

# From Web 2.0 to Conversational Knowledge Management: Towards Collaborative Intelligence

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## Abstract

Conventional knowledge management through a centralized repository framework has been the prominent approach to handle large volumes of information since the instigation of World Wide Web. However, knowledge residing in the repositories has not been accumulated or integrated to generate new intelligence. With the massive increase of communication technologies available, a change of paradigm in knowledge management is produced. This article investigates the shift from a knowledge repository approach to a conversational collaborative foundation of knowledge management. Basic applications of collaborative intelligence are proposed. It analyzes recent web trends to produce support for the change. The article demonstrates the opportunity for more effective and feasible knowledge management.

**Keywords:** Web 2.0, Conventional Knowledge Management, Conversational Knowledge Management, Collaborative Intelligence, World Wide Web

# 1. Introduction

World Wide Web was considered the future of the new digital era a decade ago. The Internet phenomenon was to construct websites with favorite contents published on the Internet for others to browse. Nowadays, the Internet has become the core platform of communication, semantic search engines are facilitating the Internet users for their needs and destinations, and many special interest groups are created in the form of virtual communities to share their common interests and knowledge (Berners-Lee, Hendler & Lassila, 2001). World Wide Web is now integrated with human behaviors and many people believe it has become part of their life. With respect to the Web technology, the fundamental concept has also been transformed from the personal-focus to the community-focus, thus the transition from Web 1.0 to Web 2.0.

The concept of “Web 2.0” was birthed by the Web 2.0 Conference in 2004, and through extensive discussion and brainstorming, the shape and characteristics of Web 2.0 were derived. To distinguish Web 2.0 from the previous version, (O'Reilly, 2005) formulated the essence of Web 2.0 by a list of examples (Figure 1).

<b>Web 1.0</b>	<b>Web 2.0</b>
DoubleClick	--> Google AdSense
Ofoto	--> Flickr
Akamai	--> BitTorrent
mp3.com	--> Napster
Britannica Online	--> Wikipedia
personal websites	--> blogging
evite	--> upcoming.org and EVDB
domain name speculation	--> search engine optimization
page views	--> cost per click
screen scraping	--> web services
publishing	--> participation
content management systems	--> wikis
directories (taxonomy)	--> tagging ("folksonomy")
stickiness	--> syndication

Figure 1. Web 1.0 versus Web 2.0 (O'Reilly 2005)

With the advancement and attractiveness of Web 2.0 technology, Internet users are relieved from learning how to use “tags” and create “style sheets”. Instead, most of the time is spent on contributing contents of their knowledge space. For instance, entomologists are able to publish their research findings of new species of insects on the entomology related online communities without learning the web design technicality such as positioning images on the appropriate x and y coordinates of a webpage.

Through Web 2.0 platform, the traditional knowledge management with centralized knowledge repository has shifted into a more interactive conversational approach. Knowledge from specific disciplines is no longer provided and assessed solely by the domain experts, but by the peers who also possess the capabilities.

To encapsulate the evolution of web technology and knowledge management approaches towards the collaborative intelligence, this paper lays down its foundation with an overview of the characteristics of Web 2.0, and discussions of conventional and conversational knowledge management. With the background, the paper further extends its focus by identifying the pillars of collaborative intelligence. The collaborative intelligence is built upon three pillars, namely, the collaboration technology environment, rallying the area of knowledge and intellectual cooperation. Each of these pillars is further delineated on its correlation and support of the collaborative intelligence.

The proposed “Web Resolution” conceptual model towards the closing of the paper illustrates the evolution and transition of a static and unreliable view of the system towards a dynamic and reliable view of the new era – Web 2.0 and beyond. Lastly, the paper concludes with a summarized list of critical success factors for a high collaborative intelligence quotient and a number of recommended future research directions.

## 2. Characteristic of Web 2.0

Web 2.0 has come into vogue in the last couple of years, following the concept of collaborative and interactive communications through the Internet based virtual communities.(O'Reilly, 2005), CEO of O'Reilly Media, Inc. defines Web 2.0 as:

*“the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences.”*

It is fascinating that Web 2.0 incorporates a two-way and interactive mechanism to enable knowledge providers (or general Internet users) to contribute knowledge contents to the shared domains. Furthermore, the knowledge contents are crafted and fine tuned to maintain the up-to-date status at any time. In building on a theme of collaborative intelligence, the following list of features may be considered as the objectives of knowledge contents development via Web 2.0.

- Contribution – every Internet user has the opportunity to freely provide their knowledge content to the relevant subject domains.
- Sharing – knowledge contents are freely available to others. Secured mechanisms may be enforced to enable the knowledge sharing amongst legitimate members within specific communities.
- Collaboration – knowledge contents are created and maintained collaboratively by knowledge providers. Internet users participating in the knowledge contents can have conversations as a kind of social interaction.
- Dynamic – knowledge contents are updated constantly to reflect the changing environment and situation.
- Reliance – knowledge contribution should be based on trust between knowledge providers and domain experts.

Web 2.0 integrates the idea of open source. Its purpose is to share the goal, share the work and share the result (Goetz, 2003). With the maturity of Web 2.0, we should get ready for the new era where collaboration replaces the cooperation.

### **3. Paradigm Shift in Knowledge Management**

The concept of knowledge management refers to a process of creating intangible assets from the combination of knowledge and experience provided by the individuals or knowledge workers within the organizations or the society. With technology evolving, approaches to knowledge management are shifting. A “traditional” or “conventional” approach to knowledge management focuses on collection of knowledge in a centralized repository and its accessibility whereas a “conversational” approach emphasizes the integration and collaboration of knowledge creation amongst knowledge workers.

The following two sub-sections detail the background and characteristics of “conventional” and “conversational” knowledge management approaches.

#### **3.1. Conventional Knowledge Management**

The approach of deploying centralized data repositories in an organization to gather organizational knowledge is considered a “conventional” or “traditional” knowledge management. In such arrangements, the concept of organizational networks is the key enabler for knowledge workers to communicate with each other (Stewart, 2001). Through the information and communications technology, organizations are capable of chaining valuable knowledge resides in business competencies into a shared domain. (Lan & Unhelkar, 2005) further explain that the sources of organizational knowledge should originate from stakeholders of business competencies in both intra-organizational and inter-organizational scopes.

When talking about intra-organizational operations, people are predominantly referring to internal business functions. Most of these business functions are

generic to any and every organization, while some of them are quite unique and dependent upon industry types. In general, these functions work together to assist the organization to survive and prosper, and they are namely management & administration, human resources, finance & accounts, purchase & procurement, and sales & marketing.

Conversely, inter-organizational transition scope focuses on the business activities and operations that are external to the organization. These external business activities and operations can be seen as the communication channels between the organization and other enterprises such as customers, suppliers, and competitors. By incorporating the external communication channels in the knowledge management strategy, a number of new business processes start emerging as part of the core business functions. These new processes extend the enterprise's organizational scope and change the organization's structure, and they are namely customer relationship management (CRM), supplier relationship management (SRM), supply and chain management (SCM).

The stakeholders of the aforementioned business functions play significant roles in maintaining and ensuring the accuracy of the knowledge in their fields. However, lack of knowledge participation from conjoining business functions present pitfalls in obsolete and isolated depository of knowledge.

### **3.2. Conversational Knowledge Management**

In contrast, conversational approach to knowledge management is constructed upon the knowledge network infrastructure and in a much more collaborative manner. (Keyes, 2006) describes the new approach to knowledge management as a "Community of Practice (COP)". COP is a group of people who are interested in the same topics and share a common practice within the same period of time. They may not stay in the same geographical location, share the same time zone, or use the same operating systems, but on the same knowledge networks.

Knowledge networks combine the positive benefits of conventional knowledge management systems with collaborative arrangement. Knowledge

networks deployed on interconnected organizations are the powerful driver for advancing organizational objectives and increasing human capital assets. Various new technology applications are invented to facilitate the conversational knowledge management through knowledge networks including Wiki Systems, Web Blogs, and Discussion Forums. Although each of these applications embraces some category of conversational technology features, Wiki Systems is considered the most flexible and focused on incremental knowledge creation and enhancement, version management and multi-user participation on an open source technology (Wagner & Bollojum, 2005). To this end the following section further explores the features of Wiki Systems.

### 3.2.1. Example of conversational knowledge management: Wiki System

The introduction of Wiki architecture in recent years has changed the perception of constructing websites for a larger scale of Internet communities. According to (Wikipedia, 2007) “Wiki is a piece of server software that allows users to freely create and edit Web page content using any Web browser. Wiki supports hyperlinks and has simple text syntax for creating new pages and crosslinks between internal pages on the fly.”

(Wagner & Bollojum, 2005) described Wiki as the incremental knowledge repositories where the histories of web contents are kept in various versions for viewing and rollback purposes. Wiki creates a common platform for people in the targeted and specified community to not merely participate in the communications but also be the content and knowledge providers of the group. Such a revolutionary concept has altered the behaviors of the Internet population and consequently it influences people’s daily life and activities. An example a system Wiki could facilitate is a research group with members dispersed across geographical boundaries, such as members located in various nations or regions with different time zones. The Wiki system allows each member to contribute their ideas to the Wiki platform collaboratively without time and geographical limitations.

Some Wiki based applications provide the functionalities similar to Webblogs to a certain extent. TiddlyWiki for instance, enables individuals and/or groups to

accumulate ideas, notes, diary activities, and events in a non-technical environment. The most prominent Wiki application is the “Wikipedia” on which every Internet user can become the knowledge provider of its contents. In such architecture, both peers and experts are equally welcomed and valued to participate in the knowledge refinement process (King, 2007).

## 4. Pillars of Collaborative Intelligence

Collaborative intelligence is the measure of the collaborative ability of an entity or a group. Knowledge derived from collaborative efforts is proportionally increasing to the magnitude of the World Wide Web, collaborative groupware like Skype, NetMeeting, WebEx, and many others.

The collaborative intelligence stands on three pillars: collaboration technology environment, rally the area of knowledge and intellectual cooperation as shown in Figure 2. These three pillars continuously interact; they are correspondent and connected.

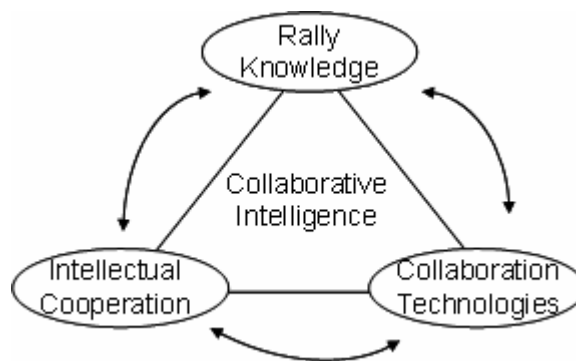


Figure 2. Pillars of Collaborative Intelligence

### 4.1. Collaboration Technology Environment

Collaboration technologies are software, hardware and networks that support the communication and collaboration of two or more people. A distributed collaborative environment is the setting for a group collaborating within a virtual

sphere of interaction. The collaborative environments use enhanced technologies to facilitate group problem solving. The collaborative environment technologies include:

- Synchronous technologies: such as instant chat, video/audio conferencing and shared white boards.
- Asynchronous technologies: such as e-mail, Weblog, and moderated discussion forums.

Collaborative environments support the work of teams, which may not necessarily be at the same place or same time. Figure 3 shows group members interact in real time or asynchronously even though they are not located within the same physical space. Group Decision Support System (GDSS) aim to be used as same-time same-place technology (Gray & Mandviwalla, 1999). Wikipedia, weblogs, websites and e-mail support communication at different time and different places. However, Wikipedia incorporates a many-to-many knowledge creation and sharing model, instead of the one-to-many model, such as E-mail (Wagner, 2004).

P l a c e	Different	Video/Audio Conferencing, Instant Chat	Wiki, Webblog, E-mail, Websites
	Same	GDSS	Electronic-Board
		Same	Different
		Time	

Figure 3. Group members interact environments

Collaborative environment creates synergy, which is a method of indirect communication in a self-organizing emergent system. The individual parts communicate with one another by modifying their local environment to stimulate the performance they have achieved (Parunak, 2003). Many emergent phenomena

on the Internet have arisen from users interacting only by modifying local parts of their shared virtual environment. Wikipedia is a typical example of this. The enormous structure of information available in a wiki could be compared to ants; one initial user leaves signs of an idea, which attracts other users who then build upon and modify this initial concept eventually constructing an elaborate structure of connected thoughts.

## **4.2. Rally the Area of Knowledge**

(Umeda, 2006) stresses that the web 2.0 revolution as well as companies like Google and Amazon, provide a different kind of cyber space, which the “old” style companies like Yahoo! and Microsoft have never shown. The difference is that the former encourages users to create new webpages, information, and dynamic links using open source technologies. In addition, they also encourage users to go beyond the original models those companies have prepared beforehand. This is the core image of Web 2.0.

Traditional thinking assumed large servers were the fastest way to handle massive amounts of data. However, Google found networked PCs to be faster. This is because Google developed scaleable architecture for servers, making customer service center applications available on the World Wide Web. Google also states “democracy on the web works” at its corporate information (Google, 2007). The architecture of participation and democracy encourage users to add value to the application as they use it (Umeda, 2006).

With the advent of information technology in cyber space, the trend is rally the area of knowledge. One of Microsoft’s monopoly powers came from the individual information residing in the personal storage (personal hard-disc). Outlook is a typical example of this kind, which can only provide personal value service (Umeda, 2006). In contrast, Google supports individual information in the network storage (far-end) to provide value-added knowledge. The value-added knowledge includes mining user behavior to provide customized service or e-mail spam in Gmail. Figure 4 shows rally the area of knowledge in cyber space.

S t o r a g e	Network	<b>Gmail</b> Value-added Knowledge	<b>Wiki, Google</b> Wisdom of Crowds
	Personal	<b>Outlook</b> Personal Value	Organizational Knowledge
		Individual	Group
		Knowledge	

Figure 4. Rally the area of knowledge in cyber space

### 4.3. Intellectual Cooperation

(Umeda, 2006) emphasizes that the most important feature of Web 2.0 is not to make money from it, but that we can cooperate to create a new world of dynamic knowledge and collective intelligence. Wikipedia demonstrates the web voluntarily and openly service. This is the core philosophy of Web 2.0, and probably the most revolutionary contribution to our cyber society. Intellectual cooperation therefore becomes a vital ingredient of collaborative intelligence.

The intellectual cooperation stresses inter-personal (two or more people) and inter-organizational (teams, companies, countries etc) interactions. (Dyer, 2000) discussed collaborative advantages through extended social networks, which leads to network value and effect. A value network is a web of relationships that produces economic value and other benefits through complex dynamic exchanges between two or more individuals, groups or companies (Allee, 2003). Value networks are complex sets of social and technical resources to generate economic value. This value takes the form of knowledge, intelligence, a product (business), services or social good.

It is essential to understand the transactional dynamics for networks and communities focused on creating knowledge value. Knowledge value can be derived by (Chen & Chunag, 2004):

$$Kvalue = (C * A + L) * Kio$$

where C is core competence; A stands for action; L means learning; K means knowledge input and knowledge out.

Google proves the above formula works. It relies on the millions of individuals posting links on websites to determine which other sites offer content of value. Google analyses every web page using a variety of techniques, including its patented PageRank™ algorithm. It assesses sites, which have been "voted" the best sources of information by other pages across the web. This technique improves as the web gets bigger, as each new site is another point of information and another vote to be counted (Google, 2007).

## **5. Web Revolution – The New Era**

Since the technology hype of World Wide Web in the late 90's, Web presence was deemed to be the dominant mission of many organizations' online strategy. With the technology evolving and the requirements to satisfy the customers' growing needs, websites are no longer merely information bulletins. Furthermore, the contemporary plan envisaged by organizations is to resolving customers' issues in the dynamic environment through the online innovative knowledge repositories. This is to be implemented as the off-line customer-centric services.

The innovative knowledge is stored in electronic repositories or known by human experts usually. The communicative challenge is to bring together the resources and the experts who can relate the existing pieces of knowledge to new contexts. If we compare web resolution technologies in terms of reliability and innovation, they can be separated into four regions as shown in Figure 5.

The unreliable/static region falls to information systems because, nowadays, the failure of the information systems has been increasingly affecting businesses/services. It has become a vital task to improve the reliability and safety of information systems. Linux, an open source software development, enables fast

and reliable version management. Linux is a more static view of production software, but consists of a skilled and motivated team of volunteer users and developers, to achieve success. The unreliable/dynamic region indicates the first generation of Internet services supplying support knowledge creation activities. However, maintaining knowledge is exceedingly difficult when that knowledge changes rapidly. The new web era, Web 2.0, tends to support distribution of dynamically changing knowledge and to facilitate a global problem solving process. Quality assurance mechanisms, including the tracking of knowledge sources, are needed to incorporate in. Google and Wiki lack self-refining mechanisms to quickly remedy errors in the knowledge base at the current stage. In other words, they may state wrong facts at some points in time.

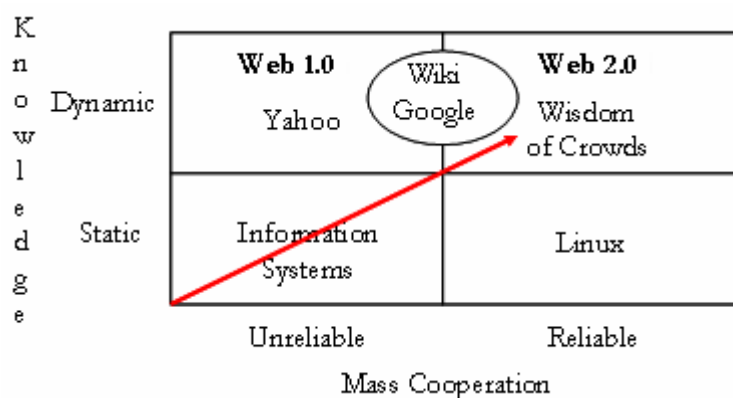


Figure 5. Web Revolution

## 6. Conclusion and Future Directions

Conversational approach to knowledge gathering and contribution through the revolutionary web technology is ubiquitous. Through the platform, the Internet users or novice users to be precise, with limited technological or web skills are able to contribute their expertise to the virtual communities. New knowledge is produced from the existing information through the collaborative framework and

transformed into intelligence. Such a virtual collaboration concept is a complete unraveling of organizational models for traditional business boundaries. However, there is a pressing need to identify the current state of organizations or community groups pursuing collaborative intelligence. Positioning the current knowledge management system status on the proposed Web Revolution model, organizations or community groups are capable of following the critical success factors and working towards the dynamic and reliable quadrant of collaborative intelligence.

The critical success factors for a high collaborative intelligence quotient include:

1. Establishing a group moderation, facilitation and satisfaction mechanism.
2. Promoting of creative and unlimited thinking.
3. Strong group membership consensus, interactions, and feedback.
4. Providing quality assurance and peer review mechanisms for conflict resolution.
5. Forming of a sufficient documented group memory or knowledge base.

Although Web 2.0 has demonstrated the ability to facilitate collaborative knowledge management, the authors believe that there are concerns still yet to be resolved. Questions to be considered are the future research directions embracing an effective assessment of creditability of knowledge providers, mechanisms and/or algorithms to measure the validity of knowledge, implications of the cultural change, and governance of the collaborative platform.

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