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Global Diffusion of the Internet XV: Web 2.0 Technologies, Principles, and Applications: A Conceptual Framework from Technology Push and Demand Pull Perspective

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Abstract:

Web 2.0, the current Internet evolution, can be described by several key features of an expanded Web that is more interactive; allows easy social interactions through participation and collaboration from a variety of human sectors; responds more immediately to users' queries and needs; is easier to search; and provides a faster, smoother, realistic and engaging user search capability, often with automatic updates to users. The purpose of this study is three-fold. First, the primary goal is to propose a conceptual Web 2.0 framework that provides better understanding of the Web 2.0 concept by classifying current key components in a holistic manner. Second, using several selective key components from the conceptual framework, this study conducts case analyses of Web 2.0 applications to discuss how they have adopted the selective key features (i.e., participation, collaboration, rich user experience, social networking, semantics, and interactivity responsiveness) of the conceptual Web 2.0 framework. Finally, the study provides insightful discussion of some challenges and opportunities provided by Web 2.0 to education, business, and social life.

Keywords: Web 2.0, conceptual Web 2.0 framework, Web 2.0 technology, Web 2.0 principles, Web 2.0 applications, comparative case analysis

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I. INTRODUCTION

In the last few years, there have been massive changes in the ways that people are interacting with technology. In fact, more interaction with technology is one of the major changes that users are experiencing. This trend and key feature of interaction can trace its roots to the increasing usage of the term *Web 2.0*.

Defining Web 2.0 has caused a chasm in the computing and information fields. Although Tim O'Reilly and Dale Dougherty coined the term Web 2.0 while investigating the differences between businesses that survived the dot com catastrophe of 2001 and those that did not [O'Reilly 2005b], the distinctions between Web 2.0 and Web 1.0 are not crystal clear; defining Web 2.0 is difficult for several reasons.

First, there are no brand new and revolutionary technologies that make Web 2.0 applications/services available. AJAX[1] (Asynchronous JavaScript and XML) is considered a major technology for Web 2.0 applications such as Google Maps, Microsoft Windows Live, Facebook, and Flickr. However, it is important to note that AJAX is not a new technique. Although AJAX relies heavily on JavaScript and XMLHttpRequest being accurately and efficiently handled by Web browsers, it comprises a group of various older technologies which includes XML, CSS, DOM (Document Object Model), XHTML, and so on. For example, its key object, XMLHttpRequest, was first introduced in Internet Explorer 5 in 1999 by Microsoft. Because of this reason, the boundary between Web 2.0 and previous Web technology (Web 1.0) is blurred, which makes it difficult to define Web 2.0 clearly.

Second, there is a varying and diffused understanding of Web 2.0. Many say Web 2.0 is a buzzword, while others claim it is a tangible structure determining how applications and services are to interact. Clearly, Web 2.0 is not a tangible object that was marketed as a product, nor is it a structure that was developed in the planning room.

Third, Web 2.0 is a massive topic with a large number of methodologies and components that interact with it. The number of Web 2.0 technologies, ideas (or principles), and applications/services involved is too complex to have a crisp boundary for clearly understanding the concept of Web 2.0. Thus, Web 2.0 needs much explanation and has many definitions. Even O'Reilly and his colleagues' definition of Web 2.0 has changed.[2] They first stated:

> Web 2.0 is 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. [O'Reilly 2005a]

Later, Musser, OReilly and their team [2006] [p. 12] defined Web 2.0 as "a set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet." Recently,[3] O'Reilly admitted that the definition is not clear. He mentioned that "Web 2.0 is not about front end technologies. It's precisely about back-end, and it's about meaning and intelligence in the back end. … Web 2.0 was a pretty crappy name for what's happening."

Another difficulty with defining Web 2.0 is narrowing down which components to cover. The interior platform structure of Web 2.0 is difficult to define because it is an evolving conceptual idea that controls the technological standard of the services that interact with it. The inner platform or core of Web 2.0 embodies all of the features and traits that define Web 2.0. The closer a tool or methodology gets to the platform core, the more features it possesses similar to the platform structure.

[1] Please refer to the Open Ajax group for a detailed overview of AJAX (http://www.openajax.org/whitepapers.html).
[2] Different definitions and explanations are well summarized at http://wiki.wsu.edu/wsuwiki/Web_2.0_at_WSU.
[3] Tim O'Reilly, 2007. "Comments in response to Web 3.0–The Official Definition Imaginable," at http://novaspivack.typepad.com/nova_spivacks_wezblog/2007/10/Web-30—the-a.html posted October 4, 2007.

Figure 1 shows a Web 2.0 visualization which has many components to explain. Some of them are technological components (e.g., AJAX, RIA's, and XML/DHTML), some are principles (e.g., participation, collective intelligence, and rich user experience), and others are actually applications and tools (e.g., Wikipedia, Flickr, and Mashups).

Figure 1. Terms and Applications Related to Web 2.0

Since Web 2.0 covers a massive number of topics, including a number of collective market/social trends and shifts, a number of Rich Internet Applications (RIAs), a set of features characterizing the RIAs, and popular technologies used in the Internet today, there is a fundamental need to better understand this massive concept and its impact on our education, business, and social life. Although studies [Anderson 2007; Kolbitsch et al. 2006; McAfee 2006; Murugesan 2007; Parameswaran et al. 2007; Tenenbaum 2006] have described conceptual developments and overviews of Web 2.0 applications principles, rarely are studies conducted on a conceptual framework of Web 2.0 to understand the Web 2.0 concept from a holistic perspective (i.e., from technology at the bottom layer to user/market demands at the top layer).

Thus, drawing from the existing literature on Web 2.0 and a technology push and demand pull perspective, the objective of this study is three-fold. First, the primary goal is to propose a conceptual Web 2.0 framework that provides better understanding of the Web 2.0 concept by classifying current key components of Web 2.0 in a holistic manner. In addition, using several selective key components from the conceptual framework, this study conducts comparative case analyses of Web 2.0 applications to discuss how current Web 2.0 applications have adopted the selective key features (i.e., participation, collaboration, rich user experience, social networking, semantics, and interactivity responsiveness) of the conceptual Web 2.0 framework. Finally, the study provides insightful discussion of some challenges and opportunities provided by Web 2.0 to education, business, and social life.

II. DEFINITIONS AND KEY CHARACTERISTICS OF WEB 2.0

Time and the continual growth of Web technologies, new Web applications/services, and ideas have determined that there is a significant difference between the key features of the Web today, compared to the key features of the Web several years ago. As mentioned, Web 2.0 is a massive topic with a large number of elements that interact with it. Viewing Web 2.0 from different angles using different lenses creates different definitions. MacManus [2005] defines Web 2.0 as service platforms. "For corporate people, the Web is a platform for business. For marketers, the Web is a platform for communications. For journalists, the Web is a platform for new media. For geeks, the Web is a platform for software development. And so on." Tenenbaum [2006] offers a general description of Web 2.0 as "a collection of emerging Web technologies and methodologies that make the Web more participatory (that is, two-way versus read-only), more semantic, and more real-time (that is, event-driven). Perhaps more importantly, Web 2.0 is a cultural phenomenon. Developers start with a simple but useful idea and get it out quickly, so others can refine and embellish it. The process has come to be known as mass collaboration—thousands of individuals build incrementally upon each others' work" [2006] [p. 53]. Funk [2009] [p. xv] describes Web 2.0 as "a social transformation that has put more interactivity and control of content into the hands of regular users, not just big site owners." The Web 2.0 is a name given to a set of loosely related key trends and technologies that have changed many of the ways people use the Internet [Geoff 2007].

In this study, we view Web 2.0 as an umbrella term that describes a set of ongoing development of Web generations which have layered conceptual ideas and newer applications/services that current technologies push and market demands pull. Although Web 2.0 is a shorthand term for many different things, some in conflict, and some overlapping, Web 2.0 is a useful term to describe the main elements of the Web today, which, together, create the boundaries around the picture of the current trend of the Web and the directions of future Web.

Drawing from the literature [Dheap et al. 2005; Geoff 2007; O'Reilly 2005b; Parameswaran et al. 2007; Tenenbaum 2006; Thomas 2005], we identify a set of characteristics of Web 2.0 compared to Web 1.0. It is worth noting that splitting Web applications or services into Web 2.0 and non-Web 2.0 in terms of time frames, features, and technologies would be difficult because of two reasons. The boundary between Web 1.0 and Web 2.0 (or Web 2.0 and Web 3.0) is blurred and developers of Web applications that survived probably have a chance to study Web 2.0 technologies and approaches and adopt them when appropriate. Table 1 summarizes the comparison[4] of Web 2.0 versus Web 1.0 with key characteristics and example applications by three categories: technology, business/application, and social/user.

Table 1. Comparison of the Characteristic Traits of Web 1.0 to Web 2.0

Dimension	Web 1.0	Web 2.0 (examples)	Source
Technology	Standalone software packages (users update their software using patches that vendors provide)	The Web as software platform: the Internet is the software (i.e., offer software via a Web browser; e.g., Google Docs, G.ho.st, a Web OS)	[Murugesan 2007; O'Reilly 2005b]
	Closed source environment	Interconnectivity, crowd-sourcing, emergent open source environment, and network externality (e.g., Joomla, eyeOS)	[Anderson 2007; Murugesan 2007; Musser et al. 2006]
	Compartmentalized applications	Modular, semantic tagging, collective intelligent component based applications, community-based architectures (e.g., Web services, Web API)	[Anderson 2007; O'Reilly 2005b]
	Centralized client-server (Web server to clients) technology and limited reach to Web sites	Wide reach to smaller sites enabling the long tail effect, may employ peer-to-peer networking (e.g. Bit Torrent, eDonkey)	[Anderson 2007; Musser et al. 2006; O'Reilly 2005b]
	Low interactivity with relatively static Web pages	High interactivity with AJAX with dynamic Web pages (e.g., Google Maps)	[Murugesan 2007; O'Reilly 2005b]
	Directories/Taxonomy/general search	Machine readable semantic data: Tagging/ Folksonomy/ Microformats/ vertical search	[Anderson 2007; O'Reilly 2005b; Tenenbaum 2006]
Business/ Application	Ad-revenue based model is one of many Web business models.	Relevance, ubiquity and the indirect benefits of network externality ensures Ad-revenue based model to become increasingly important. (e.g., Google AdSense, AdWords)	[Murugesan 2007; O'Reilly 2005b]
	Publishing using top down approach (e.g., Britannica Online),	Participation from bottom up approach (e.g., Wikipedia, blogging, MySpace, YouTube, Flickr),	[Anderson 2007; Murugesan 2007; O'Reilly 2005b; Tenenbaum 2006]
	Advertiser initiated advertisements (i.e., one-way, read-only; e.g., DoubleClick)	User oriented and enhanced advertisements (i.e., two-way & dynamic); relevant, easy to share, access, and consume: user experience, information, and knowledge [e.g., Google AdSense)	[Murugesan 2007; O'Reilly 2005b]
	Monolithic core competency (e.g., MapQuest)	Data Mashups pull together different sources of data to create a new hybrid application or service that provides more customer value (e.g., WikiCrime)	[Anderson 2007; Murugesan 2007]
Social/User	Small crowd interactions and networks	Massively connected social interactions, social networks, social computing, community empowerment (e.g., MySpace, Facebook)	[Anderson 2007; Musser et al. 2006; O'Reilly 2005b; Tenenbaum 2006]
	Limited collaboration	Collaboration; easy to participate, create, and update content (e.g., Wikipedia, blogging, MySpace)	[Anderson 2007; Murugesan 2007; O'Reilly 2005b]

[4]For some Web applications, the boundaries between Web 1.0 and Web 2.0 are not as clear as stated in the table.

III. A CONCEPTUAL WEB 2.0 FRAMEWORK

The balanced *technology push/demand pull theory* has been broadly accepted as the key rationale of technological innovations [Mowery et al. 1979; Utterback 1997]. In a demand-pull aspect, market and consumer needs may create a demand for new technology/service that is currently unavailable, which forces research and development efforts to accelerate innovation. On the other hand, for the technology-push aspect, new technology/service may evolve to spawn innovative uses and thereby generate demand.

As discussed, since Web 2.0 covers a massive topic, there is a fundamental need to better understand this massive concept. In this study from the lens of the technology push and demand pull perspective along with the view of Web 2.0 as a set of business, social, and technology trends that collectively form the basis for the next generation of the Internet, we identify four hierarchical layers related to the Web 2.0 paradigm: Web 2.0 Technologies, Web 2.0 Principles, Web 2.0 Applications/Service, and Web 2.0 Drivers (see Figure 2).

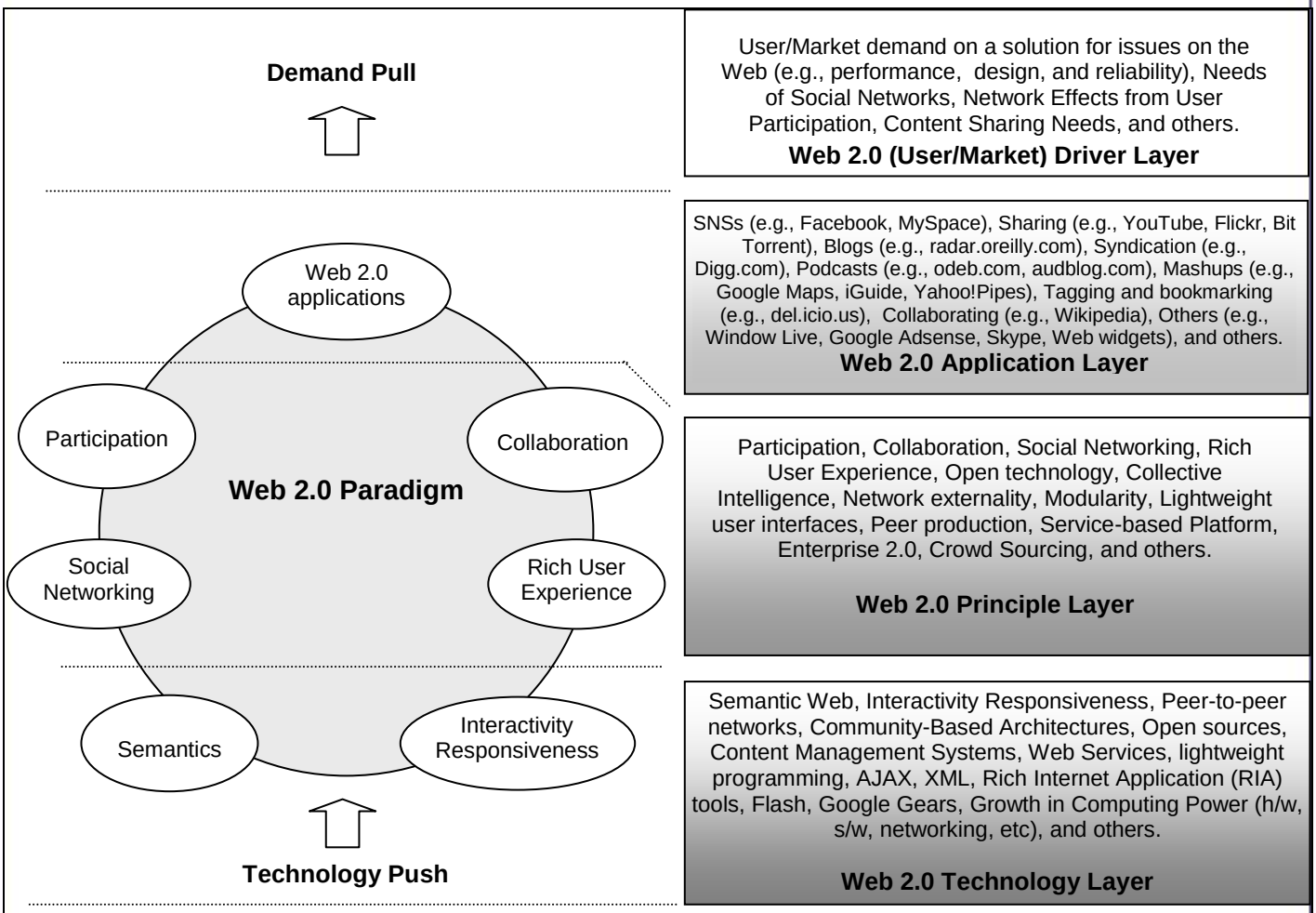

Figure 2. A Conceptual Framework of Web 2.0 Paradigm

Web 2.0 Technology layer refers to the enabling technologies or technological concepts that provide the infrastructure and building blocks for Web 2.0 RIAs while supporting Web 2.0 principles. Web 2.0 Principle layer depicts common fundamental characteristics observed from current Web 2.0 platforms that are somewhat different from traditional applications or platforms. Web 2.0 Application layer is about actual Web 2.0 RIAs that implement the lower layer principles using the enabling technologies in the technology layer. Web 2.0 Driver layer refers to the market/social/user driving forces that pull the fundamental shifts in technology, online business networks, online communities, and individual online behaviors.

A couple of examples can be considered as a case for applying the push/pull as a background rationale of Web 2.0. In general, Web users are becoming less patient. There are several reasons Web users leave a Web site (e.g.,

slow-loading, dead links, confusing navigation, and pop-up ads).[5] Slowness is one of the major reasons that Web surfers leave a Web site. In traditional HTML's page-oriented Web sites, one of the big frustrations for Web users is the time spent waiting for pages to reload after they click on a hypertext link. If a Web page contains a lot of text or figures (e.g., stock price) that need to be updated, big size images, and embedded plug-in components, the situation is worse. Several attempts have been made to address this market demand (i.e., improve the speed of loading) through individual techniques (e.g., JavaScript, DHTML, CSS, DOM, XML, XSLT, and XMLHttpRequest). Coalescing all together successfully, AJAX delivers a highly dynamic, interactive, and speedy desktop-like user experience for Web applications in popular HTML browsers. With AJAX, instead of the entire page, only small portion of a Webpage that is relevant to the response of user input is to be dynamically reloaded in real-time. In other words, small amounts of data are exchanged between the client side of AJAX-based applications and Web servers. This means improving speed and interactivity. Clearly, this is the case that demand pulls technology.

AJAX is an attractive Web technology that provides rich interaction features, such as automatic data refresh, multiple interactions, smoother responses, and continuous real time support. In turn, utilizing the technology, IT professionals (e.g., Web application developers, usability practitioners, and user interface developer) develop new RIAs that provide richer and more interactive user experiences. For example, Google makes a huge investment in developing RIAs using AJAX. Some of the major products Google has introduced are Google Maps, Google Suggest, and Google Groups. In short, AJAX has emerged as a critical technology pushing Web-based business applications/services of the next generation of Web (i.e., Web 2.0) for users on the Web. Obviously, this is the case that technology pushes demand.

As another example, the new features that make Social Network Site (SNS) successful require a new set of technology and design principles. The tremendous successes of these SNS thus prompt their development. This is demand pull. On the other hand, the availability and maturity of SNS software such as Joomla and Drupal further entice smaller business to try out SNS approach. This is technology push.

Among the components of the technology and principle layers of Web 2.0 conceptual framework, we identify and discuss six key features: participation, collaboration, social networking, rich user experience from the Web 2.0 principle layer, and semantics and interactivity responsiveness from the Web 2.0 technology layer. These identified features are based on literature review, as well as our study of leading Web 2.0 Web sites. It is worth noting that these six are not inclusive of all the features that surround Web 2.0 paradigm; however, we argue that they are the ones that users are experiencing with increasing rate on numerous Web 2.0 applications. Furthermore, these features are not mutually exclusive but, instead, tend to be supportive and complementary to each other. For example, collaboration and social networking can be considered as important advanced forms of participation. In the same token, a semantic and meaningful Web enhances participation, collaboration, and social networking. It enriches user experience. Its deployment, on the other hand, is aided by advances in technologies on interactivity responsiveness.

Participation

There is a clear shift from a traditional centralized platform to a decentralized platform that allows end-users to participate in Web 2.0 applications/services. In Web 2.0, participation means the way that an application and service is actually designed to improve and facilitate massive user with low barriers to use [Anderson 2007]. For example, a blog is a Web publishing tool that is used for easily creating Web journal entries in Web pages by end-users. Blogs are pushed onto a stack data structure and displayed in reversed chronological order on the Web page. Blogs can be displayed as an entire Web page or in a portion of a Web page along with other services. Blog entries can consist of more than just traditional types of journal entries; they can also include links, photos, and videos. Syndication feed is another service that makes Web sites more accessible and participatory to other Web sites or individual subscribers. Syndication feeds can be read through a feed reader or aggregator, software used on the client side, which uses a data format called Web feed to manage and retrieve syndicated Web contents from multiple sources automatically. Web sites are also designed to further enhance users' participation. For example, Digg.com provides news feeds but also allows users to contribute news items and the community to "dig" the news to increase its prominence.

Collaboration

Collaboration can be considered as an advanced form of participation in which participants directly or indirectly contribute to focused creation of contents serving a common purpose shared by the community. The previously

[5] http://www.bookmoreweddings.com/public/81.cfm

popular Usenet technical forum where users post questions and discuss solutions on a specific subject can be considered as a community collaborating indirectly on building a repository of a body of knowledge in the subject.

Web 2.0 applications usually have the users contributing data/content and knowledge to the sites [Yang et al. 2008]. For example, wikis are Web sites built collaboratively by a group or community and are among the most collaborative tools used with Web 2.0 technologies. Wikipedia, which consistently ranks as one of the top ten most popular Web sites, is a well-known example of a collaboratively built Web site with well-defined subject areas, goals, and policies. A group contributes to inputting and editing the data on the Web site. In the least restrictive form, anyone can make changes to an entry in Wikipedia. The changes will be reflected immediately in the site. To control quality, a core group of contributors of the entry will be notified via email. This group can then examine the changes and see whether the changes need to be modified or reverted. Moreover, large corporations and government agencies are using collaborative tools such as wikis to benefit their organizations. These organizations use wikis to build knowledge bases for their employees to reference and to collaborate with other members of the organization. One of the purposes of wikis is to get the information posted so that others can offer insight to the topic(s) of interest, thus creating a faster evolution in generating information on a topic and making a usable knowledge base for others to use.

Social Networking

A phenomenon that exemplifies Web 2.0 is the practice of social networking [Parameswaran et al. 2007]. Social Networking is an important form of user participation in which the goals are to build and maintain social connections for satisfying social, career and personal needs. Compared to traditional sites that focus in a particular *area of interest*, such as ESPN on sports, social network sites focus on *people*: the users. There is now an abundance of Web services available that connect people with friends, businesses, and services. This connection of individuals constitutes thousands of communities of voluntary subscribers who may join at no cost and who benefit in some way from the association with the community. Subscribers usually create their profiles to identify and promote themselves to the rest of the community. The community may be social in nature, such as those networks that allow friends to keep in touch with each other by publishing such details as background information, political views, current activities, pictures of themselves, and links to friends. Or the community may be professional in nature, such as those networks that connect potential employees and businesses by providing job postings and resume postings. MySpace and Facebook are examples of two extremely popular social networks. LinkedIn is an example of a professional social network. Social networks have had and will continue to have a significant impact on communications and commerce. It is evident that the hundreds of millions of people who are connected through social networks will not only communicate within their network, but they will also be more inclined to buy, vote, and be entertained within that same community.

Rich User Experience

Rich user experience is the ability of the Web to deliver full-scale GUI style applications to the client, making it easier to interact, share, and access Web content. Although rich user experience is based on rich contents, it focuses on the rich user interface to enhance how the data is presented, manipulated, and used by the users.

A combination of technological components makes up a Web application technique called Asynchronous JavaScript (AJAX), which is the foundation of a dynamic user experience [Thomas 2005]. AJAX continually transmits data between the server and the client while interacting with the Web page [Thomas 2005]. Before AJAX, Web server-side applications usually serviced a user request by providing a fresh new Web page of response content, even if only a small percentage of content changed. The sending and reloading of the response page is time-consuming and seriously reduces the interactivity of Web applications. Instead, AJAX allows Web applications running on a client side (the Web browser) to receive small chunks of data from the Web server, and subsequently use them to update the page without reloading it. Thus, only some data may be necessary to reload from the server side and this is being done through asynchronous HTTP requests with the use of XML. The tremendous speed-up by AJAX causes the pages to react more like stand-alone applications (applications that are self-contained). Google Map is a good example of the power of AJAX. A user can move from one side of the planet to the other side, zoom in, change the point of view by rotating the image, zoom out, and move to another part of the planet while experiencing a virtually seamless page. A user can simply drag the map to move it alongside in real time. This is in contrast to the older version of the static MapQuest map in which a user must wait a long time for the map to refresh to move it. Furthermore, map movement can only be in one of the eight directions in a fixed incremental distance. Thus, even though the quality of the map data is comparable, Google Map provides a much richer user experience. As a result, all leading map providers now adopt Google AJAX-based map technology.

Web 2.0 applications also incorporate more frequent uses of video, audio, and context sensitive pop-ups to enhance rich user experience. Besides AJAX, Flash and other Rich Internet Application tools make key contributions. Rich user experience has long been the linchpin of the video game world. Web 2.0 applications increasingly adopt this principle to build an enticing virtual world. Second Life is an ideal example based on a virtual 3D world which even leading academic institutions have used to conduct virtual courses.

Semantics

Advances in technologies provide a strong push for the proliferation of Web 2.0 applications. Rapid progress in the general computing area, such as growth in processing, storage and network; lightweight software development models; and open source software development, has quickly lowered the cost of software development in general, not just Web 2.0 applications. However, technology advances related to two major areas have especially been crucial in the spawning of Web 2.0 applications: semantics and interactivity responsiveness.

A semantic Web is a Web that has a consistent terminology standard, and a logical system is used to organize, manage, and link data together in a way that benefits the users of the system and improves interoperability between systems. Instead of providing only markup display information to the browsers through the use of HTML, a semantic Web strikes to supply meaning to the data so it can be better utilized, possibly by much larger communities than the content publishers. The huge success of XML lays the cornerstone for the semantic Web where meaning of the data can be annotated by XML markup. This is accompanied by the breeding of Web services based on Simple Object Access Protocol (SOAP) or REpresentational State Transfer (REST).

Combined with the participatory and collaborative nature of Web 2.0, technologies have advanced quickly in enticing the community to create and annotate Web contents. This includes community-based architectures developed by many organizations and content management software created by both open source communities and commercial vendors. As a result, Web 2.0 contents are generally accompanied with more meaningful context. For example, Web 2.0 integrates tags into databases to associate data objects with one or more keywords. Tags can have traditional types of classifications, such as headings and categories, and not so traditional classifications, such as subjective descriptors [Tenenbaum 2006]. Tags are customizable, and any label can be used to tag an object. Tags add a new dimension to search engines, providing a better retrieval system than an organized hierarchy of folders. Folksonomy[6] is another part of the system that makes Web 2.0 Semantic. An example of folksonomy is a community or group's collaborative use of a set of tags to associate objects on a Web site, thus organizing and classifying data in a flexible way. Objects can be classified in multiple ways, including numerous tags that allow several names to be attached to an object [Tenenbaum 2006].

Microformats and vertical search engines[7] are other important concepts that make Web 2.0 a semantic Web. Microformats are an emerging technology that allows different types of software to communicate and increases interactivity with the user. They are techniques used in organizing data into structures or frameworks. For example, designers use them to mark-up and embed structured metadata in Web pages and blogs, making content easier to discover, index, and aggregate [Tenenbaum 2006].

Interactivity Responsiveness

An important part of Web 2.0 is the promptness of responses that accurately cater to user demands. Many consider AJAX to be the key technology that signaled the onslaught of Web 2.0. Speedup achieved by AJAX makes many Web 2.0 applications feasible. Besides AJAX, sophisticated multi-media and Rich Internet Application (RIA) tools have become increasingly powerful and ubiquitous. For example, Flash is used for responsive and rich animation, Web components, Web pages, and RIAs. It has achieved a nearly universal adoption in the Web. Recently, a new interesting interactivity feature called "Video Annotations" was added by YouTube.[8] Using these features, video creators and users can add interactivity to their videos: add background information about the video, link to related videos, channels, or search results from within a video, or create stores with multiple possibilities (i.e., viewers click to choose different endings).

Besides enhancement by technologies obvious to the users, advances in interactivity responsiveness are also abundant in the server side and transparent to most. For example, event-driven response architecture is an

[6] Folksonomy, also known as social tagging, social indexing, and collaborative tagging, is a user (i.e., folk)-driven taxonomy. This people-powered, bottom-up classification approach allows Web users to collectively create tags to annotate and categorize content and makes a body of information increasingly easy to search, discover, and navigate over time.

[7] In contrast to the broad-based general search engine (e.g., Google), vertical search engines (e.g., Edmunds.com) provide more domain specific, quicker, and more precise search results using their indexes that contain information about a specific topic.

[8] YouTube Annotations (http://googlesystem.blogspot.com/2008/06/youtube-annotations.html)

architecture-based service and a Web 2.0 technology that runs in the background constantly updating Web content in real time. The architectural design of this technology results in looser coupled software and seamless collaboration across architectures that provides a platform for service based computing [Dheap et al. 2005]. This technology is the driving force that keeps much of the upper layer Web 2.0 applications' Web content up to date in real time. For example, after a Web page has a subscription to the architectural based service, the client or server connects to a virtual cloud that uses an event-driven architecture to update their services. The subscriber selects a topic or service and subscribes them to a real time search engine in the virtual cloud. Since the architecture is similar to an event-listener, when an event or change takes place on the selected topic or service, the change is mapped to the subscriber where the update takes place in real time, alerting the server and the client of the change.

IV. COMPARATIVE CASE ANALYSIS OF WEB 2.0 APPLICATIONS AND FINDINGS

Using the six selective key features identified previously, we conducted a short comparative case analysis of a variety of Web 2.0 applications. The purpose of the case analysis is to show the validity of the conceptual framework, presenting how various current and popular Web 2.0 applications are fitted to the selective key features of Web 2.0. The results of the analysis are summarized in Table 2.

Table 2. Comparison of Web 2.0 Applications Using the Six Key Features of Web 2.0 Paradigm

Web 2.0 Applications	Participation	Collaboration	Rich User Experience	Social Networking	Semantics	Interactivity Responsiveness
Google Adsense (Advertisement placement in Web sites)	Web site owners enroll in the program to enable text, image and video ads on their sites	Tight collaboration between Google and Web sites for placing advertisements	Algorithms ensure advertisement, most relevant to the content of the Web sites	Gives the option for the networking community to see targeted advertisement	Uses semantics technology in its search engines for advertisement placement; Uses tags to associate type advertisement with Web site content	AdSense templates, API and fast Google Ad server places advertisement quickly
Corkd.com (wine review)	Community-based free service for reviewing, sharing and discovering wine	Blogs, RSS feeds, and wikis are all tools used to collaboratively build this Web site	The combination of blogs, RSS feeds, wikis, tagging, and real-time updates makes for a rich user experience	An example of sharing information and soliciting input from the online social network community	Microformats, tags, tag clouds, and folksonomies are used	Blogs and RSS feeds are event-driven and real-time updated
Flickr (photo sharing)	Online community platform for photo management and sharing	Gives user complete control of privacy, sharing and tagging; Uses blogs to keep a timeline of photos and RSS feeds to interconnect and update other members with the same interest	Uses Organizr toolbox for managing photos, and AJAX to create a GUI style application; In addition, photos can be put on a world map similar to Yahoo Maps	Offers online photo sharing and the opportunity to keep in touch with selected community members	Uses tags, tag clouds, and folksonomies to organize photos and group similar member's photos; Allows up to 70 tags per photo for quick reference	Blogs, syndication feeds, and photos are updated in real time. Other members are notified of the updates with syndication feeds and blogs
Wikipedia (online encyclopedia)	The biggest multilingual free encyclopedia written by participants around the world	Harnesses the power of mass collaboration; Topics and information content can be created or edited by anyone	The combination of wikis and real-time updates make a rich user experience	Offers a central store of information which is available in multiple languages for a worldwide community	The site uses tags in its content to link pages that have similar interest or content connectivity to the original page	Content can be updated and changed in real time

Google Maps (Mashup)	Users can add content into Google Maps	Google Maps API allows the creation of embedded Google Maps Web applications	Google Maps uses AJAX to enrich the users experience on the site. While navigating the site, the page is constantly updating in the background	Allows users to relate to distant communities	Developers can add semantics on top of the embedded Google Maps	Google Maps allows the use of event driven programming in AJAX. Searching and updating is performed in real time while users interact with the maps
GMail/Google Reader (Web Email and news feed reader)	Users can subscribe to feeds which can be shared with other users	Google Reader offers Web feed integration and blogging services to its clients	Offers services to create a GUI-style application. Web-feed reader, blogs, word processor, spreadsheet, and Web History are all similar to PC applications	Allows for connectivity within and across communities	Tags are integrated to link Web feeds and blogs for easy access	Instant Messaging, Google talk, and advanced search engines are examples of event-driven real-time searches
BitTorrent (Lightweight Peer to peer download technology)	BitTorrent offers users peer-to-peer file sharing	Uses mass collaboration to build its site; Members become servers to other members. Personal work can also be published and distributed through BitTorrent.com	Not richer, but more available and quicker	Uses members to be a node of peer-to-peer file sharing network	Download speeds increase according to popularity. The more popular a file is the quicker the download because there are more sources available to download. This is a form of folksonomy where the files are ranked according to popularity	RSS Downloader provides search and user based RSS feeds; Click on any user name to see their uploads, and then the RSS button to view the feed
YouTube.com (now under Google; Video sharing)	A video-sharing Web site where participating users can upload, view and share video clips	It is built from participation and collaboration of a community of users. The site uses syndication feeds, blogs, and video sharing	The site offers members the ability to publish and share their own videos easily. Navigation and searching the site is simple	Allows sharing of videos within and across communities	Tags and folksonomies are used to label and file videos. Searching for videos using tags is the common method to find videos	Video annotations: users can add background information, link to related videos, channels, or search results from within a video, and create stores with multiple possibilities
Digg.com (news)	Participants discover and share content (e.g., Blogs, articles, videos, and RSS feeds) from anywhere on the Web	Members collaboratively add and rank content popularity	The combination of blogs, RSS feeds, tagging, and real-time updates make a rich user experience	Popular Web content is determined by those who participate in this application	Tagging provides semantic contents	Real-time and event-driven updates are used to update blogs and RSS feeds

Del.icio.us (social bookmarking)	Participants store, organize, share and search bookmarks of Web pages	Web site content is built collaboratively by members adding, sharing and tagging bookmarks	The combination of blogs, RSS feeds, tagging, and real-time updates make a rich user experience	Provides a mechanism for a group to bookmark shared content; or to share bookmarked content	Tags are used on content in the Webpage, and to bookmark Web pages. Tag clouds are used to determine popularity of content	Blogs and RSS feeds are updated in real time
MySpace.com (social networking)	Participants create a community and share photos, journals and interests with friends	Content is built collaboratively with member participation. Uses forums, chats, blogs, RSS feeds	The combination of blogs, RSS feeds, tagging, and real-time updates make a rich user experience	Provides forums, blogs, chats and email capabilities for communications	Tagging, tag clouds, and folksonomies are used to assist users to find content easily	Real-time and event-driven updates are used to update blogs and RSS feeds

There are several findings from the comparative case analyses. The integration of Web 2.0 features has increased the efficiency, accessibility, and popularity of many Web sites, as exhibited by the phenomenal growth of YouTube and MySpace. Such growth can be partially explained by the use of Web 2.0 features that have improved the ability of users to easily create, distribute, and use content. While there has been a recent surge in interest of Web 2.0, most of its applications were not developed overnight, but were, rather, developed and revised gradually over a period of years.

This onslaught of Web 2.0 applications affects different business models to various degrees. To one extreme, if a business model is to generate profits, we may find major Web 2.0 applications with no business model at all. This is encouraged by the open source spirit of Web 2.0 and made possible by wealthy entrepreneurs who have already struck it rich. A classic example is Wikipedia, a top-10 site in many surveys, as previously mentioned. Wikipedia does not display advertisement and has no major plan to "monetize" its popular site. It is trademarked by the not-for-profit organization, Wikimedia Foundation. Web 2.0 also marginalizes other traditional online business models. For example, we are now observing the ebbing of subscription-based models, whose proprietary and narrow-cast nature are seen not to be complementary to Web 2.0.

Meanwhile, Web 2.0 has created many new viable business models, such as video sharing in YouTube and social networking in MySpace and Facebook. However, the underlying support of many of these business models is still based on advertisement. In this respect, aggregating an audience and selling advertising continue to be fundamental for many Web 2.0 applications, as similar to that for Web 1.0 applications.

V. DISCUSSION: IMPACT OF WEB 2.0 ON EDUCATION, BUSINESS, AND SOCIAL LIFE

As a set of business, technology, and social trends, the Web 2.0 concept has been applied to many areas. In this session, we discuss the transformative impacts[9] of the Web 2.0 in the contexts of education, research, business, and social life.

Education

The radical changes that have occurred with a new generation of Web capabilities cannot be denied. The implications of Web 2.0 on education are huge and evolving. E-Learning through the Web has already increased the availability of learning materials to a very large class of audiences. Web 2.0 further amplifies their availability and richness. From the technology push's point of view, Web 2.0 techniques lower the cost of constructing e-Learning components extensively by decreasing the investment on building the necessary sites and crowd-sourcing major parts of supporting learning materials. This allows different models for e-Learning to be experimented economically, and many of them may become at least partially successful. Even individuals may be able to construct e-Learning components for a very narrow group of audiences profitably. As a result, established learning institutions will face even more fierce competitions and have to adapt accordingly.

[9] It is noteworthy that the discussion is based on our disciplined thoughts rather than careful extrapolations.

In fact, many universities may have reached the point that reconsideration of their "business model" is essential. A key traditional value of university education is the intellectual property epitomized by the lectures and class notes of the instructors. This value is strongly reduced by the abundance and accessibility of information in the Web 2.0 era. It is thus important for universities to contemplate, strengthen, and emphasize other learning values of university education. Some of these values may include certification of student learning outcomes, feedback from quality instructors, assurance of the quality of fellow students who are their learning partners, quality of the social network of the classmates and faculty members, and so forth.

The availability of various Web 2.0 techniques and their underlying philosophy also affects traditional learning models. Traditional teaching, even using a typical course management system such as WebCT, tends to favor more conventionally "administered" learning models based on the knowledge-transfer paradigm of behaviorist learning [Ullrich et al. 2008]. On the other hand, the collaborative community based nature of Web 2.0 may be more natural for alternative models such as those based on a cognitive theory of learning. It is thus expected that much experimentation and research will be conducted on identifying effective learning models to take advantage of Web 2.0 and on productively employing Web 2.0 techniques in these models for teaching.

In particular, the implications of Web 2.0 on information systems education will be even more intense as the subject of study of IS education itself is deeply affected. Web 2.0 directly influences how information systems will be built. The philosophy, methodologies, and technologies favored by Web 2.0 will gain significance in IS education and show up more often in IS curricula and courses. This provides both opportunities and challenges. For example, the abundance of Web 2.0 API and mashup may make construction of unique, creative, and meaningful IS assignments much easier. However, it may also open up other possible issues, such as intellectual property (the end product may now have economical values) and assessment (the resources used may not be fully controlled or understood by the instructor).

Research

The same force affecting learning will also act on research. By nature, Web 2.0 is open and collaborative, which meshes well with scientific research. The uses of Web 2.0 techniques such as wiki and blog can further enhance collaborations within the research community. Researchers have already experimented with Web 2.0 techniques to replace or supplement traditional techniques. For example, social network tagging has been used to supplant or complement traditional ontological indexing in various research areas [Anderson 2007]. Collective blogs such as ScienceBlog.com and Nature Protocols (nature.com), a peer-reviewed interactive online resource for laboratory protocols for researchers, provide assistance for researchers in the process of public understanding of science and research [Amsen 2006]. In terms of IS research, Web 2.0 techniques provide the opportunity for very low-cost experiment prototyping to be conducted using lightweight models and existing APIs. Thus, it is expected that many new and innovative ways for conducting IS experiments will appear in the coming years.

Business

The new trend of Web technologies that are transforming education, media, culture, and the economy are also reshaping how enterprises function. As a business initiative describing Web 2.0 trends in enterprise contexts, Enterprise 2.0 deals with how organizations are incorporating Web 2.0 technologies and principles into their work [McAfee 2006]. Enterprises can leverage their businesses in a number of different ways using Web 2.0 technologies. With social computing tools such as wikis, blogs, and virtual communities, companies can easily communicate and interact with their employees, customers, business partners, and society as well. For example, companies use wikis to provide a diverse range of business activities such as preparing project proposals, manuals, and reports; creating meeting agendas and minutes; doing business analysis and product reviews; brainstorming new ideas; managing information repositories; developing new products; and more [Murugesan 2007]. As pointed out by Tapscott and Williams [2006], we are moving toward "the wiki workplace."

The impacts of Web 2.0 in business can be classified into two general areas. First, internal business applications that are related to internal activities focus on improving business processes by delivering productivity gains, innovation, teamwork, and employee relationships, and helping to make better decisions [Murugesan 2007]. Examples of this category are internal collaborations through wikis and blogs, internal knowledge management and knowledge retrievals using tagging and folksonomy, enterprise-level information search and sharing common interested and responsibilities using social networking, and so on. Second, external business applications involve a business and its partners such as customers, suppliers, distributors, and the general public as well. Examples are data aggregation service from different sources using mashup, marketing and customer relationship improvement through corporate blogging, facilitating innovations and identifying new product needs using wikis, finding people for

hiring using social networking applications, offering highly personalized opt-in channels through gadgets/widgets[10] services, improving public relationships using RSS feeds, and others.

Social Life

Advances credited to Web 2.0 have provided many opportunities for persons with Internet access to more fully participate and interact on a globally social scale. An initial look at the impact certainly confirms that opportunities for sharing and interacting with others via the Internet has changed individuals into producers and consumers of locally created and publicly marketed art forms, merchandise, and information. The need for middlepersons as agents has been reduced. Further, an individual can participate such that the quality of his/her production is not scrutinized with regard to education or social standing and, ultimately, business models have changed worldwide.

It has never been this easy to interact through online communities: keeping in touch with friends and family, posting vacation pictures, creating meaningful relationships, playing online games, posting and searching for jobs, and participating in Webinars. News and propaganda can be quickly retrieved. Information that is syndicated and flashed in front of people can influence them socially and politically; when a single source of information, biased or balanced, is shown at login to a familiar site, viewers may be more likely to trust that source. Emerging policies and standards for a community are influenced by its users, if not completely controlled by them [Jarrett 2008].

On the frontier are issues that need to be addressed quickly: loss of privacy, loss of identity, the ability to capture and control personal information and using that information for seemingly harmless ends as advertising strategies [Zimmer 2008], ruined reputations from previous postings that cannot be erased [Albrechtslund 2008], and the continuing questions of how much surveillance is too much.

VI. CONCLUSION

In this paper, we proposed a conceptual framework to understand the Web 2.0 concept better and discussed some of the key features of Web 2.0, thus giving definition to the concept. First, the participatory components allow users to interact with Web pages. In addition, Web 2.0 has provided easy social interactions within and across the boundaries of interest groups and communities by allowing and encouraging collaboration. Semantics create a standard for the industry to provide direction and continuity between developers. Finally, the technology uses interactivity responsiveness based architectures that offer automatic update services for clients and servers in real time. With these new elements, clients are likely to rely increasingly on their computers, the Internet, and mobile devices to organize their lives and to keep them entertained.

Web 2.0 has its roots in consumer-driven technologies, which have expanded beyond the consumer sector to become popular business tools. These tools have more user-friendly multimedia collaboration features and interfaces. Drawing from our analysis, the key features of Web 2.0 are shifted paradigms of open technologies and architectural frameworks that facilitate participative and collaborative computing.

Businesses may be uncertain about how to make use of these technology paradigm shifts to achieve real business gains. Therefore, since Web 2.0 has the potential to enable rich peer-to-peer interactions and to enable collaborative value creation among business partners, organizations that are not using Web 2.0 technologies should investigate ways to use them. Clearly, we expect that Web 2.0 has affected the way businesses market their products, provide their services, and communicate with customers and partners. There will be more emphasis on using Web 2.0 tools and technologies to support innovation, creativity, collaboration, and information sharing in enterprise [Brynjolfsson et al. 2007]. Thus, further study should be done to see how business models, social relationships, standards, security, and privacy have been impacted empirically by Web 2.0.

Furthermore, customers using Web 2.0 sites extensively may have a drastically different set of expectations as compared to traditional brick-and-mortar customers. They have become accustomed to a high level of convenience, community-based reviews, instantaneous interactivity, rich contents, and reasonable pricing. This set of customer expectations may drive changes in business culture and practices and will be interesting from both the business and social points of view. We are working on a fuller treatment of the challenges and opportunities for business provided by the Web 2.0 paradigm and technologies.

[10] Gadgets or widgets are “always-on” and interactive virtual tools that provide a single highly focused service such as the current weather, stock prices, up-to-date financial news, and so on.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
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