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KNOWLEDGE INTEGRATION USING A COGNITIVE PSYCHOLOGICAL MODEL AS A KNOWLEDGE MANAGEMENT STRATEGY

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ABSTRACT

The difficulty in knowledge integration lies in the methodology of integration of knowledge between the various knowledge holders and brokers. Each knowledge holder is incomplete in one self and thus can become a major weakness in achieving a higher knowledge level. An integrated approach is the best practice of knowledge management system. Integration is viewed in terms of horizontal and vertical dimensions. The study presents the possibility of knowledge sharing and integration between experts in a multilevel multi criteria scenario using a cognitive psychological model of knowledge discovery called Johari Window model for knowledge sharing. The advantage of this model is that it takes the problem of 'the fourth quadrant', into its account where very large totally unexplored unpredicted outliers lie. It also brings a participatory approach to the knowledge management. For the implementation of the model, star, random, and complete knowledge network topologies were considered. The models have been evaluated using a social network analysis tool ORA. Among the three topologies of knowledge networks, for implementing the Johari model, the complete topology of knowledge network has been proved to be the best model in a knowledge sharing scenario for an efficient knowledge management strategy.

KEYWORDS: Johari Window, Knowledge Integration, Knowledge Pool, Knowledge Channel, Knowledge Networks

INTRODUCTION

Effective management of knowledge in an organizational setup depends the models used for knowledge creation [1] and sharing. Knowledge elicitation and sharing among the knowledge holders in knowledge management system is one of the key issues. Knowledge on a domain is either experiential gained by interaction with the situation in a particular location or experimental gained by scientific experiments performed in the situation. Experiential knowledge mostly remains tacit in nature. Purposeful sharing and integration only can transform a tacit knowledge into an explicit knowledge. Indigenous knowledge is mostly experiential or tacit, knowledge gained out of constant familiarity with the reality. Scientific knowledge is mostly experimental, knowledge gained out of rigorous study based on a proposed theory and experimenting with prototypes. The best method for knowledge management in real life situations is to combine the experiential and experimental knowledge. Knowledge elicitation and sharing among the stakeholders in natural resource management system is one of the key issues. Knowledge on natural resource is either experiential gained by using the natural resource in a particular location or experimental gained by scientific experiments performed on the natural resource. Experiential is a bottom up approach because the subject uses a natural resource and gains knowledge of it in the process of using it. Experimental takes a top down approach. Based on a proposition, one tries to fit the natural resource into that framework of the proposition. Rekha Singhal [2] states that Indigenous refers to knowledge and practices that have originated locally and are performed by a community or society in a specific place. This knowledge evolves and emerges continually over time according to people's perception and experience of their environment and is usually transmitted from generation to generation by word of mouth or by practice. In contrast, scientific forestry utilizes specialized knowledge for managing forest resources not only for local populations but also for wider objectives and the global scientific forestry community. Scientific knowledge on forest management is generally shared in formal, written, and non-traditional ways.

The best method for natural resource management is to combine the experiential and experimental knowledge. Rahman [3] has enumerated some distinctions between traditional and scientific knowledge systems and has attached explicit nature to scientific knowledge and tacit nature to indigenous knowledge. Agarwal [4] has insisted that there is a need to move beyond the dichotomy of indigenous versus scientific and work towards building bridges across the indigenous and scientific divide. Knowledge Management Models can be used to manage and to integrate indigenous knowledge with other knowledge systems taking the difference into accounts [5].

Focusing on the development of the framework for a methodological integration of indigenous and scientific knowledge Mercer et al [6] have worked on the integration frame- work. Johan et al [7] have suggested that knowledge integration processes may benefit from early recognition of the dualities at hand and strategies aimed at creating thirdness, including some suggestions on the concrete forms such thirdness may take. Stefano et al [8] have argued that an autonomy and experimental climate (i.e. shared perception that the team supports autonomous action and experimentation and risk taking) can favor the team's ability to integrate member's knowledge. Chen Kun et al [9] have proposed a general knowledge mediation infrastructure for multi-agent systems. Hsiu-Ling et al [10] have suggested that firms should be cautious in their pursuit of a strategy of vertical integration, given the non-monotonic impact on innovative performance, whilst an increase in the level of vertical integration is also likely to diminish the effectiveness of the external knowledge sourcing. Rekha Singhal [2] would argue that the methods chosen will vary according to what is appropriate and feasible within the institutional, ecological, and social environments in which they operate. Knowledge sharing can be influenced by various factors like altruism, identification, reciprocity, and shared language [11].

For example, Rist et al [12] have worked on the role of ethno sciences in the dialogue between western scientific knowledge and indigenous scientific knowledge. Epistemic networks have been studied as a framework in a knowledge network scenario [13]. Absorptive capacity and disseminative capacity either interactively or separately determine how knowledge flows or is transferred effectively and efficiently between members of intra-organization networks [14]. The contribution of social network and knowledge creation in team work has been analyzed [15]. Various typologies have been studied in designing knowledge supply networks in Mainland China [16]. The incentive of knowledge sharing using game theory has been analyzed in a knowledge sharing setting [17]. This paper proposes Johari Window as a framework for knowledge sharing between indigenous and scientific experts of natural resource management.

PROPOSED METHODOLOGY

Johari Window Framework

Johari Window is a framework developed and by Joseph Luft and Harry Ingham as a cognitive psychological approach to self-discovery (figure 1). The model can also be utilized for team building and group interactions for attaining a higher level of understanding between the members. The Johari Window model consists of four quadrants (table 1). Johari Window is used for representing the knowledge on a particular entity held by indigenous and scientific experts. You and Me of Johari Window categories are used to represent indigenous and scientific experts respectively.

The four quadrants are:

Quadrant 1 represents the knowledge held by both the indigenous expert (Ei) and scientific expert (Es) on the entity concerned.

Table 1: Four Quadrants

Quadrants	Property
Quadrant1	Known by You and Me
Quadrant2	Known by Me
Quadrant3	Known by You
Quadrant4	Unknown to both

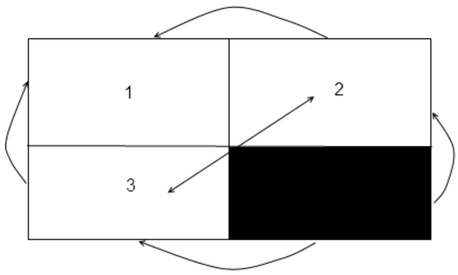

Figure 1: Knowledge Flow from Unknown to Known State

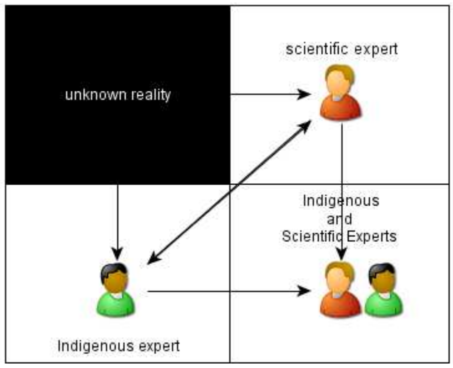

Figure 2: Johari Window for Two Experts

Table 2: Indigenous and Scientific Experts in Johari Window

Known by E_i and E_s	Known by E_i alone
Known by E_s alone	Unknown to both

Table 3: Binary Representation of Four States

Q_{11}	Q_{10}
Q_{01}	Q_{00}

Quadrant 2 represents the state where knowledge is held by the E_i alone. Quadrant 3 represents the state in which E_s alone holds the knowledge on the entity under consideration. The advantage of Johari Window model is that it incorporates the black spot (figure 2) into its system of representation (table 2).

The knowledge states of the four quadrants are represented using binary suffixes. The four Johari quadrants are identified by Johari variable k_i (indigenous knowledge) and k_s (scientific knowledge). The four quadrants of Johari window has four combinations of knowledge states: 00, 10, 01, and 11 (table 3). The knowledge states are either independent or dependent states. A dependency presupposes proceeding and succeeding knowledge states. For example if knowledge state $K3$ is dependent on $K2$ and $K2$ is dependent on $K1$, it automatically holds transitive property. Thus we can call Q_{11}, Q_{10}, Q_{01}, and Q_{00} as the four knowledge states between two knowledge holders. Knowledge sharing is possible when the knowledge of a particular property of an object is either in quadrant 2 or quadrant 3. The mutual sharing of knowledge between quadrant 2 and quadrant 3 would result to quadrant 1. Two possibilities of a particular knowledge reaching quadrant 1 are

$$Q_{10} \rightarrow Q_{01} \rightarrow Q_{11} \tag{1}$$

$$Q_{01} \rightarrow Q_{10} \rightarrow Q_{11} \tag{2}$$

The Problem of Dark Spot

Let us consider w_i and w_s as the worlds of indigenous and scientific experts respectively. Let p_i and p_s be the properties of an object O in study known to the indigenous world w_i and the scientific world w_s respectively. And let p_{xy} represent the properties with two index where xy are the combination of indigenous and scientific experts. The 2^n possible states are: 01,10,11,00. In Johari Window analysis the four states represent four quadrants. Then there may be Q_{00}, the fourth quadrant which is the dark spot for the actors in the knowledge sharing network as it lies outside the possible worlds w_i and w_s of indigenous and scientific experts respectively. Johari Window framework proposes that the fourth quadrant is to be minimized by frequent sharing of the knowledge between the experts and making a cumulative world w_{is} by combining w_i and w_s. The integration of two worlds is given as

$$w_{is} = w_i \cap w_s \tag{3}$$

Thus when there are n experts involved in knowledge sharing the integrated knowledge of world

$$w_{is} = [w_{i\,1} + w_{i\,2} ... w_{i\,n}] \cap [w_{s\,1} + w_{s\,2} .... w_{s\,n}] \tag{4}$$

$$w_{ds} = (w_i \cup w_s) - (w_i \cap w_s) \tag{5}$$

Let us consider w_{ds} the dark spot shown in Figure 1. A dark spot can be any knowledge component that is not a member of w_i or w_s. Let k be a knowledge component and w_i and w_s be worlds of indigenous and scientific experts respectively. If $k \in w_i$ then $k \rightarrow k_i$. If $k \in w_s$ then $k \rightarrow k_s$. If $k \in w_i \wedge w_s$ then $k \rightarrow k_{is}$. If $k \in/ k_i \wedge k_s$ then $k \in k_{ds}$ and in this case k would belong to the list to be updated by E_i and E_s.

The discovery of new k by E_i or by E_s might widen the world of w_{is}. In this case we have to decide on the nature of the new k. The new k may either add to k_{is} or may distort or contradict or falsify the existing k_i. If the impact factor of the new k is significant enough to modify the existing k_{is}, then we can identify it as a $-k$ or a $+k$. Depending on the nature of k the new knowledge either ($+k$) adds to the existing component of knowledge or ($-k$) modifies or falsifies the existing component of knowledge.

Table 4: Property Table with K_i and K_s Flags

Object	Property	K_i	K_s
O_1	p_1	Yes	No
O_1	p_2	No	Yes
O_2	p_1	Yes	Yes

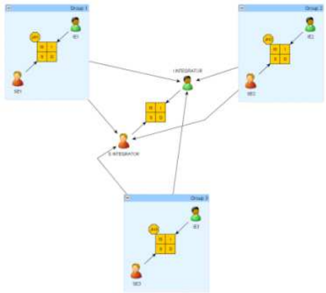

Figure 3: Johari Window in a Multi Experts Scenario

Sharing Through Johari Window

Figure 3 gives us a sample overall structure of knowledge sharing. Between the two experts involved in knowledge sharing, Johari Window framework is operative. All the indigenous and scientific knowledge holders will have an integrator respectively. There can be *n* number of experts in a group. Let us consider the following table 4 and we call it a Johari table which contains object, properties and K_i flag and K_s flag. If the properties of the objects are known to indigenous expert then K_i flag is set else it is unset. Similarly if the properties of the objects are known to scientific expert then the flag is sent else it is unset. The algorithm stores properties in the property table with K_i and K_s flags set or unset. In table 4, for example K_i of p_1 of O_1 is set while K_s of the same property is unset. Similarly K_i of p_2 of O_1 is unset while K_s of the same property is set. It means that p_1 of O_1 is from the knowledge base of indigenous expert and p_2 of O_1 is from the knowledge base of scientific expert. If p_1 of O_1 is shared with the scientific expert then Ks flag of p_2 of O_1 will be set. In the same way, if p_2 of O_1 is shared with indigenous expert, then K_i flag of p_2 of O_1 will be set. Now p_1 of O_1 and p_2 of O_1 would belong to quadrant1 Q_{11}.

Let p_i be a property of an object O_i. The algorithm checks the source of the property and then sets the flag according to the source. The flag K_i is set if pi is from an indigenous expert E_i or the flag K_s is set if p_i is from a scientific expert E_s. Otherwise we know that it is neither known to K_i nor K_s and so it belongs to quadrant Q_{00}. If the learning set of indigenous expert and scientific expert be S^i and S_s respectively. A Johari search algorithm can search a database DB_{is} and classify the S_i, Ss and S_{ds} sets where S_i contains k_i from E_i and S_s contains k_i from Es and S_{ds} contains *k* which does not belong either to S_i or S_s.

$$p_i \in S_i \wedge p_i \in S_s \rightarrow p_i\,(\text{known}) \quad \textbf{(6)}$$

$$p_i \in S_i \wedge p_i \notin S_s \rightarrow \text{move}(p_i, \text{learningset}(S_s\,)) \quad \textbf{(7)}$$

$$p_i \notin S_i \wedge p_i \in S_s \rightarrow \text{move}(p_i, \text{learningset}(S_i)) \quad \textbf{(8)}$$

$$p_i \notin S_i \wedge p_i \notin S_s \rightarrow (\text{move}(p_i, (\text{learningset}(S_i) \wedge \text{learningset}(S_s\,)))) \quad \textbf{(9)}$$

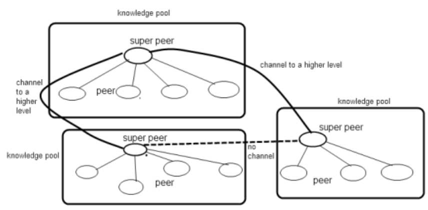

Figure 4: Hierarchical Knowledge Network Layout

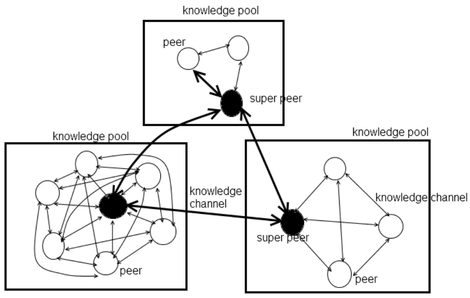

Figure 5 Participatory Knowledge Network Layout

From the above equations 6, 7, 8, and 9, Johari classification (algorithm 1) and learning set (algorithm 2) algorithms is arrived for finding the learning sets of indigenous and scientific experts. Let L_i be the list of properties of K_i, L_s be the list of properties of K_s, p_i be the property of O_i, O_i be the object, DB_{is} be the integrated database, K_i and K_s be the flags, S_i and S_s be the learning sets.

Algorithm 1 Johari Classification	
1	Read p_i of O_i from L_i
2	Read p_i of O_i from L_s
3	**if** $p_i \in K_i \wedge p_i \in K_s$ **then**
4	Store p_i in DB_{is}
5	Set K_i and K_s
6	**else**
7	**if** $p_i \in K_i \wedge p_i \notin K_s$ **then**
8	Set K_s
9	**else**
10	**if** $p_i \notin K_i \wedge p_i \in K_s$ **then**
11	Set K_s
12	**else**
13	Unset $K_i \wedge K_s$
14	**end if**
15	**end if**
16	**end if**

Algorithm 2 Johari Learning Sets	
1	Read DB_{is}
2	**if** K_i flag and K_s flag NOT set **then**
3	add p_i to $S_i \wedge S_s$
4	**else**
5	**if** K_i flag is NOT set **then**
6	add p_i to S_i
7	**else**
8	**if** K_s flag is NOT set **then**
9	add p_i to S_s
10	**end if**
11	**end if**
12	**end if**

SUITABILITY ANALYSIS OF KNOWLEDGE NETWORK STRUCTURES

Hierarchical and Participatory Networks

Johari window model of communication takes place within the peers in a peer network and between the hierarchies in a hierarchical network. The peers do not have levels as they all belong to the same level of communication whereas hierarchies have levels of communication. For this horizontal and vertical communication, we group the peers at a single level as knowledge pool. Each knowledge pool is connected through a knowledge channel and to a super peer. A super peer is a designated candidate for channeling the pooled knowledge to the next level of hierarchical structure. Knowledge flows from one knowledge pool to another knowledge pool through knowledge channels mediated by super peer. The typical hier- archical network structure under the frame work of knowledge peer, knowledge pool, and knowledge channel is given in Figure 4. The dotted lines represent no knowledge channel present. The thick lines represent the knowledge channel between the knowledge pools while the thin lines represent the knowledge channel between the super peer and the peers. The super peers of various knowledge pools would be grouped into super knowledge pool. Thus in each level of knowledge pool and super knowledge pool there is horizontal and vertical knowledge integration.

The problem with the hierarchical approach is the problem of the dark spot. The peers at one level do not have equal knowledge sharing. When there is the absence of super peer in a knowledge pool at a particular level, there is going to be delay for someone to become a super peer as there is no peer who has ’all the knowledge’ of the pool. The newly chosen super peer has to learn and in the worst scenario, the super peer might have to learn a bulk of knowledge set. This paper suggests a participatory approach (figure 5) for knowledge sharing and integration among the peers in order to avoid previously mentioned unexpected sudden absence of super peer. This makes the system robust in the times of sudden unexpected absence of the super peer in a particular pool. Figure 5 gives the participatory representation of the knowledge networks where each peer in a knowledge pool are fully connected to one another. The super peers in each pool are once again are fully connected.

Implementation

Three topologies have been considered for the study of the knowledge pool organization. Star, random and complete topologies have centralized, random and equal nodal properties. In star topolgy (figure 6) the super peer is the central knowledge integrator who integrates the knowledge from peers 1 to 6. The peers themselves are not connected among themselves. The number of knowledge channels for n peers is n - 1. Though the number of knowledge channels are minimal, 6 in this case, the responsibility of the integration solely relies on the super peer. In the worst case of the failure of the super peer (figure 7), the whole network is totally disconnected. In random (figure 8) topology, the number of knowledge channels are more for 6 peers and 1 super peer since there are channels between some peers. In case of worst scenario (figure 9), the channels between the peers remain active. In a complete topology, the number of channels are $n(n-1)/2$. In the worst case scenario when the super peer is ’dead’, the peers are still fully connected and are capable of becoming a super peer with full knowledge capacity. In a complete knowledge network at any point of time of the knowledge pooling and sharing the failure of the super peer does not affect the overall performance of the knowledge network.

The administrative organization of Forest Department of Tamil Nadu, India is taken for the study of Johari Model (Table 5). The administrative organizational setup of the Forest Department is viewed as a compete knowledge network. The whole administration can be viewed as knowledge network of knowledge networks where each category is a network and each individual in a network is a node. A single category is a peer network while two different categories form hierarchical network. For example, District Forest Officers would form a peer network while the network between District and Divisional Officers are hierarchical. The total number of knowledge levels are 15 and the total knowledge channels between of all the super peers of the 15 levels would be $15(15 - 1)/2$.

RESULTS AND DISCUSSIONS

Social network analysis is a method for analyzing theoretical constructs of relationships, ties between individuals or groups in an organizational setup. In order to implement the knowledge sharing framework of Johari Window in the Organizational Setup of Tamil Nadu Forest Department, we have considered three topologies (see figures 6, 8, 10) of knowledge network.

Centrality of Information, Centrality of Authority, Centrality of Closeness, Cognitive Expertise, and Situation Awareness have been studied for the topologies using sample network designs with the random assignment of values to the links (see tables 6, 7, 8).

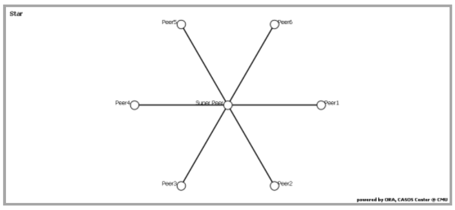

Figure 6: Star Topology Representation in ORA

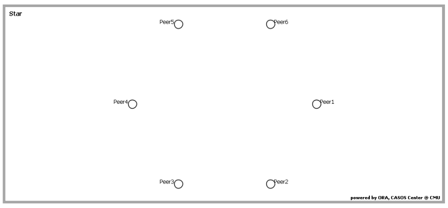

Figure 7: Isolated Knowledge Islands

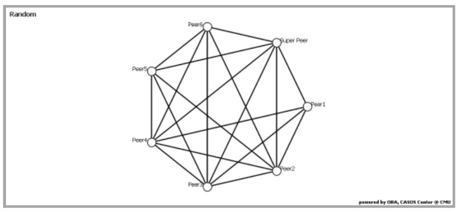

Figure 8: Random Topology Representation in ORA

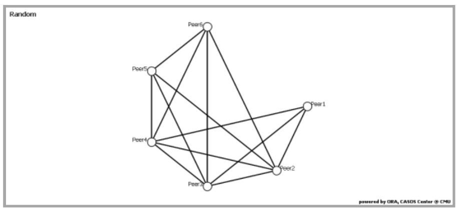

Figure 9: Super Peer Failing in Random Knowledge Network

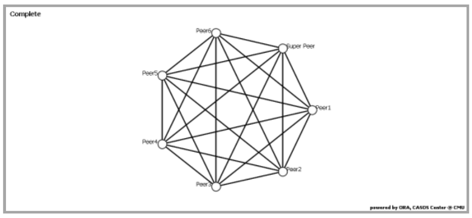

Figure 10: Complete Topology Representation in ORA

Table 5: Organizational Setup of Tamil Nadu Forest Department

Designation	Number of Peers	Knowledge Channels	Level
Principal Chief Conservator Of Forests	1	0	15
Principal Chief Conservator Of Forests & Chief Wildlife Warden	1	0	14
Addl Principal Chief Conservator Of Forests	10	10(10-1)/2	13
Chief Conservator Of Forests	26	26(26-2)/2	12
Conservator Of Forests	18	18(18-1)/2	11
Deputy Conservator Of Forests (Cadre)	39	39(39-1)/2	10
Deputy Conservator Of Forests (Non-Cadre)	29	29(29-1)/2	9
Assistant Conservator Of Forests	75	75(75-1)/2	8
Rangers	562	562(562-1)/2	7
Foresters	1312	1312(1312-1)/2	6
Forest Guards	2349	2349(2349-1)/2	5
Forest Watcher	1362	1362(1362-1)	4
Mahouts	39	39(39-1)/2	3
Cavady	42	42(42-1)/2	2
Tamil Nadu Ministerial Staff/Others	5393	5393(5393-1)	1

Table 6: Star to Pology

	Peer1	Peer2	Peer3	Peer4	Peer5	Peer6	Super Peer
Peer1	0	0	0	0	0	0	2
Peer2	0	0	0	0	0	0	3
Peer3	0	0	0	0	0	0	2
Peer4	0	0	0	0	0	0	4
Peer5	0	0	0	0	0	0	1
Peer6	0	0	0	0	0	0	2
Super Peer	2	3	2	4	1	2	0

Table 7: Random Topology

	Peer1	Peer2	Peer3	Peer4	Peer5	Peer6	Super Peer
Peer1	0	1	3	1	0	0	5
Peer2	1	0	1	2	3	1	5
Peer3	3	1	0	1	1	3	5
Peer4	1	2	1	0	2	2	5
Peer5	0	3	1	2	0	1	5
Peer6	0	1	3	2	1	0	5
Super Peer	5	5	5	5	5	5	0

Table 8: Complete Topology

	Peer1	Peer2	Peer3	Peer4	Peer5	Peer6	Super Peer
Peer1	0	1	1	1	1	1	1
Peer2	1	0	1	1	1	1	1
Peer3	1	1	0	1	1	1	1
Peer4	1	1	1	0	1	1	1
Peer5	1	1	1	1	0	1	1
Peer6	1	1	1	1	1	0	1
Super Peer	1	1	1	1	1	1	0

Centrality of Information

By comparative analysis of the centrality of information (figures 12, 13, 14) for the three topologies, it is clear that the star and random topologies rely heavily on one or a few individual nodes like super peer for knowledge flow. In star the centrality of information solely and heavily depends on super peer (figure 12).

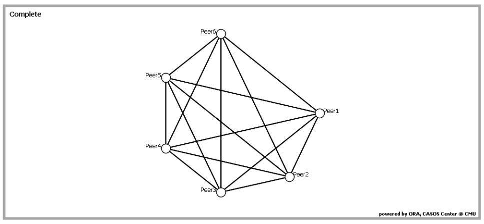

Figure 11: Super Peer Failing in Complete Knowledge Network

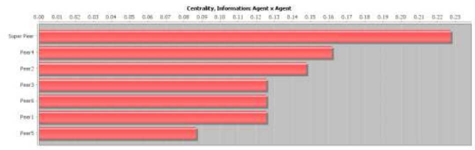

Figure 12: Centrality of Information in Star Topology

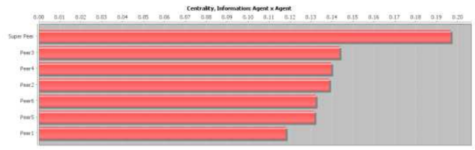

Figure 13: Centrality of Information in Random Topology

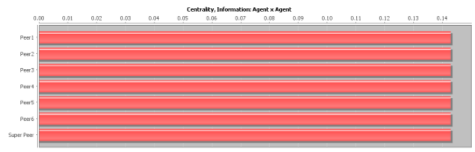

Figure 14: Centrality of Information in Complete Topology

Suppose in a worst case if the super peer fails, isolated knowledge islands will be created (figure 7) in the case of star knowledge network. Similarly, in random knowledge network, the assumption of an alternative super peer is going to be a tedious process (figure 9). Only in complete knowledge network failure of the super peer (figure 11) would not affect the knowledge capacity of the entire knowledge network because the centrality of information is equal for everyone.

Centrality of Authority

From the figures 15, 16, and 17 it is understood that the centrality of authority is equal to all in a complete network while it is not so in star and random networks. Due to the differences in their roles, it is obvious that in star and random, the centrality of authority changes according to the values assigned for each peer or super peer.

Centrality of Closeness

Centrality of closeness measures the quickness of a node to reach another entity in the network. A high value of centrality of closeness generally has quick access to other nodes in the network. The charts 18, 19, 20, present the values of centrality of closeness for six peers in study in star, random and complete topologies respectively. From the analysis, it is observed that peer1 and peer 2 have highest centrality of closeness than other peers in random topology. In star topology only peer1 has the highest centrality of closeness. But in complete network all the nodes have equal centrality of closeness due to the equal weights and their connectedness.

Cognitive Expertise

Cognitive expertise (figures 21, 22, 23) is high for super peer in star topology and for peer2, peer3, peer4, and super peer in random topology. Peer1, peer5, and peer6 in random network have lesser cognitive expertise. All the nodes are cognitively experts in complete network.

Figure 15: Centrality of Authority in Star Topology

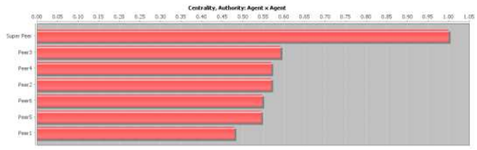

Figure 16: Centrality of Authority in Random Topology

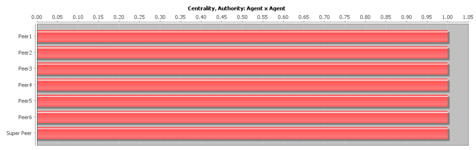

Figure 17: Centrality of Authority in Complete Topology

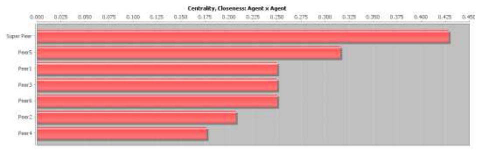

Figure 18: Centrality of Closeness in Star Topology

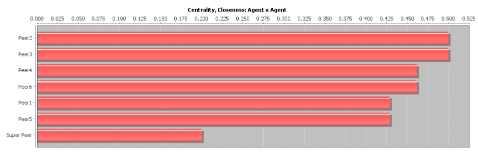

Figure 19: Centrality of Closeness in Random Topology

Figure 20: Centrality of Closeness in Complete Topology

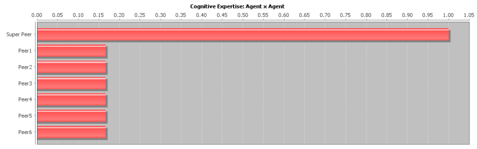

Figure 21: Cognitive Expertise in Star Topology

Figure 22: Cognitive Expertise in Random Topology

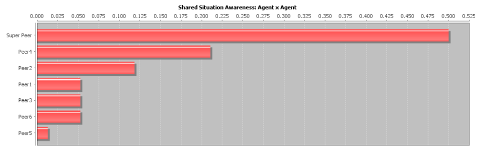

Figure 23: Cognitive Expertise in Complete Topology

Figure 24: Shared Situation Awareness in Star Topology

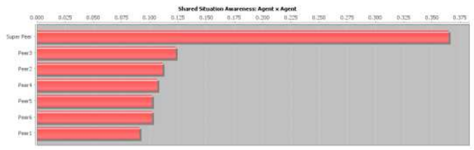

Figure 25: Shared Situation Awareness in Random Topology

Figure 26: Shared Situation Awareness in Complete Topology

Situation Awareness

Situation awareness is directly related to the full participation of the nodes in the network in full capacity. Nodes in complete network (figure 26) have full shared situation aware- ness. In star (figure 24) and random networks (figure 25) only super peer has highest value of the shared situation awareness. This makes the knowledge network very vulnerable. In worst case, if the super peer fails, the whole network suffers of big knowledge vacuum.

CONCLUSIONS

From the theoretical analysis of knowledge integration, it is desired to have a model that would consider the problem of fourth quadrant seriously and take into account the indige- nous and scientific knowledge in any real time knowledge management system. For the integration of two nature of knowledge of the same reality, Johari Window framework has been proposed and analyzed. For the analysis of the two types of knowledge networks namely hierarchical and participatory knowledge networks structure were considered. And using ORA we simulated and analyzed the networks and results have been presented.

From the results we have identified the following: Johari Window gives us an efficient framework for knowledge sharing, Johari Window framework addresses the issue of the fourth quadrant, participatory knowledge networks can be robust, the knowledge ability of peers in participatory are high, the system is prepared to withstand unexpected, sudden and very large scale events.

The future work can be in the direction of actualizing the implementation in domain specific entities. The knowledge component may vary according to the nature of entity in study. The exhaustive study of the entire organization and the practical realization of the proposed framework in the organization will be an extension of this work.

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