An Empirical Study of the Complex Relationship between KMR and Trust in GSD

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Abstract— **In GSD, trusting working relationships is critical for the success of the strategic goals of the organization. In order for an organization to build and maintain this relationship there must be a process in place. This paper outlines the use of a KMS which integrates the overall knowledge of an organization and helps in easy access and sharing of this knowledge among the distributed development teams, and ultimately helps in the development of trust. Most investigations have focused on how trust helps in knowledge sharing and acceptance by examining the impact of trust on knowledge management. In this study we focus on the dynamics of knowledge management system in the development of trust among GSD teams. This paper first investigates the relationship between KM and trust through literature review. Secondly, it aims to evaluate the role KM plays in the development of trust. Finally, we conducted a controlled experiment in academic settings with four groups of students located into two different countries to study the impact of KMS in the development of trust. The results indicate that applying KMS in GSD projects positively affects the trusting working relationship among GSD teams. An evaluation of the results is presented along with a proposal for future work.**

Index Terms— **Global software Development, Knowledge management, Knowledge Management Repository, Trust, perceived trustworthiness, propensity to trust**

I. INTRODUCTION

Over the last decade, GSD has become a mainstream business phenomenon due to the benefits and incentives associated with it; these benefits include latest technologies, availability of resources and methodologies, being closer to emerging markets, low cost, etc [1]. At the same time; GSD introduces some complexities in addition to those experienced in local software development because of the huge, physical, geographical and cultural distance involved between the stakeholders. These complexities, in turn, results in barriers to communication, lack of shared understanding and missing trust [2].

Regardless of whether a software development team work in a collocated settings or is distributed globally, trust is considered as an important factor in facilitating collaboration, improving performance, efficiency,

productivity, creativity and the overall results achieved. However, the complexities of GSD present some challenges in the development of trust that are not present in collocated teams. Trust is defined as the "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party"[4]. In GSD, working in trust oriented environment facilitates collaboration and cooperation and encourages the team members to work with a common purpose and shared goals and thus achieve the desired results [5, 6, 7, 8, 9, 10].

GSD team's members rarely meet face-to-face, even they need to communicate with those persons on daily basis who are quite strangers for them, who live and work apart from them, and they know very little about their norms and lifestyles. In this situation communication and collaboration in GSD depends, to some extent, on the level of trust that exists among distributed team members. Trust is considered as glue that holds the distributed teams together [3].

Improving communication and trust in GSD is important and KM is considered as the best means towards this end as KM holds a central role in the success of GSD projects [7, 11]. Knowledge is an intangible asset of the firm and today firms are making significant investment in KMS for initiating KM in their organizations. KM is a systematic and organizationally defined process of seeking, sharing, organizing and communicating knowledge of the organization so that the organization's employees may make use of it to be more productive in their work. Trust has a direct relationship with knowledge and could not occur without it [12, 7, 13, 14, 15]

Studies focusing on global software team performance point to the importance of KM in building trust, due to which, GSD organizations are making significant investment in implementing KMS in their organizations [12]. Information and communication technologies are considered as the best means towards implementing KM. Many tools have been designed that assist in KM process. These

days Knowledge Management Repositories (KMRs) are emerging as a powerful source of KM [12, 16, 18, 19, 20, 21, 22, 23].

Therefore, keeping in view the importance of KM and Trust for GSD based organizations; in this paper we will study the impact of KMR on building trust. KMR is an information technology tool that promotes knowledge sharing among GSD teams and it is one of the commonly used practices of KM as discussed in literature [16, 17, 18, 19, 20, 21, 22, 23].

In order to analyze the impact of KMR in the development of trust, in this paper we have chosen to conduct a controlled experiment in an academic settings. In our previous work we have presented a preliminary study [29] that was also carried out in academic settings, but only two groups were involved in that study. The results obtained from our preliminary study shows that KMS helps in building trust. In this paper we present an extended and improved study with the aim of examining the impact of KMS in the development of trust among GSD teams in greater detail. We have improved our preliminary study by: increasing the total samples and sample size, applying new data extraction criteria and synthesis techniques to evaluate our results in order to present useful information to both researchers and practitioners.

In the next section, we define the relationship between Knowledge Management and trust in the light of literature, and we elaborate on the importance of KM and trust in GSD projects. In section III, the project overview and research methodology are described. In section IV, we present the data collection and results. In section V, we present the finding and assessment of our data. Section VI discusses the limitations and future directions of our research and finally we conclude in section VII by summarizing the research work and providing the practical implications of our research.

II. RELATED WORK

Trust is considered as an important factor in the success of GSD projects, missing trust sometimes leads to the termination of further co-operation and relationships [24]. Lack of trust causes decrease in productivity, quality, information exchange and morale among the team members, and an increase in conflicts and delays. In addition, in a low trust environment employees prioritize individual goals over the group goals; they doubt negative feedback from the management and tend towards self protection [13]. Many studies suggest the use of KM tools and repositories for building trust; however we didn't find any empirical study in the literature that specifically analyzes the impact of these KM tools and repositories in the development of trust. In the following section we present a few of these studies.

An intra-organizational tool named "trusty" was designed in [8] that help the organization in communication, collaboration and knowledge management. The main goal of this tool is to increase trust among GSD teams. The study claims that this tool facilitates communication and cooperation among GSD team members by providing them with a knowledge exchange platform but no empirical validation have been conducted so far [8].

A survey was performed by NUS in 2007 in which more then 30 nations were involved and the results obtained from this survey point to an opportunity for governments from developing nations to use KM as a key driver towards increasing public sector productivity and building trust in government [25].

Developing trust in GSD settings is critical and includes several factors such as enabling a common repository and a common culture for knowledge sharing [26]. Knowledge sharing across geographically dispersed sites help in the development of trust, and KM provides an organized platform for knowledge sharing and acceptance and thus helps in the development of trust [15].

Sharing knowledge is important in building trust and improving the performance of GSD teams. Without effective sharing of knowledge projects might suffer from coordination problems leading to delay, conflicts and unsuccessful teamwork and effective sharing of knowledge is only possible in the presence of proper KMS [3].

III. RESEARCH METHODOLOGY

Research question addressed in this study is

Q: How KMR helps in the development of trust among GSD team members?

In order to study the impact of KMR in building trust, we have carried out a controlled experiment. The selected context of our experiment was an academic environment. We conducted our study with a sample of 32 students. These 32 students were divided into four groups each consisting of eight students, and these students belong to two different universities located in Pakistan and China. The reason for choosing the students from these two universities is due to the fact that the authors work at these universities. Therefore, it was easy to carry out experiment with these two universities instead of others, due to regulations and difficulties involved in obtaining permission. Moreover the variable of this choice were suitable for our experiment as we need two GSD teams where the cultural, linguistic and temporal difference is involved. These four groups of students were given a project of website development, the nature and complexity of the project was almost similar for all groups and the duration of project was three months for each group. All the students who participated in this experiment were the final year students of BS-computer science; hence the age and experience of students was almost same

Existing wiki software was used as KMR after making few modifications into it. The information that students consider to be important with respect to their remote colleagues were added in to this KMR so that they may know about their colleagues and to develop mutual understanding and trust. The few main features of this KMR are as follows

- It provides information about the remote students working on the same project, facilitates communication among team members.

- All the information about the group is accessible in an integrated way and only one click away. Every time you can get an overview of the outstanding, completed and current tasks, the last conversations, e-mails and documents, schedules and activities.

- It can be assured that the tasks are assigned and fulfilled on time and on budget. Shared documents have always the latest version, previous revisions and latest comments.

- This KM repository provides us with a space to collaborate and share projects, documents, messages, schedules, tasks and contacts within the group.

- This KM repository does not require any investment in network servers or staff. In order to work with this, all you need is a device with Internet connection and a browser. This significantly lowers the costs and technical requirements of your equipment.

- The patterns of using KM repository can be checked. It can also be observed which team member has used repository frequently and for which purpose because this KM repository maintains the information or logs of the user who has signed in, what information he/she has retrieved and when he/she has logged out. Hence in this way we can measure its usage.

- It provides a mechanism for information sharing in order to increase familiarity and develop friendship among students working as a team; consequently, the team members could trust each other. It is like a combination of groupware tool that supports communication.

- It provides a KM mechanism through which knowledge can be easily created, shared and accessed.

- It provides the facility of event creating and sharing to support useful coordination. These events include general work events, project events and personal events. Personal events promote informal communication and thus help in building trust.

During our experiment, the permission to use this KMR was given to only two groups of students and the other two groups of students were given the liberty that they can use any existing software for communication, e.g. MSN, Skype, email. etc., but not this KMR. We named these groups as G1, G2, G3 and G4. G1 and G2 were those groups who were using KMR while G3 and G4 was forbidden to use it. We did not make any recommendations to G1 and G2 about how to use the tools; we only requested that they limit their communication as much as possible to this KMR. The purpose of giving the permission of using KMR to only G1 and G2 was to empirically analyze the impact of KMR in the development of trust.

In order to measure trust four indicator/measures of trust namely (1) propensity to trust, (2) perceived trustworthiness, (3) cooperative behaviors, and (4) monitoring behaviors, were used based on prior deconstruction of team trust in literature [27]. We describe each measure briefly in turn

Propensity to trust (PTT)

It is a willingness of one or more persons in a group to trust other members of that group. PTT is affected by many factors like team culture, lifestyle, experience, education, etc. it's a general personality attribute that leads towards the general expectations about the credibility and trustworthiness of other persons which remains stable across many situations. The existence of this PTT is very important for the survival and efficient working of a team especially in case of GSD [4].

Perceived trustworthiness (PTW)

It refers to the extent to which an individual expect others to behave according to their commitments. It exists when the team members behave according to the expectations of their colleagues; they are loyal and honest with their team members and nobody takes advantage of others [4].

Cooperative behaviors (CB)

It refers to the environment in which team members work in collaboration, help others in difficult situations and share their experiences and knowledge. Cooperative behavior promotes trust and the team with cooperative behavior work efficiently towards a common goal [4].

Monitoring behavior (MB)

It refers to the extent to which team members monitor and check the actions of their team mates. Literature argues that monitoring is associated with lack of trust. This behavior decreases the efficiency and performance of the team so it should be avoided especially in GSD teams where there is a huge geographical distance involved and monitoring affects not only trust and performance of GSD teams but it also causes budget overrun[4].

Tested questions from prior studies were used to measure trust indicators in this study with the aim of enhancing the validity of the questionnaire items [27, 30, 31]. However, these questions were again checked by two independent subject matter experts. These experts evaluated these question items according to the criteria of understandability, length and redundancy. Few items were discarded because of redundancy and some more items were added, so finally after evaluation 21 items were selected. From these 21 items; 6 items were related to the propensity to trust, 6 items were related to the perceived trustworthiness, 6 items were related to the cooperative behavior and 3 items were related to the monitoring behaviors. From these four measures, the first three measures, propensity to trust, perceived trustworthiness and cooperative behavior have a positive impact on trust while monitoring behavior have negative impact on trust. Using these 21 items a questionnaire was prepared which is shown in appendix-A. Responses on the trust scales were given on a 5-point scaling ranging from 5= "strongly agree" to 1= "strongly disagree".

One month after the start of the projects, all the groups team members were asked to fill the questionnaire based

on their mutual understanding about their team mates. Strict confidentiality of their responses was ensured before giving them a questionnaire. Sixteen Chinese students (four from each groups) filled the questionnaire in the presence of first researcher while the students in Pakistani University were asked to email the questionnaire to the researcher within three days. Trust is a dynamic attribute which takes time in development and changes with the passage of time; in order to analyze the level of trust at different stages of the projects this questionnaire filling exercise was done three times by all groups of students, each with the gap of one month.

IV.   DATA COLLECTION AND RESULTS

With the help of questionnaire, we successfully collected data from each group about the level of trust existing between team members working as a group. In order to help the participants to understand questions, the questions were separated into different statements. There were 21 statements which attempted to capture the participant's position on the four measures of trust that are discussed above.

As a result of first questionnaire filling exercise, 32 questionnaires were received, 8 from each group. Further, questionnaires obtained from each group were compiled into a single questionnaire. In this way we have a total four questionnaires at the end of every stage, one for each group. These questionnaires were further aggregated into a single table by adding the values of corresponding items related to each measures of trust. The results obtained from all four groups during three stages of projects are shown in Tables 1-3

The usage of KMR was examined to determine that how KMR facilitated trust development between globally dispersed teams and enabled remote counterparts to share and integrate their knowledge. Figure1 shows us the overall usage of the KMR by two groups of students namely G1 and G2.

Now we discuss the students' use of KMR in detail. Both groups have accessed the following tools during their projects: email, chat postings, announcements, discussion forum postings, upload file, download file and a few others like reporting, and notes, etc., and a short description of each feature is provided. Email facility allows the students to send and receive an email to and from their team members; this feature was mostly used for communication by both the groups. Chat postings feature is used for live chat with team members, and it was observed that most students used the chat room for scheduled, synchronous discussions during their projects. Chat posting feature was used the greatest number of times by both student group. The announcements facility enabled students to post news and project-relevant information through this KMR. Students can choose to send an email alert when adding a new announcement and this feature was also used by both groups of students but not as frequently as chat postings and Email. This KMR had a discussion forum, designed to facilitate asynchronous communication. Although both teams used the discussion forums for project related activity, it is surprising that this forum was

not used more extensively, Group 1 team used this feature only 25 times during the three-month duration of the project while group 2 used this feature only 7 times and even they did not use it in the last month.

For this study, we examined the role of KMR in the development of trust among globally dispersed teams. In doing so, we conducted a controlled experiment to examine the impact of KMR in the development of trust. The empirical results revealed several important findings.

TABLE 1:
INITIAL STAGE INDIVIDUAL TRUST DEVELOPMENT VALUES

Groups	Propensity to trust	Perceived trustworthiness	Cooperative behavior	Monitoring behavior
G1	37	33	35	12
G2	34	33	32	10
G3	22	20	15	16
G4	20	18	19	13

TABLE 2:
2ND STAGE INDIVIDUAL TRUST DEVELOPMENT VALUES

Groups	Propensity to trust	Perceived trustworthiness	Cooperative behavior	Monitoring behavior
G1	39	37	41	10
G2	39	36	35	8
G3	27	23	20	15
G4	24	29	23	11

TABLE3:
3RD STAGE INDIVIDUAL TRUST DEVELOPMENT VALUES

Groups	Propensity to trust	Perceived trustworthiness	Cooperative behavior	Monitoring behavior
G1	40	42	42	9
G2	38	38	30	8
G3	23	24	22	12
G4	27	23	24	15

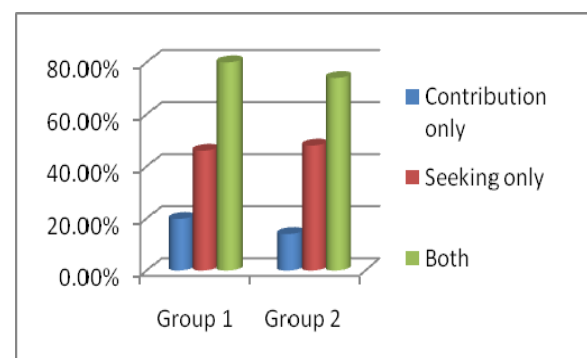Figure 1: KMR usage by G1 and G2

Case 1: Both groups are using KMR

As mentioned above we have developed a KMR and from four groups of students involved in this experiment two groups were requested to limit their communication as much as possible to this KMR. The usage of the KMR was analyzed on regular basis in order to analyze the role of KMR in building trust.

Table 4 shows us the overall usage of KMR by both Group 1 and Group 2. If we compare the values of Table 4, there is a fluctuation in the values of each feature for Group1 and Group 2, but still if we aggregate the overall usage of KMR we can see that Group 1 used KMR a bit more than Group 2 and the same fluctuation we can see in the trust level of both teams as shown in Figure 2 and figure 3.

Case 2: Both Groups are not using KMR

The purpose of this experiment was to analyze the role of KMR in the development of trust. In doing so, we requested Group 1 and group 2 team members to limit their maximum communication to this KMR; on the other hand we did not recommend any communication tool for Group 3 and Group 4 and gave them the liberty that they can use any communication tool except this KMR. All four groups involved in this experiment had to complete a web development project in three months and all these groups filled the questionnaire three times during the duration of their projects. Figure4 and 5 show us the level of trust for both Group3 and Group 4 who were not using KMR

If we compare the trust level of those groups who were using KMR with that of those Groups who were not using KMR it is clear from Figures 2-3 and Figure 4-5 that there is a clear difference in the trust level of those groups who were using KMR as compared to those Groups who were not using it. The results show that KMR if implemented and used properly in GSD projects helps in building and maintaining trust among team members. We would like to further add that the role of top management and leader is important in order to appreciate and involve the team members to use KMR. In case of this experiment, 1st researcher played the leadership role by requesting the Group 1 and Group2 development teams to limit their maximum communication to this KMR, and she maintained the record of KMR usage during the overall duration of the projects.
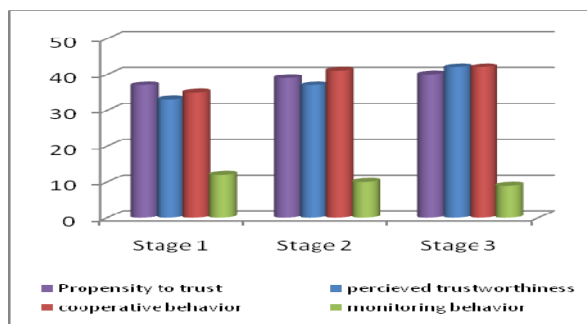
TABLE4:
Summary of KMR usage by G1 and G2

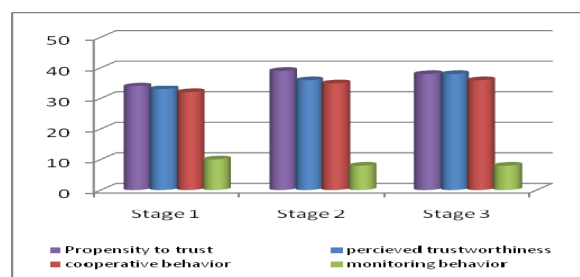| Groups	KMR features	E-mail	Chat-postings	Announcements	Discussion forum postings	File uploaded	File Downloaded	Others
G1	1st Month	330	711	58	11	12	7	32
	2nd Month	383	798	39	6	8	13	19
	3rd Month	422	670	24	8	14	16	18
G2	1st Month	380	980	62	4	17	12	16
	2nd Month	180	672	32	3	12	14	19
	3rd Month	78	764	26	0	8	6	12

Figure3: Trust development values for group2 during three stages of the project
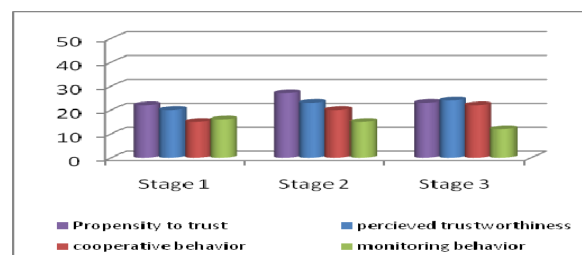

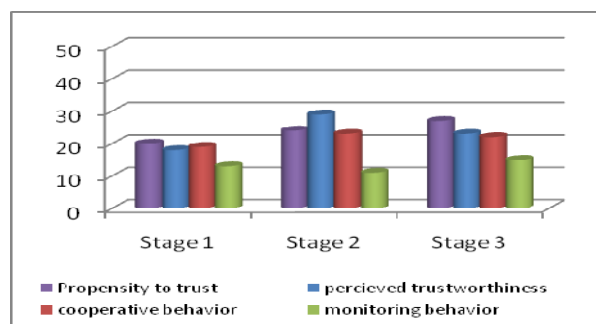Figure4: Trust development values for Group3 during three stages of the project

Figure5: Trust development values for Group4 during three stages of the project

Figure2: Trust development values for group1 during three stages of the project

V. ANALYSIS OF RESULTS

In this section we will discuss the four indicators of trust individually to analyze the results in order to understand the impact of KMR on building and sustenance of trust in GSD organizational settings.

Propensity to Trust (PTT)

Propensity to trust is the expectation of an individual or group that another individual can be relied upon. It varies from person to person with several socioeconomic factors like different life experiences, personality types, cultural backgrounds, etc. contributing to the development of this PTT [27]. In this experiment we tried to eliminate the external factors affect to some extent by taking the samples belonging to same age group, experience and education although the difference of culture and language was involved which cannot be separated in GSD setting. The results obtained from our experiment shows that the team who was using KMR posses much PTT towards their team members in contrast to those teams who are not using KMR. Figure 6 shows us the difference of PTT between 4 groups of students who were involved in this experiment from which two groups namely G1 and G2 were using KMR while the other two groups were not using it.

In Figure 6, three stages of the projects are shown along x-axis from stage 1 to 3 and the level of PTT for all groups of students who were working as GSD teams is shown along y-axis. If we compare the level of PTT for G1 and G2, although there is a slight difference in this measure of trust for both teams which may be due to some external factors or the usage of KMR, G1 and G2 still have higher PTT as compared to G3 and G4. The results indicate that KMS helps in promoting trust among GSD team members.

In Figure 6, the level of PTT for G1 is increasing gradually with the passage of time, while in G2 there is a slight decrement in the level of PTT between stage 2 and stage 3 which is almost negligible. On the other hand, if we look at the results of G3 the level of PTT increases from 22 to 27 from stage 1 to stage 2 which was a good positive change, but in contrast to that it decreased in stage 3 from 27 to 23 which was surprising and it shows us that trust is a dynamic attribute and there must be some process in the organization in order to sustain the level of trust among GSD teams.
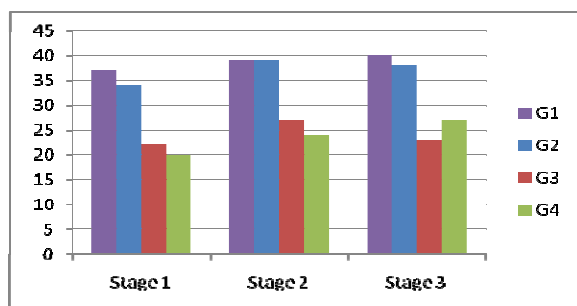

Figure6: level of PTT of four Groups during three stages of the projects

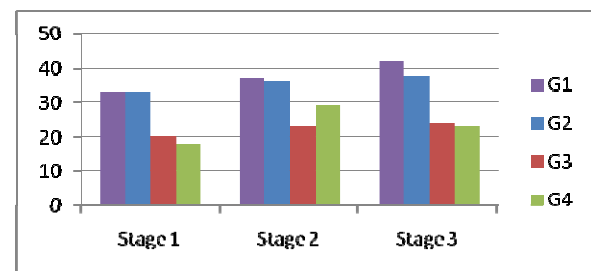### Perceived Trustworthiness (PTW)

Figure7: Level of PTW of four groups during three stages of the projects

Perceived trustworthiness is the expectation of a person or a group towards other persons that they will behave according to his expectation. Three approaches are suggested in [28] upon which trustworthiness of an individual or group can be determined; that is, it is the belief that another person or group (1) is honest in his commitments (2) makes good efforts to behave according to his commitments (3) does not take advantage of the available opportunity. We tried to access the PTW between teams through these dimensions by using the questionnaire statements. The results obtained from the four groups of students are shown in Figure7

In Figure7, three stages of the projects are shown along x-axis and the value of PTW is shown along y-axis. If we compare the value of PTW for G1 and G2 who were using KMR with that of G3 and G4 who were not using KMR, it is clear that the level of PTW is high in G1 and G2 as compared to other two groups. On the other hand, if we look at the behavior of the graph, the value of PTW is increasing gradually for G1, G2 and G3 but the results of G4 are different. Initially the level of PTW for G4 increased from 18 to 29 which was a sign of good positive change, while in contrast to that it declined in stage 3 from 29 to 23.

Cooperative behavior (CB)

Cooperative behavior corresponds to a number of positive actions that include reliance on other team members, accepting the influence of others, communication openness, information sharing and the spirit of cooperation [27]. This behavior promotes teamwork and the atmosphere of trust within the team. We measured this behavior within all groups of students by using 6-iteams related to this behavior in the questionnaire. The results of CB obtained from all groups of students during three stages of the projects are shown in Figure8
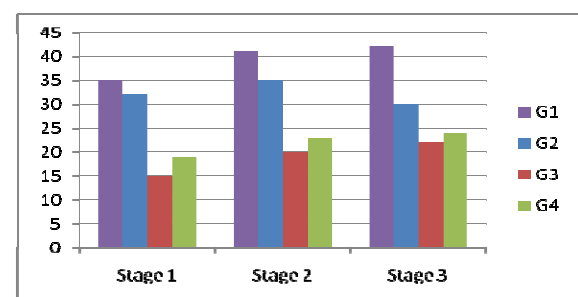

Figure8: Level of CB of four Groups during three stages of the projects

The results obtained from Figure 8 also show that the groups who were using KMR posses high CB as compared to the groups who were not using it. However, the behavior of the graph for group 2 is different from others. Initially the level of CB increased for G2 from stage 1 to stage 2 but at the end of the project when the final questionnaire filling exercise was conducted the value of CB decreased from 35 to 30 which was surprising. The reason of this behavior was asked from the students after the end of the projects when we conducted an open-ended interview which will be discussed later on.

Monitoring behavior (MB)

Monitoring is often considered as a negative behavior as it leads the team members towards protecting their personal interest rather than accomplishing team goals. The teams with high level of trust engage less in monitoring behaviors and spend their efforts in practical dimensions [27]. This behavior is reversely related with trust; we tried to measure the existence of this behavior within the four groups of students involved in our experiment. The results of MB are shown in Figure9

Figure 9 shows that monitoring behavior is low in G1 and G2 as compared to G3 and G4. The above three measures, namely PTT, PTW and CB, are positively related wit trust while MB has a negative impact on trust. The results of Figure6 to Figure8 show us that the values of PTT, PTW and CB are comparatively high within those Group members who were using KMR as compared to the Groups who were not using it. The results of figure 9 further support our previous results, as we can see in figure 9 that the level of MB is low in G1 and G2 as compared to G3 and G4.

We further validated our results by conducting an open-ended discussion at the end of the projects with all the students who participated in this experiment in order to know the reasons of this behavior. The response obtained from this discussion can be summarized as follows: KMR is an easy to use tool which not only helps in KM rather it also provides a platform for communication & collaboration and promotes informal communication which helps in the development of trust among GSD teams. The students also emphasized the importance of leadership and management as they said that if they were not encouraged and asked by the first researcher to limit their conversation to this KMR and use it for their maximum communication it was really difficult for them to get benefits from it.

Group 2 team members were asked about the declining trend of CB from stage 2 to stage 3. They said that at the end of the project they lost their interest in the use of KMR and they preferred to work individually in order to complete their project timely. This behavior is also shown in Table 4, which shows the usage of KMR by both groups G1 and G2. The response of G3 and G4 team members was that the existence of some process is necessary in the development of trust; otherwise, it is really difficult to trust the strangers. Moreover, G3 and G4 also said that conflicts and change management is difficult to handle in GSD settings, especially in the absence of a
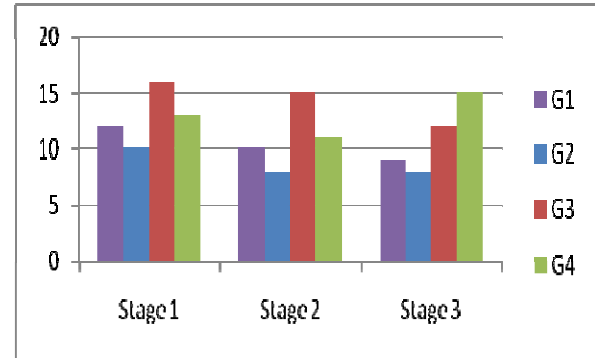

Figure9: Level of MB of four groups during three stages of the projects

project management software and common communication platform.

VI.   LIMITATION AND FUTURE RESEARCH

Several limitations of the study should be noted. First, it was a controlled experiment and all data was collected from four groups of students, which represent relatively homogeneous samples. Replicating this research in real GSD organizational settings could strengthen the external validity of our research findings. Second, this study only focuses on the role of KMR in building and sustaining trust within GSD teams, trust in leadership and trust in artifacts (i.e., the trustworthiness of the KMR itself) also may be meaningful to the user's intention to use KMR for knowledge seeking and contribution.

We used only four indicators to measure trust; future research can command a broad prospect of trust indicators. Future research should focus on how trust can be affected by various social and organizational dynamics of knowledge seeking and acceptance behavior through KMR. Finally, there is a need to implement this KMR in real GSD organization and to study the impact of this KMR on trust by using the same 21-items measures of trust.

VII.   CONCLUSION

To conclude, trust is considered as an important mechanism to improve performance and effectiveness of GSD teams. The 21-item measures indicated in this study provides an insight to the organization about the level of trust existing among the team members. Moreover, some major results obtained from the study shows that there must be a knowledge management and sharing mechanism like the KMR in this experiment. This KMR helps the teams in building and maintaining trust by providing them with a platform for communication and discussion. KMR if implemented and used properly helps the team members in resolving conflicts, propagating the changes among teams and maintaining informal communication. The practical implication of the study is that management can use KMR in order to manage the knowledge of the organization which is really a valuable asset of the organizations. Implementation and use of this KMR will help in the development of trusting working relationship within the organization, in this way; the employees will focus their attentions in achieving the shared goals of the organ-

ization rather than individual goals and objectives. Furthermore, the managers can recognize the presence or absence of trust through these measures, and can take proper measures if necessary in order to create or sustain trust.

REFERENCES

[1] Damian, D., & Moitra, D. (2006). Global Software Development: How Far Have We Come? *IEEE software, 23*(5), 17-19.

[2] John. Noll, Saarah. Beecham and Ita. Richardson. Global Software Development and Collaboration: Barriers and Solutions. 2010. ACM Inroads, pp.66-78.

[3] Julia. Kotlarsky, Ilan. Oshri. Social ties, knowledge sharing and successful collaboration in globally distributed system development projects. European Journal of Information Systems (2005) 14, 37–48.

[4] Roger C. Mayer and James H. Davis and David. Schoorman. An integrative model of organizational trust. Academy of Management Review, 20(3). 1995, pp. 709–734.

[5] Ani, Al. Ban, Wilensky. H, Redmiles. D,Simmons. E. An Understanding of the Role of Trust in Knowledge Seeking and Acceptance Practices in Distributed Development Teams. . *ICGSE'11.* 2011, pp. 25-34.

[6] Sami. Haq. Mushtaq. Raza, Asraf. Zia and Ahmed. Khan. Issues in Global Software Development: A Critical Review, *J. Software Engineering & Applications,* 2011, 4, pp. 590-595.

[7] Paivi. Parviainen, Maarit. Tihinen. Knowledge-related challenges and solutions in GSD. *Expert Systems a Journal of Knowledge Engineering.* 2011.

[8] Gabriela. Aranda, Aurora. Vizcaíno, José. Luís-Hernández ,Ramón. Palacio and Alberto. Morán. Trusty: A Tool to Improve Communication and Collaboration in DSD. A.S. Vivacqua, C. Gutwin, and M.R.S. Borges (Eds.): CRIWG 2011, LNCS 6969, pp. 224–231.

[9] Casey. Valentine. Developing Trust in Virtual Software Development Teams. *Journal of Theoretical and applied commerce Research.*2010, 5(2), pp.41-58.

[10] Samireh. Jalali, Cigdem. Gencel and Darja. Smite. Trust Dynamics in Global Software Engineering. *ESEM'10, September 2010,* pp. 16-17 Bolzano-Bozen, Italy.

[11] Yuen, Hui. Yum. Overview of the knowledge management in the public sector. 7th Global Forum on Reinventing Government: Building Trust in Government Workshop on managing Knowledge to Build Trust in Government.2008.

[12] Hahn, J., & Subramani, M. R. (2000). A framework of knowledge management systems: issues and challenges for theory and practice. (W. J. Orlikowski, P. W. S Ang, H. C. Krcmar, & J. I. DeGross, Eds.)*Idea,* (1999), 302-312. Association for Information Systems.

[13] Nils. Brede and Darja. Smite. Understanding a Lack of Trust in Global Software Teams: A Multiple-case Study. 2008. *Softw. Process Improve. Pract.* 2008, 13(3), pp. 217–231.

[14] Fares. Anwar, Rozilawati. Razali and Ahmad. Kamsuriah. Achieving Effective Communication during requirements Elicitation - A Conceptual Framework. *ICSECS* .2011. Part III, CCIS 181, pp. 600–610.

[15] Julia. Kotlarsky, Paul c. van Fenema and Lesle P. willcocks. Developing a knowledge-based perspective on coordination; the case of global software projects; information and management 45.2008, pp. 96-108.

[16] Muneera. Bano & Naveed. Ikram. KM-SORE: Knowledge Management for Service Oriented Requirements Engineering. Copyright (c) IARIA, 2011.

[17] V. Clerc. Towards Architectural Knowledge Management Practices for Global Software Development. *Third ICSE Workshop on Sharing and reusing architectural Knowledge (SHARK'08), Leipzig, Germany.2008*, pp. 23-28.

[18] Daniela. Damian and Didar. Zowghi. Requirements Engineering challenges in multi-site software development organizations. *Requirements Engineering Journal, 8.*2003, pp. 149-160.

[19] Christof. Ebert and Philip. DeNeve. Surviving Global Software Development. *IEEE Software*, 18(2) .2001, pp. 62-69.

[20] Clerc. Viktor, Lago. Patricia and Vliet. Hans. The Usefulness of Architectural Knowledge Management Practices in GSD. Fourth *IEEE International Conference on Global Software Engineering.*2009, pp. 73-82.

[21] Nguyen. Tracey, Smyth. Robert & Gable. Guy. Knowledge Management Issues and Practices: A Case Study of a Professional services Firm. Fifteenth Australian conference on information system. 2004.

[22] ur. Ali, Sarah. Beechman and Mistrik. Ivan. Architectural Knowledge Management in Global Software Development: A Review. *International Conference on Global Software Engineering* .2010, pp.347-352.

[23] Sarah. Beechman, John. Noll, Ita. Richardson and Nour. Ali. Crafting a Global Teaming Model for Architectural Knowledge. *International Conference on Global Software Engineering* .2010, pp.55-63.

[24] Darja. Smite, Nils Brede. Moe and Richard Torkard. Pitfalls in Remote Team Coordination: Lessons Learned from a Case Study. Lecture Note in computer Science, 2008, volume 5089/2008, pp. 345–359.

[25] Yuen, Hui. Yum. Overview of the knowledge management in the public sector. *7th Global Forum on Reinventing Government*: *Building Trust in Government Workshop on managing Knowledge to Build Trust in Government.*2008.

[26] Ángel. García-Crespo, Ricardo. Colomo-Palacios, Pedro. Soto-Acosta and Marcos. Ruano-Mayoral. Qualitative Study of Hard Decision Making in Managing Global Software Development Teams, Information Systems Management.2010, 27:3, pp. 247-252.

[27] Ana Cristina. Costa and Neil. Anderson. Measuring trust in teams: Development and validation of a multifaceted measure of formative and reflective indicators of team trust. European Journal of Work and Organizational Psychology. 20(1). 2001, pp. 119-154.

[28] Cummings, L. L., & Bromiley, P. (1996). The Organizational Trust Inventory (OTI): Development and validation. In R. M. Kramer, & T. R. Tyler (Eds.), Trust in organizations: Frontiers of theory and research. (pp. 302–330). Thousand Oaks, CA: Sage.

[29] Mamoona Humayun, Cui Gang. An Empirical Study on Improving Trust among GSD Teams Using KMR. SEKE 2012: 131-134

[30] Graham Dietz. Measuring trust inside organizations. Emerald journal Vol. 35 No. 5, 2006. The current issue and full text archive of this journal is available at www.emeraldinsight.com/0048-3486.htm

[31] Hupcey J.E., Enrod J., Morse J.M. & Mitcham C. An exploration and advancement of the concept of trust. (2001) Journal of Advanced Nursing 36(2), 282±293

APPENDIX-A

Final 21-Item measure of trust

Propensity to trust

- People usually tell the truth, even in difficult situations.
- Everyone in this team is truly concerned about the problems of others.
- In this team most people stand behind their convictions.
- In this team most people speak out for what they believe in.
- Most people in this team do not hesitate to help a needy person.
- Most people will act as a good governor if given the opportunity.

Perceived trustworthiness

- We are fully confident about the abilities of each others to perform tasks.
- In this team people will means what they say.
- There are no hidden policies in this team.
- People in this team always try to fulfill their commitments.
- In this team everyone look for other's interests honestly.
- Every team member is fully reliable.

Cooperative behavior

- There exists a climate of cooperation among team.
- In this team issues and problems are discussed openly.
- In this team opinion of everyone is considered while taking some important decision.
- Most people in this team are open to help and advice others.
- In this team people discuss themselves.
- Most people help others in their personal matters.

Monitoring behavior

- In this team people check whether everybody fulfils their responsibility.
- In this team people check whether others keep their promises.
- In this team most people tend to keep each other's work under observations.

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