

The 8C Framework as a Reference Model for *Collaborative Value Webs* in the Context of Web 2.0

T. Andrew Yang

Dan J. Kim

Vishal Dhalwani

Tri K. Vu

yang@UHCL.edu

KimDan@UHCL.edu

vishaldhalwani@yahoo.com

vktri2006@yahoo.com

University of Houston – Clear Lake
Houston, Texas 77058, US

Abstract

After a decade of innovations and advancement in Internet technologies (roughly from early 1990s to early 2000s), the first generation of Web-based applications (aka. Web 1.0) have evolved into a new trend of Web-based services, commonly referred to as Web 2.0. In this paper we present a framework for understanding the various design elements of a collaborative value Web in the context of Web 2.0. We first examine characteristics of Web 2.0 applications, and then discuss why the current 7C Framework fails to capture all the design elements of a Web 2.0 application, especially with respect to collaboration, which is one of the unique features of Web 2.0 applications. Although the 7C Framework is a model commonly used by researchers to analyze the design elements of Web-based applications, it needs to be revised in order to accommodate new features present in Web 2.0 applications. We have extended the 7C Framework to an 8C Framework by incorporating into the model the collaboration element. A side-by-side comparison reveals how each of the design elements may be interpreted under Web 2.0 and Web 1.0. As a demonstration of using the extended framework as a reference model, we analyze a set of representative Web-based services using the 8C Framework.

1. Introduction

Starting with its embryo state of a DARPA-sponsored¹ research project, the Internet has evolved from an internetworking system mainly used by researchers and scientists in the 70s and 80s to today's World Wide Web, used by billions of people around the globe for almost every conceivable application. Since the first commercial Web browser (Netscape Navigator) was released in 1995, we have

witnessed the explosion of Internet use, as the enabling technologies become more cost effective, and diverse applications are made available over the Web. Table 1 illustrates some sample Web-based services, which have emerged as Internet applications over the last decade, from the original static Web sites to today's dynamic e-commerce sites, online social networks, and collaboration sites.

Existing models such as the 7C Framework [15] are useful in representing the interface elements of traditional Web-based applications. The framework is considered as a useful reference model for developers, analysts, managers, and executives, when designing and/or evaluating the interface channels between the customer and the Web-based application [15].

With the advancement of Internet technologies and innovations in developing Web-based services, Web-based applications are moving towards a new trend, that is Web 2.0. It is our first goal to investigate what Web 2.0 actually means, and what are the characteristics of Web 2.0 applications.

Our second goal is to create a reference model for Web 2.0 applications, by first inspecting the 7C Framework as to whether it is a sufficient reference model for Web 2.0 applications. After investigating the 7C Framework and Web 2.0 characteristics, we claim that the 7C Framework is not sufficient, because it fails to capture an important element in Web 2.0 applications, which is *collaboration*, an element present in almost all Web 2.0 applications. Although the 7C Framework provides a good reference model for the interface design elements of a Web-based application, it is insufficient to completely address the new generation of Web applications. Collaboration and user-generated content are two closely related elements, and are two important features in Web 2.0 applications.

¹ Defense Advanced Research Project Agency

Therefore, we have extended the 7C Framework into the 8C Framework by adding collaboration as the 8th element in the model. In addition, we examine and update the meaning of each of the eight design elements, so that they are effective in representing the interface design elements of Web 2.0 applications.

In the rest of the paper, we first examine the characteristics of Web 2.0 applications and the role of

collaboration in the new applications. We then discuss why the 7C Framework is insufficient with regard to some of the Web 2.0 applications, and examine the design elements in the extended 8C Framework. Using the framework, we analyze a set of sample Web-based services (as shown in Table 1), and conclude the paper with discussions and future work.

Table 1: Major Progress of Web-based services and examples

Web-based services	Year of inception	Example services / tools
1. Static Web Sites (SWS)	Early 1990s	The first commercial Web browser, <i>Netscape Navigator</i> , was launched in 1995.
2. Interactive Web Sites (IWS)	1995/1996	Java applets, Java scripts, VB scripts, Flash technology
3. Search Engines (SE)	1995	Lycos, Yahoo, ..., Google
4. Discussion Groups (DG)	1995	Yahoo groups, Google groups
5. E-Commerce Sites (ECS)	1995	Amazon.com, e-Bay, ...
6. Online Social Networks (OSN)	Early 2000s	MySpace (2003), LinkedIn (2003), Facebook (2004), Ning (2005), Flickr, YouTube, ...
7. Online Collaboration sites (OCS)	Early 2000s	Wikipedia.org, online group work, ...

2. Characteristics of Web 2.0 Applications

Over the last few years, the World Wide Web has undergone many innovative changes, such as changes in application design (e.g., the look and feel components), development technologies and tools (e.g., Java scripts, Flash technology, etc.), and services provided (e.g., commerce, social networking, collaboration, etc.). A new term *Web 2.0* has been coined by O'Reilly Media [11] to distinguish between the old and the new generations of Web sites. In this section, we examine what Web 2.0 is and its characteristics from different perspectives.

Tim O'Reilly, president and CEO of O'Reilly Media, is the one who is instrumental in coining the term "Web 2.0". He explained what Web 2.0 is by using seven principles/features, which are considered as the core competencies of Web 2.0 applications [11].

- 1) *Services, not packaged software, with cost-effective scalability*: This means that it is the services that are generating the revenue for the organizations, as opposed to selling products in traditional applications.
- 2) *Control over unique, hard-to-recreate data sources that get richer as more people use them*: An example is the bit-torrent where people using the services add their own resources to the whole

set of consumers. Thus the services get better and better as more people use it.

- 3) *Trusting users as co-developers*: This type of development model is used in developing many open source products. The feedback from the users helps the developer and/or the organization to make the product better, and in many cases, the users are active developers as well. Therefore, the *collective intelligence* (see below) of the users/developers adds value to the products.
- 4) *Harnessing collective intelligence*: This aspect deals with collaborative services provided by the Web site. The network effects from user contributions are the key to market dominance in Web 2.0. The success of companies such as Google and Amazon.com are directly linked to their success in "harnessing collective intelligence" created by customers' contributions via product reviews, blogging, online profiles, etc. [12]
- 5) *Leveraging the long tail through customer self-service*: The "long tail" represents the collective power of the small sites that make up the bulk of the Web's content. Let's use online ads as examples. DoubleClick's offerings, for example, require a formal sales contract, therefore limiting their market to the few thousand largest Websites. Overture and Google, on the other hand, figured out how to enable ad placement on

virtually any Web page, leading to their success in online advertisements. What's more, they shunned advertising formats such as banner ads and pop-ups, which are publisher/ad-agency friendly but are not favored by customers, and instead favored minimally intrusive, context-sensitive, and consumer-friendly text advertising.

- 6) *Software above the level of a single device*: This means that the software (Web application) should work on different devices and different client platforms in such a way that they will be able to deliver the same quality and performance on different devices and platforms.
- 7) *Lightweight user interfaces, development models, and business models*: The interfaces are lightweight, meaning that they do not consist of heavy graphics. Besides, the development model focuses on simultaneous developing, testing, and releasing of different features, and feedback from the users is considered in the development process.

The above seven features may be used as criteria gauging a Web application. As pointed out by O'Reilly, "The next time a company claims that it's 'Web 2.0', test their features against the list above. The more points they score, the more they are worthy of the name. Remember, though, that excellence in one area may be more telling than some small steps in all seven" [11].

What is Web 2.0 from the technological perspectives?

It is worth noticing that the seven principles of Web 2.0 discussed above are *technology neutral*, meaning they do not require any specific technologies be used in order to make a Web-based application 'Web 2.0 conforming'. Andi Gutmans of Zend Technologies², on the other hand, provides a technological perspective of Web 2.0. He considers that a Web 2.0 application can be divided into three parts: rich Internet applications, service-oriented architecture, and social Web/collaborations [5].

a) Rich Internet Applications (RIA)

Being "rich" means the Web-based application provides a desktop-like feel/experience to the Internet users (e.g., drag and drop). The significance of Web 2.0 being rich Internet applications was well

² Zend Technologies created the Zend engine, which is the core of PHP.

explained by Shantanu Narayen, CEO of the Adobe Inc. While talking about Adobe's future direction, Narayen said [7], "A key element of what has been called 'Web 2.0' -- along with ideas such as user-generated content and social networks -- is the concept of 'rich Internet applications' ..., which use the Web as a platform for new types of online experiences. From delivering browser-based software that functions like a traditional desktop application to providing immersive video experiences online, a new generation of Internet-connected applications is beginning to evolve."

b) Service-Oriented Architectures (SOA) [10]

A *service-oriented* architecture means the Web application adopts an open architecture based on the notion of Web services, such that other applications may leverage and integrate those services. This is important for the businesses that are service-oriented. The more services a Web application publishes to the external applications, the more the usability of that Web application. This will directly or indirectly affect the revenue of the organization. Examples of service-oriented architecture include RSS (Really Simple Syndication), Web services, and mash-ups.

c) Social Web/Collaboration

In most Web 2.0 applications, the user is not just a simple user. Instead, he or she is contributing to the content of the site. In addition to the traditional feedback mechanism, the contribution may be made in the form of blogging, wiki, podcast, tagging, etc. Working collaboratively is proving to be beneficial and is inherently social by nature. Alongside collaboration, a Web application and its users can greatly benefit from user-generated content, may it be in the form of articles, blogs, music, or video clips. Although online collaboration was not a predominant factor in the Web 1.0 type of applications, it is an essential ingredient of Web 2.0 type of applications. Every notion of Web 2.0 speaks about the collaborative nature as well as user-generated content of the Web applications.

An excellent example that integrates all the 3 parts of the Web 2.0 type of application is the *iGoogle* and the *Google universal gadgets*, which are provided by the Google, Inc. *iGoogle* is the user's personalized Webpage where the user can add gadgets and set preferences. Gadgets are user-generated content by creating widgets using html and JavaScript. The content can be anything from RSS feed readers, clocks, or any other custom gadget. It is also a type of service-oriented architecture (SOA) in

a simple form. Therefore, people using the *iGoogle* service generate gadgets (an example of user-generated content) which make the *iGoogle* service richer and more useable to the overall user community. The *iGoogle* is a Web 2.0 type of application that integrates all the three parts of Web 2.0 as discussed above.

3. What is the Role of Collaboration in Web 2.0 Applications?

In the beginning the term ‘Web 2.0’ was very vague and could hardly be understood, but at present all the definitions of Web 2.0 lead us to the same principles with acceptable little variations. One thing is clear: Web 2.0 applications usually have the users contributing data/content and intelligence to the sites. Organizations aiming to build Web 2.0 applications will be focusing on providing the users the tools to create/edit the content which they use.

Parameswaran and Whinston [14] indicate that the Web 2.0 or the social computing “empower individual users with relatively low technological sophistication in using the Web to manifest their creativity, engage in social interaction, contribute their expertise, share content, collectively build new tools, disseminate information and propaganda, and assimilate collective bargaining power.”

An excellent example of such *online collaboration* is Wikipedia.org³, where people create and edit the content of a free online encyclopedia. The degree of collaboration in Web applications such as Wikipedia is very high.

3.1 Wikipedia as an example of online collaborative Web 2.0 application

As described by Christian Wagner [19], Wikis (meaning ‘fast’ in Hawaiian) are “a promising new technology that supports conversational knowledge creation and sharing. A Wiki is a collaboratively created and iteratively improved set of Web pages, together with the software that manages the Web pages.”

In Wikipedia, people may view free content, participate in editing an existing topic, or start writing about a topic. They may also contribute their knowledge to the published topics by writing a comment or becoming one of the editors. All the material that one posts has to be under GNU Free

Documentation License. Anyone who does not want the material that he/she posts to be freely available to the public should not post the material in Wikipedia.

To maintain consistency and quality, a consensus needs to be made before changing (edit/delete) the content of a published page. However, not all content can be edited/deleted using the consensus. Figure 1 is a flowchart that illustrates how consensus is reached. A user first edits an article, and then he waits to see if the article is further edited. If the article is changed and the user disagrees with the change, he could propose a reasonable change to integrate his ideas with the new ones. If the edit is a revert and the user does not agree with the revert, he/she may discuss/support it on the talk page. It is hoped that using such a process will provide the necessary mechanism helping consensus to be reached.

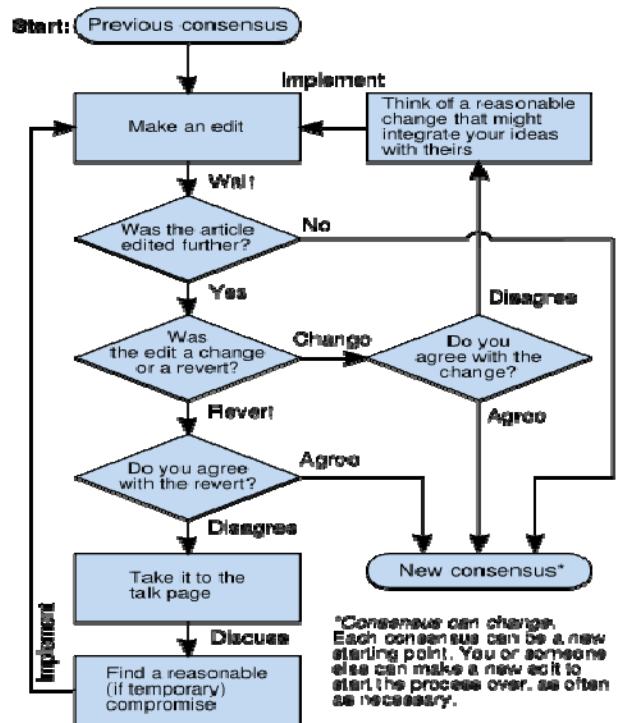


Figure 1: The Consensus Flowchart illustrates Wikipedia’s collaborative editing process⁴

A *wiki* may be defined as a Website that allows visitors to add, remove, edit and change content. Various “wiki” applications have been built by adopting the model of Wikipedia. Wikis allow for linking among any number of pages. This ease of interaction and operation makes a wiki an effective tool for mass collaborative authoring.

³ <http://en.wikipedia.org>

⁴ http://en.wikipedia.org/wiki/Image:Consensus_new_and_old.svg#file

Wikipedia is just an example of Web-based applications that support high collaboration. It can be classified as an online collaborative writing/editing application. There exist other examples of successful collaborative writing applications, such as the Linux documentation project (see <http://www.tldp.org>).

3.2 Other Examples of Collaboration

In addition to collaborative writing applications, online collaboration can be applied to various fields, including business management, education, production, etc. Online collaboration provides scalability and flexibility to users, helps establish close relationship between online partners, and provide operational efficiency and competitive advantages. The growth of online collaboration is witnessed by the increasing number of tools that enable users to build online communities, manage teamwork, and share documents, spreadsheets, and workspace.

Nigel Spicer, the president of 1stWorks Corporation, describes the application of online collaboration in the context of online conferencing [16]. Since online conferencing has fallen in short of its collaborative capacities, he suggests a client-centric architecture which enables more efficient collaboration among users through efficient online communications.

Another example of online collaboration is its use in dispersed project management, in which team members are located away from each other geographically. As advertised by Groove Networks (now acquired by Microsoft), the maker of an online collaboration application, "Any user can set up and deploy a Groove workspace in seconds without the effort of setting up secure servers or VPNs ... Groove Virtual Office is everything your team needs to share information, manage projects, conduct meetings and get work done ... When you reconnect to the network, Groove automatically synchronizes all your changes." [4] Jeff Raikes, the group vice president of the Microsoft Information Worker Business, said⁵: "With our shared vision for making collaboration natural and easy, Microsoft and Groove can offer businesses complete, highly integrated collaboration software and services that enrich any kind of work situation".

Online collaboration is extensively used in education and research as well. For example, the Wharton School of the University of Pennsylvania has integrated collaboration software based on Documentum's *eRoom* into the school's learning environment [3]. Faculty members in all 11 Wharton academic departments utilize Wharton's collaborative courseware environment in over 400 courses each year, teaching more than 6,900 students across all of the school's curricula [3].

In the field of distance learning, Maushak and Ou [9] point out the importance of online collaboration through synchronous communications. Because of its capability to provide immediate feedbacks and responses, synchronous communications enable effective cooperation among learners in their work.

A 'weaker' form of collaboration exists in the recent trend of social networking Websites, where people come and share their knowledge and interests, resulting in the formation of online collaborative communities [2]. Participants in these communities may be categorized into three types: The *toolmakers* are those who build, add, or customize tools for others to use; the *gatherers* gather/filter media, music, and information, or give comments on blogs; the *entertainers* share movies, media, and music [2].

Encouraging user contributions and online collaborations not only benefits the users, who can get valuable information from others' contributions, but also benefits the company sponsoring the Website, mainly because the rich content contributed to the Website helps the growth of the user community, and increase the potential of attracting online advertisements and businesses.

As the communities grow, businesses may place online ads on those Websites, aiming to capture the attention of those users whose interests are potentially related to the businesses' products or services.

All these examples lead to one observation: Collaboration, to some extent, is changing the way people work in many areas, especially in dispersed project management and online learning. The beauty of collaboration is that, as the number of people grows and contributes toward the content or the management of the application, the application's value increases. Online collaboration enables user-generated content, which is a unique feature of Web 2.0 applications.

⁵<http://www.microsoft.com/presspass/features/2005/apr05/04-08Groove.mspx>

Incorporating online collaboration into a Web-based application may incur overhead. As discussed earlier in the context of Wikipedia, managing the collaborators and ensuring the quality of their contributions are issues that need to be addressed. Although it is beyond the scope of this paper to address those issues, how they are tackled in an online collaboration system will impact the effectiveness of the collaboration.

Based on our survey, we believe that collaboration is an important factor while developing new generation (Web 2.0) of Web applications. A reference model for Web 2.0 applications must be able to capture the design aspect of collaboration. The 7C Framework [15] has been used by many as a reference model for developing Web applications, mainly because it defines seven different interface design elements for typical Web-based applications. In the following section we first present the 7C Framework, and then analyze the framework with respect to the characteristics of Web 2.0.

4. The 7C Framework and Related Work

As a reference model for the interface design elements of a Web-based system, especially in an e-commerce application, the *7C Framework* was recommended [8, 15]. As shown in the shaded area of Table 2, the 7C Framework includes seven elements, each of which represents a specific component of the system: *Context* (how the Web site is designed), *Content* (what information are presented), *Community* (how users communicate with each other), *Customization* (is the site customizable), *Communication* (how the site communicate with the user), *Connection* (how the site is related to other sites), and *Commerce* (what e-commerce functionalities are provided) [8, 15].

As indicated by Lee and Benbasat [9], “the 7C framework is chosen as the reference for comparison, because it emphasizes the specific role of interface elements as a communication channel between retailers and their customers. In other words, the 7C’s are the interface components through which retailers communicate with their customers to deliver the core value proposition the company wants to convey.”

Even though the 7C Framework seems to encompass all the interface design aspects of Web applications, it fails to accommodate the interface design element for *collaboration*. Among the seven Cs, the *community* element comes closest to mimic collaboration, but it fails to do so because

collaboration is task-specific while the community element defines a set of communication methods and is usually not related to a specific task or goal.

Interestingly, there are several 7Cs and 8Cs models proposed by researchers in related or different domains. Hamilton and Gunesh [6], for example, define an 8C Framework by adding ‘characterization’ as the 8th C, in order to account for the Web site’s ability to adapt and modify itself, giving the impression of a made-to-order site made specifically for the customer. Although adaptability is important for Web 2.0 applications, we believe that the ‘characterization’ element can be accommodated in the ‘context’ and/or ‘customization’ elements for Web 2.0 type of applications.

Oinas-Kukkonen [13] describes a conceptual model for the evaluation of knowledge management systems, known as the 7C model for organizational knowledge creation. The model includes the following 7Cs: Connection, Concurrency, Comprehension, Communication, Conceptualization, Collaboration, and Collective intelligence. Collaboration, in the model, is explained as “a true team interaction process of using the produced conceptualizations within teamwork and other organizational processes”. Oinas-Kukkonen’s 7C model, however, was proposed as a model of organization knowledge creation, and is not a model of interface design elements of Web applications, for which the Rayport and Jaworski’s 7C Framework was proposed.

Adapting from Kearney’s framework [18], Cleland [1] proposed an 8Cs online brand experience model to explain how brand building is achieved in an online environment. The 8C components are Convenience, Content, Customization, Community, Connectivity, Customer Care, Communication, and Consent. Since the model focuses on an online brand-building process, few of the C’s are similar to the Rayport and Jaworski’s 7C model, which we are extending in this study to accommodate Web 2.0.

The potential benefits of the 7C Framework can be found in the effective evaluation and designing of marketing communication and advertisement on the Internet. As indicated by Triki and Abidi [17], “e-advertisement was considered as a promising constituent of the economic activity enticed by the big potentialities offered by the advertisement on the Internet.” They assert that the advancement of the Internet and related technologies provides businesses with the means to conduct marketing communication functions economically and efficiently [17]. In order

to evaluate the effectiveness of Websites, Triki and Abidi rely on Rayport and Jaworski's 7C model when evaluating ergonomics and classify the Internet sites of those companies.

The effectiveness of online communications and the overall design of the Website greatly impact the size of the online community and the contributions made by online users, both of which directly affect

the potentiality of attracting online advertisements and the generated revenue. An effective reference model, such as Rayport and Jaworski's 7C Framework, is important in the development and evaluation of effective Websites. By extending the 7C Framework to encompass *collaboration*, we aim to create a reference model for evaluating and designing effective Web 2.0 applications.

Table 2: The 7C Framework (the shaded area) and the 8C Framework, in the Contexts of Web 1.0 and 2.0

Interface elements	Meaning/Types (Examples) in Web 1.0	Meaning/Types in Web 2.0
1: Context	<i>How the site is organized, and how the content is presented to the users?</i> a. Functionalities: layout, performance b. Aesthetics (look-and-feel): color schemes, visual themes	<i>The Web 2.0 Web sites have layouts that are more dynamic. The performance and dynamism increase greatly by the use of technologies such as AJAX and FLASH.</i>
2: Content	<i>What are offered by the site?</i> Offering mix is the mix of product and service information on a Web site; Appeal mix refers to promotional and communication messaging, <i>Multimedia mix</i> deals with the choice of media; <i>Content type</i> refers to the degree of time-sensitivity.	<i>Collective Intelligence mix is the new addition which deals with all traditional three "mixes" with users participating in the generation of the content. This is typical of Web 2.0 applications.</i>
3: Community	<i>Non-interactive communication; Interactive communication</i> (instant messaging, message boards, member-to-member emailing lists)	<i>Collaborative communication</i> may be enabled via non-interactive and, most likely, interactive communication mechanisms.
4: Customization	Refers to the site's ability to tailor itself (<i>tailoring</i>) or to be tailored by each user (<i>personalization</i>) [9, 15].	The content of the site can now be tailored in a collaborative manner, since the content will be user-generated. Also the customization can be done in more dynamic fashion (<i>desktop-like feel</i>).
5: Communication	Site-to-user communications: <i>Broadcast, Interactive, and Hybrid</i>	Site-to-user communications: <i>Broadcast, Interactive, Hybrid, and Push/Pull</i> (e.g., RSS)
6: Connection	Refers to the extent of formal linkage from one site to others: <i>outsourced content, percent of home site content, and pathways of connection</i> [9, 15].	Lots of content from external sites may be pulled in the form of blogs, advertisements, mash-ups, etc.
7: Commerce	Deals with the interface that supports the various aspects of e-commerce, such as shopping carts, security, order tracking, etc.	Deals with the interface that supports the various aspects of e-commerce, such as shopping carts, security, order tracking, affiliates and advertisements, etc.
8: Collaboration	Generally in the form of feedback forms, forums, and bulletin boards.	Refers to the site's ability to provide users with interface and services to carry out high degree of collaboration, such as collaborative editing, project managements, etc.

5. Extending the 7C Framework for Web 2.0

To accommodate the features of Web 2.0 applications in the extended reference model, the meaning of the elements needs to be updated. In

addition, *collaboration* needs to be added as the 8th C in the Framework. Table 2 provides a comparison of the two frameworks, in terms of their interface elements, meanings and types, in the contexts of Web 1.0 and Web 2.0 applications, respectively.

It is interesting to see in Table 2 how the meaning/type of different interface elements has changed from Web 1.0 to Web 2.0 type of applications. In terms of “Context”, Web 1.0 applications generally use html and CSS plus the regular graphics, etc.; Web 2.0 applications generally use AJAX, FLASH and advanced CSS technologies.

In terms of “Content”, Web 1.0 applications contain information, products and services for sale; Web 2.0 applications have services along with lots of user generated information/content. In terms of “Community”, there is an addition of collaborative communication in Web 2.0. In terms of “Customization”, Web 1.0 applications have fewer facilities/techniques for customizations than Web 2.0, which takes advantages of the advanced technologies. In terms of “Communication”, Web 2.0 has the added push-pull model for communication between Web application/site and its users. In terms of “Connection”, Web 2.0 has added content from many external sites in the form of blogs, mash-ups, etc. In terms of “Commerce”, Web 2.0 applications have added service-oriented architecture to collect revenue. In terms of “Collaboration”, Web 2.0 provides the users with interface and services to carry out high degree collaboration, such as collaborative editing, project managements, etc.

6. An Analysis of Representative Web-based Services using the 8C Framework

We have performed a comparison analysis of representative Web-based services (Table 1), by using the *8C Framework* as the reference model. The result of the analysis is shown in Table 3, which gives a brief summary of the types of Web based services/applications from the lens of the 8C Framework.

Table 3 highlights which interface elements are used by a particular type of Web-based service. One thing that is revealed in Table 3 is that recent innovations, such as online social networks and online collaborations, seem to have *accumulated* most of the design elements existent in the Web-based services that emerged earlier in the history of the Internet. The functions provided by the first three Web-based services (i.e., SWS, IWS, and SE), for example, had all been incorporated into the later services.

Online social networks and online collaboration sites appear to share similar characteristics with

respect to most of the eight elements. While the traditional discussion groups (e.g., *Yahoo groups* and *Google groups*) are still active and alive, many online social network sites have incorporated discussion groups (or forums) into their services.

With respect to the *collaboration* element, although both online social networks and online collaboration sites have the 8th C (i.e., collaboration), the kinds of collaboration in those two types of services are inherently different. In online social networks, the collaborations tend to be limited to sharing of information, comments, and media; in online collaboration sites (e.g., Wikipedia), collaboration among the users are much stronger, often in the form of collaborative editing or project management. In online social networks, a user can form various groups and share information; in online collaboration sites, members of the same group tend to work together to accomplish a certain task.

There exist collaboration tools⁶ for various types of applications, including those for project management, cross-company communications, information sharing, etc. Collaboration tools make it easy for people around the world to be part of the same team, and provide distinct benefits for business continuity. In particular, collaboration brings in the benefit of user-generated content to Websites, which is an important feature of next generation Web applications. Table 3 clearly illustrates the significance of including ‘collaboration’ as a design element in the extended 8C Framework.

7. Conclusion and Future Work

Web 2.0 represents a new shift in Internet applications, and is now accepted by most people as the term representing the next generation of Web-based services and applications. The Web 2.0 type of applications should have certain features as explained in Section 2 of the paper. Obviously, collaboration is an important feature of Web 2.0 applications. Some applications are inherently collaborative by nature, but even the applications that are not can also benefit by integrating collaborative services. This may be either in the form of feedbacks or forums, which may help to improve the usability of the application. Alternatively, the collaboration services may be used to incorporate user-generated content to the Website, making it even more attractive to potential users and advertisers.

⁶ <http://www.networkworld.com/topics/collaboration.html>

The 7C Framework is fundamental in the sense that it can be applied to any type and generation of Web applications. It helps to identify the interface elements that are built into the Web application. It also helps developers to construct effective interface for a new Web application. We have tried to analyze the 7C Framework with respect to Web 2.0 and found it necessary to add one more C to it, which is 'collaboration'. This gives us the 8C Framework. We

have also updated the meaning of the eight Cs with respect to the Web 2.0 features. In a similar manner as the 7C framework has been used in evaluating and guiding the interface design of traditional (Web 1.0) web-based applications, the 8C framework that we have developed in this study can be used to evaluate the current Web 2.0 applications, and/or be used as a reference model for developing web interfaces for new generation of Web applications.

Table 3: Comparative analysis of representative Web-based services, using the 8C Framework

Services	Context	Content	Community	Customization	Communication	Connection	Commerce	Collaboration
Static Web sites (SWS)	Linking between pages, coloring, some graphics	Static content	<i>Interactive</i> (User-to-Admin emails)	N/A	N/A, or <i>Interactive</i> (email-discussions)	Online ads	N/A	N/A
Interactive Web sites (IWS)	Linking between pages, coloring, graphics + animation	Static + dynamic content	<i>Interactive</i> (User-to-Admin emails)	N/A	N/A, or <i>Interactive</i> (email-discussions)	Online ads	N/A	N/A
Search engines (SE)	Linking between pages, coloring, graphics, animation + Query/response	Query results	<i>Interactive</i> (User-to-Admin emails)	N/A	N/A, or <i>Interactive</i> (email-discussions)	Online ads	N/A	N/A
Discussion groups (DG)	Linking between pages, coloring, graphics, animation, Query/response	Exchange of information	<i>Interactive</i> (discussion groups, file sharing)	Create your own groups; Manage My groups	<i>Broadcast</i> (email-announcements), <i>Interactive</i> (email-discussions)	Online ads	N/A	N/A
E-commerce sites (ECS)	Linking between pages, coloring, graphics, animation, Query/response	Browsing of products	<i>Interactive</i> (Buyer-to-vendor emails)	<i>Personalization</i> (My page, Watch list)	<i>Hybrid</i>	Online ads	Shopping cart, security, orders thru affiliates, order tracking, delivery options	N/A
Online social networks (OSN)	Linking between pages, coloring, graphics, animation, Query/response	User profiles, group highlights	Social network groups, friend-to-friend emails, chatting, Inst Mesg	<i>Personalization</i> (My page, My groups, My friends)	<i>Hybrid</i> (emails, blogging, forums, chatters, RSS Feed, etc.)	Online ads, External links for peers	Affiliates and advertisements	Sharing information and building information with limited collaboration
Online collaboration sites (OCS)	Linking between pages, coloring, graphics, animation, Query/response	User profiles, groups, exchange/addition/editing of information	Interactive (user-to-user, user-to-admin)	Create groups; customize look & feel of the site for a group.	Hybrid	Online ads, External links	Selling s/w, affiliates, online ads, donations	Main tools/functions provided for collaboration (e.g., collaborative editing)

Since so much is emphasized about collaboration and user-generated content in Web 2.0 applications, there are several directions of future work. First, our endeavor should focus on analyzing the revenue models that are and could be created around the applications providing these types of services (collaborative services). Second, the issue of information quality in collaborative information creation and editing mechanisms should be addressed. Third, from an organizational perspective, the impact of collaboration including social interactions and knowledge sharing should be investigated.

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