Toward A Concept of Community Intelligence:
A View on knowledge sharing and fusion in Web-mediated communities

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Abstract—Inspired by the ideas of the “global brain” and Swarm Intelligence, a concept of “community intelligence” is suggested in the present paper, reflecting that some “intelligent” features may emerge in a Web-mediated community from interactions and knowledge-transmissions between community members. A conceptual model of community intelligence is developed from two views. From the structural view, the community intelligent system is modeled as a knowledge supernetwork that is comprised of triple interwoven networks of the media network (the Web), the human network, and the knowledge networks. Furthermore, based on a dyad of knowledge in two forms of “knowing” and “knoware”, the dynamic view describes the basic mechanics of the formation and evolution of “community intelligence”. Two categories of relevant research issues are shortly discussed on the basis of the proposed conceptual model.

Keywords—Community intelligence, Web-mediated community, knowledge supernetwork, knowing, knoware

I. INTRODUCTION

Today human society has been densely interconnected by all sorts of communication channels. Especially, the Internet and the World-Wide-Web have created a cyberspace for mass information exchange and communications amongst people all around the world. Correspondingly, some researchers have suspected that the networked individuals might form a “Global Brain” (e.g. [1], [2], [3]). Following Mayer-Kress and Barczys[2], the Global Brain is the network of interconnected humans and computers that yields higher-level information-processing capabilities than any individual can attain, analogous to human brains that manifest high-level cognitive abilities from the complex, highly-interconnected network of lower-level information processing cellular units. This Global Brain vision is insightful and inspiring; however, from a practical point of view, more thorough theoretic analysis following the speculative discussions of the global brain would become extremely difficult owing not only to the giant scale of the “global brain” but also to the intrinsic heterogeneity of the participant individuals. It seems that a more realistic subject of research is the collective intelligence of a smaller group of people with some shared interests or focused intents.

In the present paper, we would narrow our concern to the scope of a “community” and suggest studying the “community intelligence” emerging from the interactions amongst the intellectual community members. Informally speaking, a “community” is a group of people with particular common characteristics or interests. These communities have long been a subject of research in various disciplines such as sociology, anthropology, and psychology. Especially in sociology, tremendous efforts have been conducted since the early 20th century (e.g. see a review in [4]); more recently, with the bloom of the complex network research, the social community structure has been widely investigated in the context of social network analysis (e.g. [5] [6]). The concept of “community” has also attracted management researchers and practitioners with the spreading of the ideas behind the “community of practice”, which was originally proposed in the context of “situated learning” of human groups [7]. With the rapid development of the Internet and the Web, nowadays more and more virtual or online communities emerge, and such virtual communities have become a hot research subject [8]. In this paper we pay a special attention to those virtual communities in which computer-mediated communications (CMC) are a prominent channel to interconnect the community members. Different from the prior researches, we try to investigate CMC from a knowledge perspective, regarding CMC as an entity to convey knowledge, to create knowledge, and simultaneously to solve problems by using knowledge. In this sense our attempt is to explore the “intelligence” of the community, with the belief that developing such community intelligence might be a first step to reify the bold vision of the “global brain”.

This concept of “community intelligence” is also inspired by “Swarm Intelligence” [9] [10], which has been extensively studied in the field of evolutionary computing. The basic idea of “Swarm Intelligence” is to exploit the emergent collective intelligence of groups of less-intelligent individuals that simply act in terms of particular local rules. The Swarm Intelligence phenomena can often be observed in nature, from ant colonies to bird flocks; and people have accordingly designed various programmatic algorithms to solve different societal and technological problems. With the development of Swarm Intelligence, an interesting question may come to the front: what would be case if the participants are the much-more intelligent human beings rather than the ants or the birds. This question would consequently lead to the concept of “community intelligence”. On one hand, the individuals within a human community are knowledgeable and intelligent by themselves. On the other hand, the dense interactions and
knowledge transmission between the individuals within the highly-interconnected community would give rise to the emergence of higher-level intelligence of the entire community together with the community’s shared knowledge assets. This process can somehow be analogous to the process in which Swarm Intelligence emerges from the local interactions. The major difference lies in that the interactions to form community intelligence are more knowledge-centric, rather than the simpler synergistic-based interactions [11] in the case of Swarm Intelligence. Thus, knowledge transmission and group sense-making (or knowledge fusion) amongst the community members would become a key research subject.

Based on the prior considerations, the major focus of this paper is to give an attempt to sketch out the basic conceptions of the research subject of “community intelligence”. This paper would then consist of two parts, i.e. the conceptual modeling of community intelligence and the consequent discussions on the relevant research issues.

II. CONCEPTUALIZING COMMUNITY INTELLIGENCE

To investigate community intelligence, we need to clarify the concept of a “community” first. As previously mentioned, a “community” refers to any human group in which the members have some common characteristics or share some interests. Thus a community may be formed around the people who have similar hobbies, who share specific academic interests, or who use a same company’s products. The collective intelligence of such communities is more investigable than the “global brain” of the entire human society for two reasons: first, the size of a community is usually much smaller than that of the entire human society so that the evolution of “community intelligence” is more traceable; second, the members of a community usually have shared interests and this makes the knowledge structure at the aggregate level more focused and more utilizable to actual problem situations.

The openness is another vital feature of a community. Unlike an institutional organization whose members are relatively fixed, it is often the case that a community is loosely-wired and open in the sense that the community boundary is somehow vague and people have the relative freedom of joining and leaving the community. Fresh new source of ideas and knowledge may then be brought in together with the recruitment of the new members; and this continual flowing-in of new ideas and knowledge is beneficial for knowledge innovation inside the community. What’s more, with the interactions and knowledge exchange between the members, we can anticipate that the community intelligence may emerge from some Swarm-Intelligence-like self-reinforcement process.

Furthermore, the modern information and communication technologies (ICT) are of great help to boost information exchange and knowledge dissemination in the community, and consequently to boost the formation of community intelligence. Especially, with the rapid development of the World Wide Web, a special attention would be deserved to study the “community intelligence” rising from the Web-mediated communities, in which much of the information and knowledge is transferred through the Web-based applications. The Web technology facilitates the formation of community intelligence in two aspects. On one hand, the Web has grown to be a platform for wide-area communications and collaborations, hence facilitating the knowledge (and information) exchange and fusion (e.g. consensus building) between the Web-mediated community members. On the other hand, the Web itself can be viewed as a huge-scale distributed inventory of information and knowledge so that it partially fulfills the functionality of a distributed “memory” system. Keeping the support of the Web technology in mind, we can try to give a further analysis of the concept of community intelligence.

A. The Structural View of “Community Intelligence”

Behind the notion of “community intelligence” is our contention that a Web-mediated community may self-grow to have at least two essential characteristics or “capabilities” of an “intelligent” system. First, the community should, generally in a distributed fashion, contain a memory system that stores information and knowledge, analogous to the memory system in a human brain. Second, the community should have the capability of “intelligent” problem-solving, i.e. the capability of utilizing the stored knowledge to solve problems; and the community should commonly exhibit higher-level intelligent capability than any community member per se.

Comparing to the human brain which is comprised of the interconnected neurons, the intelligent system of a community can also be viewed as a neural network in which the “neurons” are the community members (i.e. human participants) together with the underlying computer systems. Furthermore, this “neural network” is not just a network, but a network of networks or a “supernetwork” [12]. This knowledge supernetwork basically consists of triple interwoven networks, namely a technological network of Websites, a human network of community members, and a content network of knowledge and information which is hosted in humans and computer systems. A sample structure of such knowledge supernetwork is illustrated in Figure 1.

![Figure 1. Illustration of the supernetwork of community intelligence](image)

This work is partially supported by National Natural Science Foundation of China under Grants 70301009, 70431001 and 70620140115.
network, i.e. the Web (or more strictly a fraction of the Web that is associated with the specific human community) and we call it as media network since the basic media to convey knowledge and information and to support human communications and interactions. This Web-based media network is interwoven with the human network in that it provides a cyberspace to promote human communications and collaborations. The nodes of the technological network (i.e. the Websites) are created by humans (i.e. the nodes of the human network) and accessed by other nodes of the human network. Through the Web-mediated communications, knowledge creation, sharing and fusion happen within the human network or the human community. The collective activities of the community member would then give rise to the emergence of the third network, i.e. the “knowledge network”.

The knowledge network embodies the collective knowledge of the community. As having been widely discussed in Knowledge Engineering, knowledge may essentially be represented as a networked structure, for example, a semantic network of concepts and predicative relations, a linked structure of a set of reasoning rules, or elements interconnected by a cognitive schema or a mental model. Thus the overall knowledge content of a community can naturally be viewed as a network of “knowledge elements”, or the “knowledge network”. This knowledge network is an abstract network with its components (or fragments) being actually embedded in the human brains (i.e. the nodes of the human network) and the Websites (i.e. the nodes of the media network). The overall knowledge network is structured by the conceptual and logical connections of these knowledge components.

Some components or fragments of the knowledge network, which are basically classified as codified knowledge, are contained in the nodes of the technological network (or the Websites). One Website may connect to multiple nodes of the knowledge network, and one node of the knowledge network can vice versa be stored in multiple Websites. The connections between the Websites and the fragments of the knowledge network exhibit the basic means to link the technological network and the knowledge network. The knowledge network is also connected to the human network in that the largest proportion of the overall knowledge of the community is still stored in human brains although the media network may help contain some amount of codified knowledge. A single member of the human community connects to a sub-network of the entire knowledge network, which actually maps to the personal knowledge structure residing in the member’s brain. The whole knowledge network is then the union of all these sub-networks, indicating that the knowledge network as a whole serves as the “memory” of the intelligent system of the community, which can furthermore be regarded as the collective “memory” of all the participants. Such “memory” structure can further be illustrated by Figure 2.

As shown in Figure 2, the community members have their own knowledge remaining in their personal memory systems. Furthermore, collective knowledge creation, transmission, and fusion take place through Web-mediated interactions amongst the community members. Through these collective knowledge activities, on one hand the community members update their personal knowledge; on the other hand, a virtual knowledge network at the collective level may emerge by interconnecting the personal knowledge of the members. In general, there exist two basic ways to interconnect the personal knowledge. First, through communications and interactions, one community member may get the “know-who” knowledge of some other members; thus he or she may direct seek help from them when encountering problems. By such direct knowledge exchange, virtual knowledge links may be established between these members. The second way of knowledge interconnection is an indirect way. The members can “externalize” their personal knowledge to the media network by, for example, posting articles in some Web-space. By reading the articles, some other members may assimilate the embedded knowledge into their own knowledge structure. In this way, the media network then intermediates to connect the knowledge structures of the different community members. By these direct and indirect connections, the knowledge network of the whole community, which is actually a virtual network embedded in the human network and the media network, may form from the individual knowledge structures of all the community members. The structure of this knowledge network is the logical union of the knowledge structures of all the community members.

The previously-described networked “memory” structure of the Web-mediated community also implies the utilization of knowledge in the solving of the real-world problems. Analogous to human problem-solving by integrating different knowledge sources in human memory, the basic process of “intelligent” problem-solving in the community is accomplished by integrating different knowledge sources from the collective “memory” of the community. Such knowledge integration and utilization is further accomplished by direct and indirect communications between the community members.

B. The Dynamic View of “Community Intelligence”

Based on the prior structural view of “community intelligence”, we can go a further step to a more dynamic view, to study the evolution of the community’s knowledge network,
The development of the knowledge network is essentially based on the creation, transmission and fusion of knowledge within the community. This subject has been discussed in the knowledge management circle for years. For example, a well-known model is the SECI model proposed by Nonaka [13] in the context of an organization. In that model, a learning spiral is presented in which knowledge is transformed between the tacit and explicit forms and transferred between the individual and the organization levels. Despite this salient work and many further developments thereafter, e.g. Wierzbicki and Nakamori’s [14] "trofoil" knowledge creation model, the very basic notions behind knowledge and knowledge-related activities and processes are still under debate in academia. Cook and Brown [15] criticize that in the models proposed by Nonaka as well as other organization-learning advocates what is taken into account is “knowledge” being regarded as something that people “possess” whilst the actions people do during epistemic work are largely neglected. Therefore, regarding “knowing” as “the epistemic work that is done as part of action or practice”, they draw a distinction between knowledge and knowing, and argue that the actual organizational learning process is a “generative dance” between knowledge and knowing.

We agree with Cook and Brown’s ideas with reservations. One of our reservations is that their concept of “knowing” is somewhat confusing. If “knowing” were just a process or “action itself” as they argued, it would be of no necessity to conceptually distinguish “knowing” from knowledge, since it has been a commonsense that knowledge is achieved and used in the process of “knowing”. What makes “knowing” comparable with “knowledge” is that “knowing” can also be regarded as some “entity” in its own right. From an epistemological view, all an individual knows is from his or her experiences or practices; in return, any action of learning and doing of an individual is based on what he or she knows. Thus, to an individual, the action of knowing and the “entity” of what he or she knows are actually not able to be separated. Furthermore, what an individual knows is intrinsically dynamic because of the continuing action of knowing of that individual. In this sense we can term what an individual knows as “knowing”, which can not be apart from the individual’s action of learning and doing. Another characteristic of this “knowing” is that it cannot be apart from the individual who holds it; in another word, here “knowing” refers to personal knowledge endogenously embedded in one’s mind or consciousness. Thus the development of personal cognition essentially means the development of personal “knowing” in the process of learning and doing.

The previous understanding of “knowing” implies that “knowing” is one form of knowledge. Our second contention is that there is another form of knowledge, which is something “out there” or something existing independent of any individual’s mind. For example, we usually acknowledge that books contain “knowledge”. However, this “knowledge” contained in a book is very much different from the above-mentioned “knowing” residing in one’s mind. If one individual dies, the “knowing” of his or her disappears accordingly. Nevertheless, if he or she writes a book, the “knowledge” contained in the book would remain even after the author’s death. A book about the superstring theory would mean nothing to an individual without the knowledge background of modern physics. That means, cognitive endeavors are required to absorb external knowledge sources into an individual’s personal “knowing”. Following the pattern of the words “hardware” and “software” being created, we use a term “knoware” to refer to this external form of knowledge, in hope to stress that there is something out-there or something stand-alone behind this concept.

The dyad of “knowing” and “knoware” of knowledge makes the dynamics of the knowledge development in a group (i.e. in a team, an organization or a community) more understandable. First, “knowing” adheres to its owner and it cannot be transferred from one person to another. However, one individual can externalize a part of his or her “knowing”, i.e. the explicit “knowing”, toward some media space (e.g. audio, video, or texts) to generate “knoware”. Such “knoware” can then be acquired by another individual; and through a series of internal cognitive activities, the second individual may assimilate the external “knoware” to his or her internal “knowing”. With the mediation of “knoware”, in this process it would look like that the sender’s “knowing” is transferred to the receiver. However, in reality what the receiver does is to assimilate the “knoware” somehow through the re-invention of his or her own “knowing”. Especially, tacit knowing is not directly conveyed in the external “knoware”, the basic way for the receiver to achieve the sender’s tacit knowing is to regenerate it from the transferred explicit “knoware”.

In the context of a community, the aforementioned supernetwork structure of community intelligence implies the basic mechanics of the “cognitive” development of the community. At the individual level, each community member develops his or her personal knowledge network, or personal “knowing” through the personal cognitive processes. What’s more, the collective “cognitive” processes may emerge from all sorts of communications and interactions amongst the community members. In the collective cognitive processes, knowledge is transmitted between the community members through different types of “knoware”, which is conveyed by the “media network”. Figure 3 illustrates the general picture of the “knowing-knoware” transformation and the media-network-bridged knowledge transmission.
III. SHORT DISCUSSION ON RELEVANT RESEARCH ISSUES

In the preceding section we try to develop a conceptual model of “community intelligence”. However, this model is very primitive and it may bring about a bunch of research issues. Two categories of endeavors are most urgently deserved at the current stage.

First, the previously-noted conceptual model just provides a rough overview. More elaborate logical construction of the structure and dynamics of community intelligence is vital for better understanding of community intelligence. Especially, community intelligence essentially emerges from bottom up through the interactions and knowledge-transmissions between the community members. Correspondingly, an unanswered question as of yet is the underlying dynamic mechanisms to direct the formation of community intelligence, or in another word, the mechanisms of the knowledge network development. Since the knowledge network is a virtual network highly dependent on the associating human network and media network, the study of the knowledge network development would inevitably lead to the study of the dynamic processes of a supernetwork. Such study can be respectively carried out at the micro- and macro-levels following a generative research style [19]. At the micro-level, one key research issue is the deeper analyses of the knowledge transfer model between human beings. A rough “knowing-knoware-knowing” framework is suggested in the preceding section. Further conceptual, logical and empirical analyses, which may be rooted on social psychological and communicational studies, are necessary to pursue better understandings of actual knowledge-transferring through human communications and collaborations.

Based on the exploration of the micro-process of inter-human knowledge transferring, the macro-level community intelligence may be investigated. We suspect that the Swarm-Intelligence-like dynamics may take effect so that the community would evolve to be an “intelligent being” from local inter-personal interactions. However, this evolutionary process must be more complex than any Swarm-Intelligence process does. Two reasons can instantly be identified. One is the inherent structural complexity of the involved system. We have to investigate the co-evolution of three interwoven networks at least (namely the media network, the human network and the knowledge network), or we have to handle the structural development of a supernetwork with heterogeneous relationships. Another reason is the knowledge complexity. To explore the dynamics of the formation and evolution of community intelligence, we must set the focus on the knowledge movements such as knowledge transmission, integration and creation, which are somehow subtle and intangible. Modeling of such knowledge movements in the social and technological environments would be of a great challenge. Despite the difficulties, we are not pessimistic in conducting researches in this direction. Various researches on knowledge diffusion, especially those on agent-based modeling of knowledge diffusion patterns such as what has been done by Cowan and his collaborators [20] [21], may give implications to the study of the knowledge network evolution in our settings.

The second category of research efforts that catches our attention is stemmed from a practical and technological point of view. The basic question is: how the community and community intelligence can be supported by the media network. More specifically, in our Internet age, how can the Internet and Web technologies be adopted to facilitate smoothening knowledge transmission, integration and creation in a Web-mediated community? Again this question may be respectively
answered at the micro- and macro-levels. At the micro-level, the problem is to exploit IT technologies to bridge the knowledge gaps between individuals. Conceptually, knowledge is transferred from one person to another through a “knowing-knoware-knowing” procedure as we contend, thus the key to smoothen knowledge transferring is to alleviate the difficulties of “knowing-knoware” transformation. The “knowledge organization” [22] and “knowledge visualization” [23] technologies may be of great help in this respect. More computing tools that are developed under deeper comprehensions of group and social cognitions and communications would also be worthy of pursuing. At the macro-level, the problem is how the Internet/Web technologies to support the knowledge activities in a community, for example in a community of e-learning groups. Due to the evolutionary nature of community intelligence, the emphasis should be paid on using computing tools to promote participation and to facilitate more dynamic and “democratic” knowledge dissemination, integration, and creation. From this aspect, various technologies under the umbrella of “Web 2.0” [24] may set the technological cornerstones for further research and development.

IV. CONCLUSION

In literature, “intelligence” has become a widely-discussed metaphor to describe various social entities. The discussions are generally focused on the group and organizational levels, aiming at developing models of the “collective mind” [25], the “knowledge creating company” [13], and “organizational learning” [26], etc. Another stream of inquiry is on the vision of the “global brain” [1][2][3]. The attention of the present research subject and expect more research issues are briefly discussed. However, we have to study the phenomena of “community intelligence”. To note, such “community intelligence” is by nature human intelligence rather than machine intelligence, although ICT plays an important role in information and knowledge transmission between the community members. This differentiates the research on “community intelligence” from that of the Semantic Web and Web 2.0 etc.

From this aspect, in this paper a rough conceptual model of community intelligence is proposed; and accordingly, some research issues are briefly discussed. However, we have to admit that the ideas presented here is fairly primitive, and we do call for attention on this research subject and expect more thoughtful endeavors.

REFERENCES


