A Study on the Development and Applications of Collective Intelligence

Zhang Xiwen
School of Management, Wuhan University of Technology, Wuhan, P.R.China, 430070
(E-mail: zhangxw-cs@petrochina.com.cn)

Abstract This paper mainly presents a state-of-the-art overview of the development and applications of collective intelligence, introduces the characteristics of collective intelligence, and then analyzes the applications of collective intelligence in web, specifically in Wikipedia and Google, as well as issues concerned with its further development. The paper also explores the application of collective intelligence in effective team management. The genetic framework and problem solving mechanism provided by CI are discussed to promote knowledge sharing and innovation in team work.
Keywords Web2.0; Collective intelligence; Gene mechanism

1 Introduction

Collective intelligence (CI) is a shared or group intelligence emerging from cooperation and competition among many individuals. CI is exhibited in the bacteria, animal, human and computer network, and it appears as a decision-making pattern in various forms of consensus. As the research work of it is concerned, CI can be considered as a cross-discipline of sociology, business, computer science, mass media and the public behavior. This cross-discipline studies group behavior among individuals from very junior level to very senior level, i.e. from level of Quark, bacteria, plants, animals, to level of human society

CI can also be defined as some forms of networking, such as Internet. The newly-developed form of web, web 2.0, provides an interactive environment where users can publish, maintain and share their own content. CI improves the social sharing of existing knowledge with interactions among web users. According to Henry Jenkins, one of the main theorists in the area of new media and media convergence, CI can be attributed to the integration of media and the sharing of culture. CI is not only the contribution of all the cultures in the amount of information, but also that in the quality of information.

In this paper, we present the development and applications of CI. The rest of this paper is outlined as follows: Section 2 describes the characteristics of CI. Sections 3 explore the applications of CI in web, specifically in Wikipedia and Google, as well as its further development. Section 4 discusses the application of CI in effective team management by taking advantage of the genetic framework provided by CI. Section 5 concludes this paper.

2 Characteristics of Collective Intelligence

Collective information is often beneficial to making much better decisions than that made by each member individually. As Figure 1 shows, CI can be divided into three types: cognition, coordination and cooperation. CI has four characteristics: distributed, good-scalability, simplicity, self-organization, which is detailed as follows.

(1)Distributed. There is no central control on CI as the sources of the intelligence may be at different places or on different servers. This enables CI to be better adapted to the work status under current network environment and maintain strong robustness, that is, the failure of one or several individuals will not affect the group to solve the whole problem.

(2)Good-scalability. Each individual in the group may exert influence on the environment which further exerts influence on behavior of other individuals. So individuals communicate and cooperate with each other indirectly. This approach is known as stigmergy. When the number of individuals in a group increases, the expense in group communication only increases by a narrow margin. That results in a good scalability.

(3)Simplicity. Both the ability of each individual in a group and the principles in the group they need to follow are very simple, therefore, collective intelligence is easy to realize.

(4)Self-organization. The complex behaviors exhibited by groups are emergent intelligence shown by simple individuals' interactions. As self-organization implies, the process of a system constantly improves its own degree of complexity and the fineness driven by mechanism of interactions among its members, develops towards the direction from simple to complex, from rough to detailed. CI embodies

such a characteristic and so is self-organized.

3 Application of CI in Web

Instead of allowing users to browse web content as web1.0 does, web 2.0 focuses on users' interaction. Users are both web content browser and producer. The core of Web2.0 is that it uses collective intelligence wherever it can. There are many applications of CI in web, such as clustering, optimization, personalized recommendations and so on. The detail information is described in the Figure 2. Besides, Wikipedia and Google are two organizations famous for employing CI.

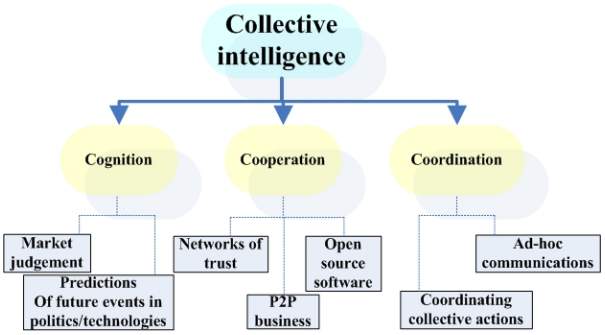

Figure 1 Collective Intelligence Types

Figure 2 Collective Intelligence Applications

3.1 Wikipedia

Wikipedia is an online encyclopedia maintained entirely by users, as well as an intellectual project of high-quality created by tens of thousands of people across the globe with almost no centralized control. As Jimmy Wales, the founder of Wikipedia, said, Wikipedia relies on spontaneous users instant editing, has accumulated more than 78 million entries and become the world's largest encyclopedia, which proves the creativity of open sharing. Wikipedia is often taken as a model of CI by people, for thousands of contributors all over the world have collectively created the world's largest encyclopedia, with articles of remarkably high quality. Anyone can change almost anything as he/she wants, and decisions about keeping what changes are made by a loose consensus of those who care. What's more, the people are volunteers who do all this work without getting paid. This means that whoever you are, as long as you can access Internet, you are able to provide information free of charge for others, and get more information from others free of charge too.

3.2 Google

The general connotation of CI usually means creating new ideas with a group of people's behaviors, preferences or thoughts. At the initiating stage, Google was a relatively small search engine company, but later the founders of Google adopted a new approach to sort search results, that is its famous page ranking algorithm which uses millions of links on the websites to determine which one is the best relevant page. While Google is the world's most popular search engine, it is also the first search engine evaluating the current page level based on the number of reference to the current page by other web pages. Different from Wikipedia inviting users to provide information and content, Google extracts important information through operations made by the creator themselves who provide the web content, and use that information to score and rank each website for users' reference. In short, Google uses

advanced algorithms which combines data from different groups and draws new conclusions as well as creates new business opportunities. Google's search results are far superior to its counterparts and it has now become the world's largest search engine company.

3.3 Further development of CI

As regards further development of CI, people began to consider how to make people contact with computers more closely, and how to employ CI to makes ideas more intelligent than a single individual, group or computer does. Researchers of the MIT Center for Collective Intelligence have been studying and exploring CI in groups composed of people and computers. Their main goal is to answer such a big question: how can people and computers be connected so that collectively they act more intelligently than any person, group, or computer has ever done before? Malone, director of the MIT Center for Collective Intelligence, put forward that for a website to realize its potential it should have at least thousands, maybe tens of thousands of people involved.

4 Applications of CI in Team Management

The success of modern enterprises can not do without an effective and efficient team as personal abilities of business managers and owners are limited. To establish an effective and efficient team, an organization must first create a corporate culture of pursuing excellence, form a sense of crisis, and set global optimization as the highest goal. To improve the efficiency of the team and to realize their full potential and initiative, a wise organization should have the following four characteristics:, the diversity of opinions, independence, decentralization and aggregation. The reason for the failure of the groups in an organization is mainly that individuals of the group understand each other' views too well to think independently, which often results in being too homogeneous, too centralized, too divided, too imitative, too emotional, and even too connected.

These examples of Web enabled collective intelligence are inspiring to read about. But to take advantage of the new possibilities they represent, it's necessary to go beyond just seeing the examples as a fuzzy collection of "cool" ideas. To unlock the potential of collective intelligence, managers instead need a deeper understanding of how these systems work.

How could we get crowds to do what our business needs them to do? To take advantage of the new possibilities CI, it's necessary to go beyond just taking those successful applications as a fuzzy collection of cool ideas. To tap the potential of CI, managers need a deeper understanding of how CI system works to get works done by a group, in a cheap and perfect way. It is known that synergy among group members is formed in various forms, ranging from mere information sharing to coordination, cooperation and collaboration. CI represents a kind of synergy of new and high level, and provides a more effective mechanism for solving problems. It's very important to understand the mechanism of applying CI in team management for the benefits of an organization.

Thomas et al. presented a user's guide to the building blocks of collective intelligence [10]. They pointed out that managers can design the powerful system they need by recombining CI genes according to the work required. Their work is based on the theory of the Collective Intelligence Genome invented by MIT CCI and harnesses it to describe the steps adopted by enterprise to build a CI system. The steps are as follows.

(1)Crowds

As Figure 3 shows, the society is full of people and each one is taken as a gene in crowd genes. Activities can be performed by anybody in an organization who chooses to do so, without being assigned by someone in a position of authority. Crowds could do some certain things, like brainstorming, for a long time. Low cost in communication enabled by Internet makes it feasible for crowds to do many more things than ever before. For instance, people could make a link to a web page, and each new link becomes one part of the database Google uses to serve up answers to searches.

(2)Clustering

Of course, the linked but distributed genes can do something much better than before. The problem is how to bring their potential power into full play. As Figure 4 shows, the stimulations, such as good reputation, wealth and love, can be exploited to motivate genes distributed in the society to work together. In traditional hierarchical organizations, problems are generally answered by a particular person or group of people performing the corresponding task. Whereas, the task could be solved with a large number of people through the CI mechanism by which their ideas and genes are clustered.

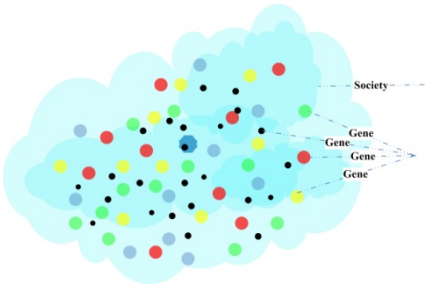

Figure 3 Genes in the Society

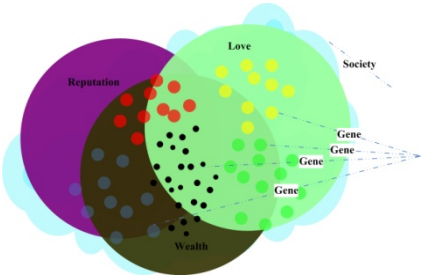

Figure 4 Clustered Genes

(3)Creation

As Figure 5 shows, gene clusters should collaborate with each other to correlate, spark and create good, new and innovative ideas. Most online forums, for example, provide open hosts to visitors and visitors who are very active in discussion. They also provide platform for visitors to debate, which offers a concise look at key issues and different positions on them. The design is based on argument mapping, an approach developed by team member Mark Klein, CCI principal research associate.

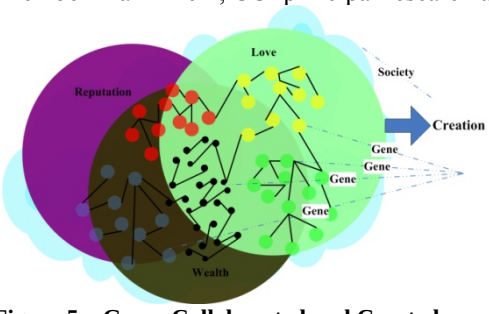

Figure 5 Genes Collaborated and Created

(4)Decision

It is believed that the collaborated group ideas can offer a better solution than single ideas. The CI mechanism makes those genes work together and discuss with each other through some tools like Internet. They are motivated by certain kinds of stimulations to form main solutions, and then decide which one is the best after they evaluate all alternatives

5 Conclusions

The above mentioned applications and developments of web-enabled collective intelligence are not the end of the story. On the contrary, it's just the beginning. As Web2.0 continues to improve, there will be a myriad of other examples to appear. We believe that CI provides a good genetic framework for knowledge sharing and innovation. We agree with Malone that CI, to some extend, is a kind of societal phenomenon that actively involves many tens or even hundreds of thousands of people around the world who contribute information, express themselves, and help to formulate the best possible program for the world to deal with social problems.

References

[1] Kennedy, Russell C. Eberhart, Yuhui Shi. Swarm Intelligence.[J] Genetic Programming and Evolvable Machines,2002,1(3): 93-97

[2] Sean Lane. Collective Intelligence for Competitive Advantage: Crowd sourcing and Open Innovation [J]. University of Oregon Applied Information Management Program, February, 2010

[3] P. Clint ROGERS, Stephen W. LIDDLE, Peter CHAN, Brady ISOM. WEB 2.0 LEARNING PLATFORMS: Harnessing Collective Intelligence [J]. Turkish Online Journal of Distance Education, 2007, (8): 1

[4] Thomas W. Malone, Robert Laucher, Chrysanthos Dellarocas. The Collective Intelligence Genome[J].MIT Sloan Management Review,2010,51(3):28