Ontology Rule based retrieval of Knowledge sharing and Trust behavior: An Global Software Development Perspective.

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***Abstract*—Global software development (GSD) is originally an outsourcing technique the development take place globally the offshore and on-site software teams participates their development effort with different time zone and language and culture. The main aim of this paper is to study the impact of offshore and onsite teams knowledge sharing and trust behavior in the overall outcome of GSD project. The objective of this paper is to measure the various factors that contribute to the knowledge sharing and trust among offshore/on-site development teams towards the outcome of GSD. In this paper, we are trying to evaluate the impact of offshore/on-site teams knowledge sharing and trust behavior on the overall process of GSD via ontology retrieval system by creating knowledge sharing and trust ontology. We have been formulated set of hypothesis to test the behavior of knowledge sharing and trust among offshore and onsite teams in GSD based on the data from literature studies [15,16,17,18]. In the result, we found out offshore/on-site teams trust, and knowledge sharing is positive impact in overall process of GSD.**

Keywords - Global software development, offshore, onsite, knowledge sharing, trust, and ontology retrieval.

I. INTRODUCTION

Global software development is one of the key areas in software development these days. Nowadays software is being developed at a multi-site environment due to various reasons that is reducing cost, time etc. The various factors that contribute to global software development, but in this paper, we are mainly focusing on knowledge sharing and trust behavior of offshore and onsite team via ontology based retrieval system. In GSD, two teams on-site and offshore teams might share various types of information like customer requirements, customer expectation in addition to sharing of code and documentation about the software that is being developed. The sharing the knowledge between offshore and onsite team is necessary in order to develop a product in distributed environment. GSD involves virtual team strategy knowledge sharing, trust between offshore and on-site teams are key determinant towards outcome of a GSD project.[16] In our earlier work [16] trust is positively associated with the behavior of knowledge sharing among development team. Therefore, we classified knowledge sharing and trust as the two most important factors in the GSD based on previous literature studies. The focus is to analyze the impact of knowledge sharing and trust behavior in offshore software development outsourcing environment. In our paper representing knowledge sharing and trust ontology towards the outcome of GSD project.

II. MOTIVATION

The previous study [16] mentioned the importance of knowledge sharing and trust between offshore and on-site teams in offshore software development environment. Many studies have mentioned that trust is often one of the key determinants for successful knowledge sharing. Establishing trust among development teams is not easy, particularly in the virtual software team environment. Trust has to be actively facilitated, fostered and developed. [5] Therefore, we identified knowledge sharing and trust as the two most important factors in the GSD. The knowledge sharing, trust ontology and rule based retrieval have been implemented via the protégé editor and then comparing the various factors affecting these, two stages of GSD.

III. LITERATURE SURVEY

Construct	Referential Source	View point	Research Gap
GSD	Arun Kumar et al., (2012)	This paper describes a research-in-progress project that aims to provide an understanding of the critical success factors of offshore software development projects.	Factors that is critical for the successful development of a software.
	Arun Kumar et al., (2012)	This study develops a research model to assess and classify existing literature and addresses the factors that affect the project outcome in the context of GSD projects.	Knowledge sharing and trust towards the GSD project outcome /success.
Knowledge Sharing	Sulayman et al., (2010)	This investigation presents Annals of Knowledge Sharing in Distributed Software Development Environments.	Knowledge sharing within a team and among all team have different ways to influence the project.
	Arun Kumar et al., (2012)	This paper use case studies and shows how knowledge play effective role in developing better trust environment.	Knowledge sharing produce best result when trust with in team is good enough to transfer knowledge.
Trust	Valentine et al., (2010)	Impact of distance on the trust building between the virtual software developing teams.	How trust between onsite and offshore teams are affected by the distance between them.
	Arun Kumar et al., (2012), Ban Al-Ani et al., (2011)	This study provides a substantial understanding of knowledge-seeking practices, knowledge acceptance needs, and the role trust plays in these practices and needs.	The role of trust in knowledge sharing practices between global software development teams.

TABLE-1: OPERATIONAL CONSTRUCTS AND ITS REFERENTIAL SOURCES

IV. OVERVIEW OF PROPOSED APPRACH

1. To identify various factors that affecting the process of GSD through literature studies.
2. Based on previous studies we created trust and knowledge sharing ontology.
3. Based on the ontology we created several functions that are used for relating various fields in the ontology to one another.
4. We performed ontology retrieval based on certain inference rules to represent the quantities present in the knowledge sharing and trust ontology.
5. We created set of hypotheses for checking our findings and represented them using the inference rules.
6. To prove the hypotheses based on the collected data from earlier studies.

In this paper, we have implemented following classes shown in fig.1 to represent the knowledge sharing and trust ontology and rule based retrieval based on GSD perspective.

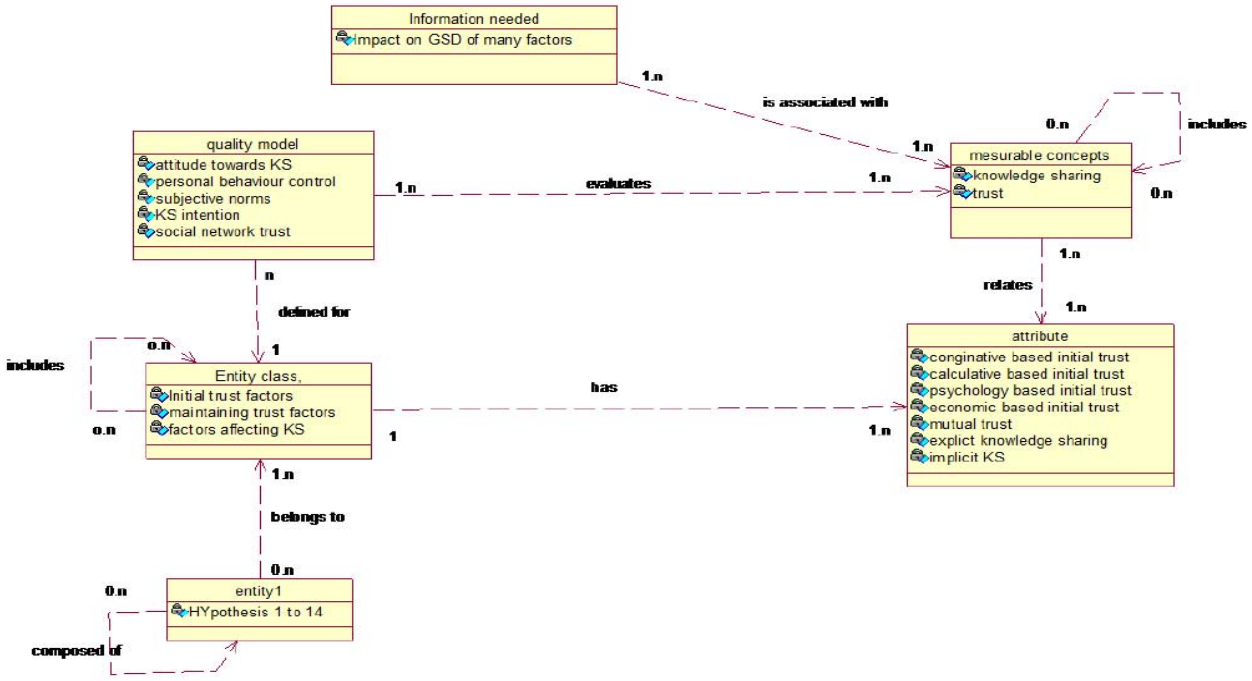

Fig 1:Class diagram of proposed approach

V. ONTOLOGY REPRESENTATION

To analyze the behavior of knowledge sharing and trust we identified factors that affect GSD project outcome either directly or indirectly. The factors are affecting the knowledge sharing and trust between offshore and on-site teams towards the GSD project outcome represented via ontology. We developed this ontology in protégé OWL editor. The ontology structure is shown in fig.2.

VI. INFERENCE RULES

Based on the ontology structure, we created certain hypotheses and represented them into Boolean form by drafting three inference rules. These rules were:

(i)	Rule for positive effect: MO(x)^mutual complement(x,y)=>MO(Y)
(ii)	Rule for mediating: MO(y)^partial complement(x,y)=>MO(Y)
(iii)	Rule for improving MO(x)^inherited(x,y)=>MO(y)

x and y are the quantities that are being compared and whose impact on each other is being measured. We created above inference rules keeping in mind that there are only these ways that a quantity can be related with another quantity and those t- test values are are:

1. It can have a positive effect i.e., when one quantity increases other also increases.
2. It can help in improving another quantity.
3. It can indirectly help in improving another quantity i.e., mediating effect;
4. Two quantities are unrelated i.e., they have no effect on each other

Fig 2: Ontology structure

While drafting our hypotheses we did not consider the fourth possibility separately as the quantities are not among the first three relations they are unrelated and need not be considered. For proving below hypotheses we used the fact that if the result obtained is greater than 0.82 then the hypotheses is true else it is false.

We created following hypotheses for relating the factors listed in ontology structure.

1. The degree of knowledge sharing(K) among offshore and onsite teams will have a positive effect on GSD project outcome(O).

   MO(K)^mutual complement(K,O)=>MO(O)

   a) The degree of implicit knowledge sharing(IK) among offshore and onsite teams will have a positive impact on outsourcing success(O).

b) The degree of explicit knowledge sharing(EK) among offshore and onsite teams will have a positive impact on outsourcing success(O).

2. The relation between the degree of knowledge sharing(K) and GSD project outcome(O) is mediated by the quality of the partnership among offshore and onsite teams.

MO(K)^partial complement(K,O)=>MO(O)

a) The relation between the degree of implicit knowledge sharing (IK) and GSD project outcome (O) is mediated by the quality of the partnership among offshore and onsite teams.
b) The relation between the degree of explicit knowledge sharing(EK) and GSD project outcome (O) is mediated by the quality of the partnership among offshore and onsite teams.

3. Interpersonal trust (IS) of team will have a positive impact on offshore/onsite teams performance (TP).

MO(IS)^inherited(IS,TP)=>MO(TP)

4. Interpersonal trust (IS) of offshore/onsite teams will have a positive impact on the behavior of knowledge sharing (K).

MO(IS)^inherited(IS,K)=>MO(K)

a) Interpersonal trust (IS) of offshore/onsite teams will have a impact on sharing willingness (SW).
b) Interpersonal trust (IS) of offshore/onsite team will help to improve sharing ability (SA).
c) Interpersonal trust (IS) of offshore/onsite team will help to improve sharing environment (SE).

5. Knowledge sharing (K) will have a impact on offshore/onsite team performance (TP).

MO(K)^inherited(K,TP)=>MO(TP)

a) Sharing willingness (SW) will help to improve offshore/onsite teams performance (TP).
b) Sharing ability (SA) will help to improve offshore/onsite teams performance (TP)
c) Sharing environment (SE) will help to improve offshore/onsite team performance (TP).

6. Knowledge sharing (K) will help strengthen the impact of trust (IS) on offshore/onsite teams performance (TP).

MO(K^IS)^inherited(K^IS,TP)=>MO(TP)

a) Sharing willingness (SW) will help strengthen the impact of trust (IS) on offshore/onsite team performance (TP).
b) Sharing ability (SA) will help strengthen the impact of trust (IS) on offshore/onsite team performance (TP).
c) Sharing environment (SE) will help strengthen the impact of trust (IS) on offshore/onsite team performance (TP)

7. Knowledge sharing intention (KI) positively influences online knowledge sharing behavior (KB)

MO(KI)^mutual complement(KI,KB)=>MO(KB)

8. Subjective norm (SN) positively influences knowledge sharing intention (KI).

MO(SN)^mutual complement(SN,KI)=>MO(KI)

9. Participants' attitude (A) toward online knowledge sharing positively influences knowledge sharing intention (KI).

MO(A)^mutual complement(A,KI)=>MO(KI)

a) Knowledge creation (KC) self-efficacy positively influences knowledge sharing intention (KI).

MO(KC)^mutual complement(KC,KI)=>MO(KI)

10. Knowledge creation (KC) self-efficacy positively influences knowledge sharing behavior (KB).

MO(KC)^mutual complement(KC,KB)=>MO(KB)

11. Web-specific self-efficacy (E) positively influences knowledge sharing intention (KI).

MO(E)^mutual complement(E,KI)=>MO(KI)

a) Web-specific self-efficacy (E) positively influences knowledge sharing behavior (KB).

MO(E)^mutual complement(E,KB)=>MO(KB)

12. Social network ties (ST) positively influence knowledge sharing intention (KI).

MO(ST)^mutual complement(SE,KI)=>MO(KI)

VII. DISCUSSION

According to the standard LISREL methodology [19] the threshold value for reliability is taken as standard 0.82 Cronbach's alpha value. In our work we are also, follow same method that we are calculating reliability for the factors listed and then based on those values, we are calculating cronbach alpha factor for each hypotheses. If this value is greater than 0.82 than that hypotheses is true else false.

Hypotheses	Value for quantity 1	Value for quantity 2	Result obtained	Inference
MO(K)∧mutual complement(K,O)⇒ MO(O)	0.95	0.98	0.97	True
MO(K)∧partial complement(K,O)⇒ MO(O)	0.95	0.728	0.87	True
MO(IS)∧inherited(IS,TP)⇒MO(TP)	0.94	0.807	0.88	True
MO(IS)∧inherited(IS,K)⇒MO(K)	0.94	0.95	0.93	True
MO(K)∧inherited(K,TP)⇒MO(TP)	0.95	0.69	0.81	False
MO(K∧IS)∧inherited(K∧IS,TP)⇒MO(TP)	0.93	0.69	0.80	False
MO(KI)∧mutual complement(KI,KB)⇒ MO(KB)	0.87	0.86	0.84	True
MO(SN)∧mutual complement(SN,KI)⇒ MO(KI)	0.77	0.87	0.82	True
MO(A)∧mutual complement(A,KI)⇒ MO(KI)	0.96	0.87	0.90	True
MO(KC)∧mutual complement(KC,KI)⇒ MO(KI)	0.85	0.87	0.85	True
MO(KC)∧mutual complement(KC,KB)⇒ MO(KB)	0.85	0.86	0.84	True
MO(E)∧mutual complement(E,KI)⇒ MO(KI)	0.987	0.87	0.89	True
MO(E)∧mutual complement(E,KB)⇒ MO(KB)	0.987	0.86	0.89	True
MO(ST)∧mutual complement(SE,KI)⇒ MO(KI)	0.74	0.87	0.81	false

TABLE-2: HYPOTHESIS AND ITS INFERENCES

As we mentioned hypothesis and its inferences in table-2 the knowledge sharing and outsourcing success partially depends on each other that is the value of outsourcing success does not depends on the degree of outsourcing after a particular point. In other case inter personal trust and team performance; these two parameters are inherited from

each other and closely dependent. So while working in a team atmosphere if the value of trust increases then there is a corresponding increase in value of team performance also and vice versa. Therefore, from this we can conclude that if team performance improves if there is more trust among the team members. However, knowledge sharing is independent of interpersonal trust and team performance and has almost no effect on these two factors. Similarly, knowledge sharing behavior versus knowledge sharing intention, subjective norms versus knowledge sharing intention, attitude versus knowledge sharing intention, knowledge creation versus knowledge sharing intention, knowledge creation versus knowledge sharing behavior ,web specific self efficacy versus knowledge sharing intention has positive effect on each other which is similarly the relation between knowledge sharing and outsourcing success.

Following is a sample code for the parameter attitude that we used to represent the ontology :-

```
<rdfs:subClassOf>
    <owl:Class rdf:about="#model2"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:about="#Attitude_(ATT)">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >Construct Measure
Attitude Toward Knowledge Sharing
ATT1 Members of offshore/on-site in GSD share the vision of helping others to solove their professional problem towards the outcome of the project.
ATT2 Members of offshore/on-site in GSD share the same goal of learning from each other.
ATT3  The knowledge shared by offshore/on-site members in the GSD is complete.
ATT4  The knowledge shared by offshore/on-site members in the GSD is accurate.
Subjective Norm</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#model2"/>
  </rdfs:subClassOf>
 </owl:Class>
```

Code similar to above is written for all other properties that are included in our ontology rule based retrival of knowledge sharing and trust behavior of offshore and onsite teams.

VIII. RESULTS AND CONCLUSION

We tested our hypotheses by using the data that we collected from various verified sources.[16,17,18] As a result we found that following factors are affected among offshore/onsite teams knowledge sharing and trust behavior to

have a positive impact in overall process of GSD. The factors are 1) Outsourcing success 2) Partnership quality 3) Interpersonal trust 4) Sharing willingness 5) Sharing environment 6) Sharing ability 7) Sharing behavior 8) Subjective norms 9) Knowledge sharing intention 10) Knowledge sharing self-efficacy. As we observed that above factors positively affected by the behavior of knowledge sharing and trust between the teams working together i.e. onsite team and offshore team on GSD projects. Apart from above said factors there are other factors also that affect the trust and knowledge sharing in GSD but we have not included in our studies because real time data was not available and some of the constructs that cannot be measured based on a specific scale. We have tried to adhere to only one scale for data collection and tried to include verified data from reliable sources used for our analysis.

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