommended most preferred interests. The data are collected daily to see agent learnability trend. The number of 'Agree' feedback shows that users accept the recommendation of most preferred interest. This proves the suitability of the technique used by the Recommender agent in determining potential members for the user and validates the appropriateness of the algorithm used by the Profiler. At the end of the testing period, users are asked to rate significance of the agent-recommended most preferred interest. Table 2 shows the significance scale used by the users.

Table 2: Significance Scale

Score	Scale
1	Not Significant
2	Less Significant
3	Significant
4	Very Significant
5	Most Significant

The average rating significant score input by users in the agent-recommended most-preferred interest evaluation (Table 2) are calculated to get the result on the suitability of the adopted profiling algorithm.

5.0 QUESTIONNAIRE

Questions in the questionnaire include the evaluation on profiling ability, recommendation service, staff directory service and document repository. These questions cover task support satisfaction, decision support satisfaction, and individual impact. The questions are also prepared to verify user satisfaction towards the Profiler and Recommender efficience. .

5.1 Profiling ability
There are two approaches used in proving the profiling ability. First is through the questionnaire. Table 3.2 shows the questions in the user profile evaluation factor. Users are asked to rate their satisfaction with KSFaci in qA1 and qA2 using a 5–point significance Likert scale.

Table 3: User Profile Factor Questions

Question	Description
qA1	The keyword usage record helped me identify my current interest
qA2	The keyword usage record helped me identify my most preferred interest

5.2 Recommendation Ability
There are three data collection types to evaluate the recommendation service:
(i) Overlap analysis between users' specified most preferred interest and user selected most preferred interest. The overlap analysis is carried out 2 days after the system testing duration ends. This is to see whether user's interest have changed within the gap. Users are asked to choose from a combo box containing agent's recorded interest and enter manually an interest into a text box. The number of overlaps shows the efficiency of the interest identification algorithm.
(ii) User's rating on the significance of the recommended most preferred interest. Users are asked to select three of their main interest based from the combo box which contain list of agent recorded user's interest. Users are then asked to rate their selection. A 5-point Likert-scale is used for users to give scores upon the selected interest they choose where 5 indicates the interest is most significant to the user and 1 least significant. The analyzed data from this experiment portion will show the efficiency of the agents in

recommending users' interests and validate the adopted recommendation algorithm.
(iii) Five-questions set under the recommendation factor (Table 4).

Table 4: Recommendation Factor Questions

Question	Description
qB1	The recommended member really share similar interest with me
qB2	The recommendation alert me of new member sharing similar interest
qB3	The recommendation is helpful
qB4	I had interact with the recommended member about our shared interest
qB5	A new member had contacted me about our shared interest

Users are asked to rate their satisfaction with KSFaci in qB1, qB2, and qB3 using a 5–point Likert scale. Users have to select "Yes" or "No" as responds in qB4 and qB5.

5.3 Staff Directory Service
The efficiency of staff directory in facilitating knowledge sharing is evaluated by capturing sers' responds in the following question (Table 3.4).

Table 5: Staff Directory Factor Questions

Question	Description
qC1	I uploaded the document to let other people use it
qC2	The repository gives benefit to me
qC3	The repository provides me a new reference source for me to find help

Users have to select "Yes" or "No" as responds in qC1, qC2 and qC3.

Links to details of members are provided in the "Interest Member" (Figure 5.4), "My Member" (Figure 5.5) and "Browse Users" (Figure 5.6) page by the Recommender agent. The system stores information on the user and the user's requested members to analyze the facilitation of the member recommendation and the achievement of KSFaci in being a medium to provide reference source towards users.

5.4 Document Repository Service
The efficiency of document repository in facilitating knowledge sharing is evaluated by capturing users' responds in the following question.

Table 6: Document Repository Factor Questions

Question	Description
qD1	The staff directory let me browse other staff's expertise to find help
qD2	The staff directory is a new reference source for me to find help

Users have to select "Yes" or "No" as responds in qD1 and qD2.

6.0   DISCUSSION

Table 7 shows the adjective responses and corresponding numeric figures collected from the overall evaluation questionnaire while Table 8 shows the tabulation of responds in each question. Table 9 shows the calculation of user satisfaction towards KSFaci based on the questionnaire responds.

The user satisfaction score is 0.68. Referring to Table 1, this value plots to 'Maximally Satisfied'.

Table 7: User reactions in corresponding numeric figures

user	qA1	qA2	qB1	qB2	qB3	qC1	qC2	qC3	qD1	qD2	Average
1	1	-1	1	1	0	1	0	1	1	1	0.6
2	1	1	1	1	1	1	1	1	1	1	1
3	2	2	0	0	0	-1	0	0	2	2	0.7
4	1	0	1	1	1	2	0	0	0	0	0.6
5	0	0	1	1	1	-1	0	0	1	1	0.4
6	-1	0	-1	-2	-1	1	1	0	1	-2	-0.4
7	-1	-1	0	2	1	2	1	2	1	2	0.9
8	1	0	-1	0	0	1	1	1	1	0	0.4
9	2	2	2	2	1	-1	2	2	0	0	1.2
10	2	2	2	2	1	-1	2	2	1	1	1.4
Average	0.8	0.5	0.6	0.8	0.5	0.4	0.8	0.9	0.9	0.6	0.68

Table 8: Reaction tabulation

	qA1	qA2	qB1	qB2	qB3	qC1	qC2	qC3	qD1	qD2	Total
Strongly Agree	3	**3**	2	2	0	2	2	3	1	2	20
Agree	**4**	1	**4**	**4**	**5**	**4**	**4**	3	**7**	**4**	40
Not Sure	1	**3**	2	2	2	0	3	**4**	2	3	22
Disagree	2	2	2	0	1	**4**	0	0	0	0	11
Strongly Disagree	0	0	0	1	0	0	0	0	0	1	2

Table 9: Reactions to the four factors

Factor	Factors	Average Reaction, R	¼ * R
User Profile	qA	0.65	0.16
Recommendation	qB	0.63	0.16
Document Repository	qC	0.70	0.18
Staff Directory	qD	0.75	0.19

User Satisfaction, S = 0.16+0.16+0.18+0.19=0.68 (Maximally Satisfied)

Table 10: Recommendation Significant Score

Score	Frequency	Weight	Frequency * Weight
5	20	5	100
4	11	4	44
3	3	3	9
2	2	2	4
1	0	1	0
		Total	157
		Average	4.36

A significance scale is used by users to give score on the significance of the recommended interest provided by the agents. Table 10 shows the significance scores captured through Recommendation Significance Evaluation page (Figure 4).
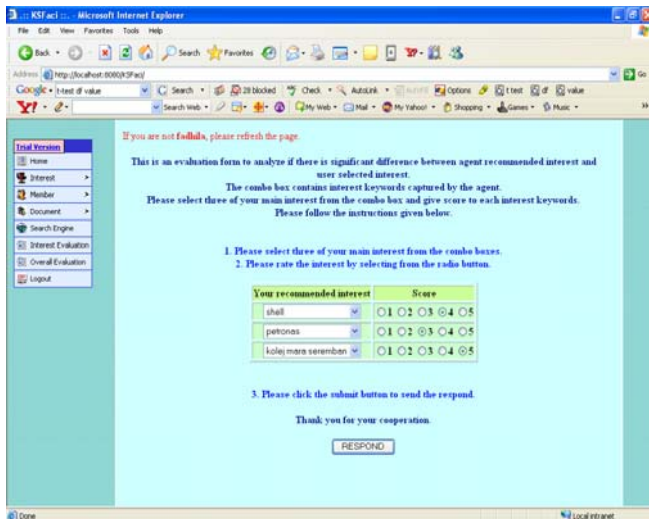

Figure 4: Capturing Significance of Recommended Interest

The overlap analysis is used to see the overlaps between user-decided most preferred interest and user-selected most preferred interest based on the agent's recommendation. Nine users have responded in the overlap analysis of users' selected most preferred interest based on agent recommendation and user's stated most preferred interest. Four users have a matching interest in the selected and entered most preferred interest which leads to 44% overlaps. Figure 5 shows the interface where users are asked to select their most preferred interest based on the list provided by the agent and input a keyword representing their most preferred interest.
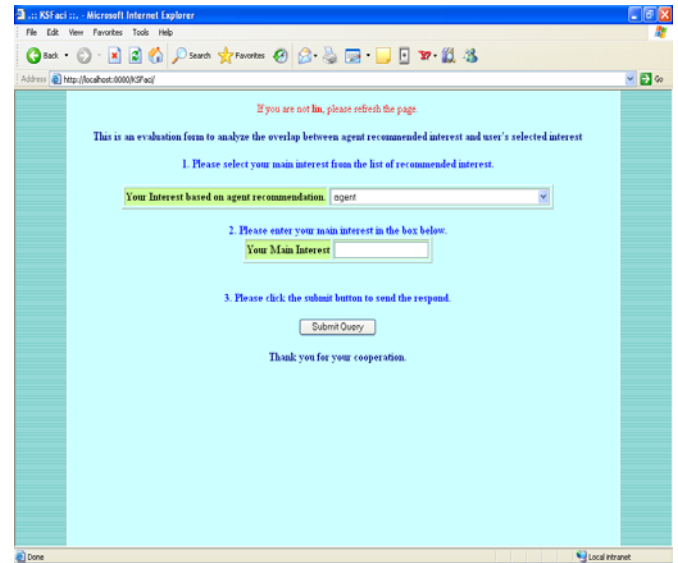

Figure 5: Capturing the recommendation preciseness

7.0   CONCLUSION

This paper has investigated the significant of Profiler and Recommender agent in knowledge sharing context. The article has covered KSFaci design and implementation followed by discussion on the evaluation metric to study KSFaci performance. User satisfaction towards the system has also been discussed. The experiment setting has been detailed and it is concluded that user satisfaction survey in KSFaci has gained a 'Maximally Satisfied' score. This proves the significance of user profiling and recommendation in knowledge sharing context and validates the applicability of the algorithms adopted by Profiler and Recommender. This evaluation metric is also suitable to any agent-based system for knowledge management and can be used in any experiment setting regarding user satisfaction evaluation.

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Nurfadhlina Mohd Sharef graduated with M.S in Software Engineering in 2007 from Universiti Putra Malaysia. Her research interest include software agent and knowledge management and already published a number of papers in this area. She work as an academic staf in The department of Computer Science, Universiti Putra Malaysia and now on study leave as a PhD candidate at Bristol University, UK.

Mohd Hasan Selamat received his M. Sc in Computer Science from Essex University in 1981 and M. Phil in Information System form East Anglia University in 1989. His research interest include component-based software development, knowledge management, software costing, and strategic information system planning. He is now an Associate Professor in The Department of Information System, Faculty of Computer Science and Information Technology, Universiti Putra Malaysia. He has published a number of papers related to this area.

Md. Nasir Sulaiman received his M. Sc in Computer Science from Bradford University and Ph.D from Loughborough University, UK. His research interest include intelligent computing, software agent, and data mining. He has published a number of papers in these areas. His current is Associate Professor in The Department of computer Science, Universiti Putra Malaysia.

Wan Nurhayati Wan Abd. Rahman obtained her M. Sc in Computer Science from Salford University, Manchester, UK. Her research interest include e-commerce and knowledge management and already published several papers in these areas. Her present position is Computer Science lecturer in The Department of Information System, Faculty of Computer Science and Information Technology, Universiti Putra Malaysia and now on study leave as a Ph. D candidate at Salford University, UK.