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UNDERSTANDING ADVANCES IN WEB TECHNOLOGIES: EVOLUTION FROM WEB 2.0 TO WEB 3.0

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Abstract

The current generation of Web applications (Web 2.0) have made them an outright phenomenon in today's society helping to redefine the way organisations and individuals communicate and collaborate with each other. The purpose of this paper is to conceptualise the evolution of Web technologies from a user perspective. Based on inference from existing studies, this paper attempts to identify the architectural direction that the next generation (Web 3.0) of Web applications would meld itself into. The paper emphasizes limitations of current Web technologies and how future trends may address these limitations by focusing on migration that has been witnessed in the scope of the applications presented and features delivered on the Web from a users' perspective.

Keywords: Web 2.0; Web 3.0; Definition; Applications; Architectural Framework; Critical Success Factors; Advantages; Barriers; Shortcomings

1 Introduction

From being deployed as a mere group work tool to assist scientists at CERN, to being a global information space with more than a billion users, the World Wide Web has exponentially grown in the past 15 years (Anderson, 2007). Through its life cycle, the World Wide Web has been through various phases of development. On the back of widespread acceptance and elevated growth seen by Web 1.0, Web 2.0 emerged to incorporate new online activities, many of which could not have been previously achieved (Boulos & Wheeler, 2007). Going by the trend of constant evolution, the Web is now slowly but surely transiting to more data centric phase in the context of Web version 3.0 (Motta & Sabou, 2006).

Due to its evolutionary nature Web technology has seen a large explosion of new ideas, applications and start-up companies working towards extending and generating new services to add leverage to existing services (Anderson, 2007). In the evolution of the World Wide Web, Web 3.0 is considered to be the next frontier in Web technology which beholds the potential of intelligent information and semantic web. A steady migration towards this new version of the Web could be noticed with instances like coding geocodes on pictures and ability to keep information on an annotation platform with photos in Flickr. Such developments would enable other viewers to see photos from a geographical context, say for instance in a map. One could just click on Fisher-man's Wharf in Google Maps and obtain pictures that others have downloaded in Flickr (Sankar & Bouchard, 2009). Web searches are another example to elaborate implications of advantage of the Semantic web. This is where Web 3.0 artefacts such as the semantic search and its different methods of navigation through the massive data present on the internet would come under focus. On the whole, Web 3.0 promises to

enhance data mining with improved search capability, bigger distributed database, intelligent and smart search options across multimedia, improved connectivity between applications and more mobility capabilities (Sankar & Bouchard, 2009).

According to Kidd and Chen (2009), many believe that like Web 2.0, Web 3.0 is expected to revolutionize the entire architectural framework of the World Wide Web and frame the reference base for a future wave of Internet innovations. In contrast though, such innovative trends show disparate progress, influenced by different views and directions of internet development. Critics question the core drive of Web 3.0 as a mere marketing gimmick to propel it through the slowdown that the World Wide Web has seen in the recent financial depression. Even when a few of the definitions of Web 3.0 come across as woolly whilst yet others are controversial as well, this is because the main concept of Web 3.0 continues to be vague. Another obstacle for Web 3.0 is the lack of practical illustrations of the model. Several existent discussions seem to be guidelines based on conceptual theories. Whilst most of these theories were only bound with research yet very few of them have practical implications (Kidd & Chen, 2009).

This paper therefore would attempt to first delineate Web 2.0 from any arbitrary technologies by identifying evolutionary features and applications that make up Web 2.0 as how we see it today. Second after developing a broader appreciation of the composition of Web 2.0 from a users' perspective, the paper would attempt to build a user centric view of the composition of features that would be expected to be incorporated in future generations of Web technology. In sum, the paper presents a holistic view of the World Wide Web.

The research is structured in such a way that, the paper by classifying obtaining nature of Web 2.0 and projecting prospective characteristics of Web 3.0 different dimensions of the Web 2.0 frameworks, whilst its scope is directed to explore a stronger appreciation into architectural foundations of the next generation (Web 3.0) of Web applications.

Based on understanding of Web 2.0 features, this paper attempts to explore directions of development that the next generation of the Web (i.e. Web 3.0) is likely to incline towards. The analysis of existing literature on Web 2.0 and Web 3.0 will focus mainly on: (1) Understanding Web 2.0, based on the varied definitions available; (2) Framework of Web 2.0 as it is seen today by Web users; (3) The core applications that make up Web 2.0; (4) The critical success factors influencing the adoption of Web 2.0; (5) Advantages involved in adoption of Web 2.0; (6) Shortcomings in the current Web technology and the barriers that it would come across; and (7) Features incorporated in Web 3.0.

The remaining part of this paper is organised as follows: The next section provides an overview of the terminology surrounding Web 2.0, reviews the architectural framework literature available on Web 2.0 together with the core array of Web applications and their adoption of Web 2.0. A discussion of the critical factors contributing to the success of Web 2.0 and the advantages of Web 2.0, and the shortcomings and barriers of Web 2.0 are also offered in this section. Section 3 then presents an analysis of literature on Web 3.0, by examining the features incorporated in it. Section 4 dwells on a brief discussion, limitations and future research directions. Finally, Section 5 outlines concluding remarks of this analysis.

2 Understanding Web 2.0

Over the recent past, the Web has been transformed from being a medium in which information is transmitted and consumed, to a platform where content is created, shared, altered and reproduced (Downes, 2005 cited in Chatti et al., 2008). At the same time differentiation between Web 1.0 and Web 2.0 is not clearly defined. Indeed Sir Tim Berners-Lee, creator of the World Wide Web, has suggested that there is no real difference between the two, as some of the elements of Web 2.0 were fundamental parts of Web 1.0 (Myhill et al., 2009).

The term 'Web 2.0' peaked in popularity during the early part of 2007 and was believed to have enormous potential in its features. The concept of 'the social web' proposed initially by O'Reilly (2005) has had controversial definitions which were woolly and its validity as a discrete development in the realm of information management has also been questioned. However murky the definition of Web 2.0 may be, its underlying features emphasize flexibility of access, interaction, mobility,

multimedia capability, participation, informality and feedback (Abbott, 2010). Though frequently these terms are associated with Web 2.0, the technical developments are not its essence (O'Reilly, 2006 cited in Harrison & Barthel, 2009). Web 2.0 is instead a label coined by Tim O'Reilly (2005) and associates to reference the transition of the World Wide Web to a new phase of use and service development (Harrison & Barthel, 2009). Table 1 is used to elaborate on the understanding of Web 2.0 achieved through varied definitions prompted by different authors**.**

Technology Centric Definitions/Sources
Web has become a platform with software above the level of a single device, leveraging the power of the "long Tail" and with data as a defining force. (Hsieh et al., 2008; p 99); Technology that is associated with blogs, wikis, podcasts, RSS feeds etc. (Anderson, 2007); and An Umbrella terms used as a Synonym for the various development that the Web has seen. (Chiang et al., 2009; p 1350).
Business Centric Definitions/Sources
A way of architecting software and businesses. (Harrison & Barthel, 2009; p 159); The business revolution in the computer industry caused by the move to internet as platform and an attempt to understand the rules for success on that new platform (O'Reilly, 2006); and a description of terms and business models that survived the technology sector market crash in the 1990's (O'Reilly, 2005).
User Centric Definitions/Sources
The Social Web (Abbott, 2010; p 5); Is often used to characterize sites that consist of communities (Isaías et al., 2009; p 354); A social phenomenon, not a technology per se (Isaías et al., 2009; p 355); The philosophy of mutually maximising collective intelligence and added value for each participant by formalised and dynamic information sharing and creation (Hoegg et al., 2006 cited in Isaías et al., 2009; p 355); Is about content management and new ways of communication and interaction between users. (Boulakfouf & Zampunieris, 2008; p 127); Web applications that facilitate collective knowledge production, social networking and increases user to user information exchange. (Adams, 2010; p 392); "A trend towards greater creativity, information sharing and collaboration amongst the internet users" (Kompen et al., 2009; p 33); and Web 1.0 took people to information; Web 2.0 will take information to people. (Harinarayana & Raju, 2010; p 69)

Table 1. Understanding Web 2.0, Illustrates Various Definitions Put Across by Different Authors on Web 2.0, Providing a Better Understanding of Web 2.0.

T**able 1** has been created on the bases of Technological, Business and User centric categorizations of different authors that have attempted to either bring out the meaning of the terminology of "Web 2.0" or have interpreted their understanding of Tim O'Reilly's (2005) explanation of Web 2.0. Definitions such as that suggested by Tambouris and Tarabanis (2008) which propose Web 2.0 as "Web as a platform" that is a umbrella of software services run in a browser, communicating with network and other servers, offers a good overview of the technological diversity and the vastness that the Web 2.0 space caries. A generic business focused definition quoted by Tim O'Reilly, in 2006 as cited in Chiang et al., (2009) introduces Web 2.0 as a business revolution that the software industry has recently seen as a result of the shifted ideology in the way the Web has been viewed (i.e. as a platform, underpinning the enormous success that the Web 2.0 domain has seen as a business model). From a Web user's point of view other quotes that encapsulate the varying dimensions of Web 2.0 include "the Social Web" by Abbott, (2010, p 5); or "A social phenomenon, not a technology per se" by Isaías et al., (2009, p 355); or "A trend towards greater creativity, information sharing and collaboration amongst the internet users" by Kompen et al., (2009, p 33); all of which simply sum up the holistic view that Web 2.0 portrays across to the end user helping them to connect across all physical barriers reinstating the true sense of the social nature of the web.

To summarise, the array of varied definitions as seen in the table 1 would reiterate the fact that the expression 'Web 2.0' itself does not stand for one single technology. It is used as a broader generic phrase to represent the current generation of technology that connects people together on the internet platform. But in contrast with the third generation of the Web, more broadly known as Web 3.0, Web 2.0's emergence was not a response to a planned and coordinated effort, neither the assumption of experts that the Web was evolving autonomously, was suggesting such a proposal (Morato et al., 2008).

2.1 Framework of Web 2.0

Sharing tacit knowledge is a major challenge facing knowledge economies of today's era (Richards, 2009). Some part of what we "know" could be expressed, documented, structured and stored in repositories such as books, database and knowledge base. In the past, the focus of computer systems was on managing data, information and explicit type knowledge was found in expert systems. Of late, techniques have emerged for acquiring more implicit knowledge using social software such as Wikis, online Communities of Practice (CoP), Weblogs and many others which 'helps to realize the original vision of the Web as a space where anyone can participate' (Schaffert et al., 2005 quoted in Richards, 2009). The emergence of these behaviours indicates a trend towards which the World Wide Web is constellating in, broadly known as Web 2.0. This generation of the Web indulges in a creative use by individuals of the existing internet based technologies embedded with information sharing and collaboration (Richards, 2009).

Like many important concepts, Web 2.0 does not have a definite boundary that distinguishes it from other technologies, but rather is bound by a gravitational core. It could be considered that Web 2.0 as a set of principles and practices that branch together a veritable solar system of sites that incorporate and demonstrate some or all those features, at varying level from the core (O'Reilly, 2005). The basic ethos of Web 2.0 encourages individuals' freedom to create, annotate, and comment upon, index or share web content- trends which contradict or bypass traditional models of editorial control, centralized publishing and professional indexing (Abbott, 2010). Table 2 illustrates the architectural framework of Web 2.0. This would help create an in-depth understanding on the - versatility that the Web 2.0 carries in its applications.

Outlining Fundamental Framework of Web 2.0 - Remarks/Sources
Web as a Platform: The potentials of the user generated content and voluntary collaboration enhanced by data migration techniques would help data across various sources to be accessed simultaneously and seamlessly. Source: O'Reilly (2005); Web 2.0 applications use technologies which ease the creation and manipulation of internet content using Rich Internet Applications (RIA's); In short provide user content development tools. Source: Isaías et al. (2009); and The shift in Web technology and standards used (e.g., XML, AJAX, Flash). Source: Chiang et al. (2009)
The User Interface More Enhanced: Within Web 2.0, the newer set of applications are not so much as technological advances but mere enhancement in services delivered underpinning the technology surround the Internet and the web. Source: Anderson (2007): Users are propelled by services providers to keep their content updated and constantly adding new information to their profiles. Source: Isaías et al. (2009); and UI technologies used such as Rich Internet Application (RIA's). Source: (Preciado et al., 2008)
Richer User Experience: Provide Web based applications with richer user interface. Source: (O'Reilly, 2005); (Preciado et al., 2008); and Web applications have pleasant yet practical look and feel for its user-interface. Source: (Kristaly et al., 2008)
Ideas and content harness through more concrete manifestation: Web users collaborate with each other on various platform underlined by social computing Source: (Anderson, 2007); Individual production, harnessing the power of the crowd, data on epic scale, architecture of participation, network effects, & openness all provide a theoretical framework for the Web 2.0. Source: (Chiang et al., 2009); Standardization Source: (Kristaly et al., 2008) and Syndication Source: (Chen, 2008).
User generated content (UGC): The web user nowadays not only consumes but also supplies content through applications. Source: (Anderson, 2007; Abbott, 2010); and Demands the existence of trust in users and in the content they bring to the communities supporting the idea of cooperation as a core concept. Source: Source: Isaías et al. (2009); Harrison & Barthel (2009)
Harnessing Collective Intelligence: Hyper linking is the fundamental core of the web. Yahoo being the prime example as the first catalogue or directory of links. Then came google which pioneered page rank method, using link structure of the web. Network effects from the web user contribution are the key to market dynamics for web 2.0. Source: (O'Reilly, 2005; Chiang et al., 2009); User's critical mass figures, where success generate use and use generate success. Source: Source: (Isaías et al., 2009); and User centred and unremitting improvement, where the user is both the consumer and producer. Source: Source: (Isaías et al., 2009); (Harrison & Barthel, 2009); (Tahamtan et al., 2010); and Participation Source: (Kristaly et al., 2008)
Data Centric: All significant internet applications today are backed by specific and specialized database. Database management has also become the core competency of Web 2.0 companies today so much so that the applications are sometimes referred to as "infowar". Source: (O'Reilly, 2005); The utilization of data on a vast scale, the 'architecture of

participation'. Source: (Abbott, 2010).
End of the software release cycle: Software delivered as a service, not as a product. Source: (O'Reilly, 2005); Revenue generating strategies include the use or combination of advertising, subscription and affiliation models, business transactions and pecuniary contributions. Source: Source: (Isaías et al., 2009); and User-friendly applications using software as a service supported by the network effect. Source: (Isaías et al., 2009)
Lightweight Programming models: Has a simple program for ideal design adhering to syndication of data outwards. Source: (O'Reilly, 2005); Since the user participation is among the expectations of web 2.0 era services that offer mediated access to information resources. Source: (Abbott, 2010) and Ease of use of components Source: Source: (Isaías et al., 2009); Applications make use of many different technologies, yet it is presented to the user a unique, coherent interface. Source: (Kristaly et al., 2008); and The applications must be easy to use. Source: (Kristaly et al., 2008); and Support lightweight programming model that allow for loosely coupled systems. Source: (Chen, 2008).
Software adoptable on multiple devices: The usage of Web 2.0 applications no longer restricted to PC's alone. Source: (O'Reilly, 2005); Software above the level of a single device. Source: (O'Reilly, 2005)
Anytime, anywhere: Users interaction model where the user dictates how and when he or she can perform action. Source: (Chadwick-Dias et al., 2007) & Leveraging the long tail through customer self service. Source: (O'Reilly 2005)
Global phenomenon: Mass phenomenon with more individual participating with their own content. Source: Source: (Isaías et al., 2009)
Adoption of RIA: With dynamic contents on the web pages to improve user experience. Source:(Preciado et al., 2008)
Operation a core competency: Focuses on operation as its main strength. Source: (O'Reilly, 2005); (O'Reilly, 2005 cited in Chen, 2008).
User treated as co-developers: Trusting users as co-developers Source: (O'Reilly, 2005; Chen, 2008).

Table 2. Illustrates the Fundamental Framework of Web 2.0.

Table 2 tries to highlight the key architectural characteristics like, as stated by Anderson (2007), Isaías et al., (2009) and Preciado et al., (2008) each giving their version of illustration on how the user interface have become more enhanced as compared to that found in Web 1.0; also more affluent user experience as stated by O'Reilly (2005), Preciado et al. (2008) and Kristaly et al. (2008); platform for harnessing Collective Intelligence as emphasized by O'Reilly (2005), Chiang et al. (2009), Isaías et al. (2009), Harrison & Barthel (2009) and Kristaly et al. (2008); Lightweight Programming models with the ease and comfort of using components involved as stated by Abbott (2010) or Isaías et al. (2009) are a few among the gamut of features that make up the Web 2.0 framework. Evolutionary architectural features that are incorporated in Web 2.0 and highlighted in table 2 are mostly user centric, facilitating Web users to use this platform more flexibly. However when compared to Web 3.0, the architecture of the applications on Web 2.0 lacks a central core that is used to organise and standardize the way that Web is managed, which hampers the predetermined general growth on behalf of computer applications (Morato et al., 2008).

2.2 Adoption of Web 2.0 Applications

Even though most of the early studies and discussions were directed around the meaning of Web 2.0 and its applications, on a wider spectrum, Web 2.0 may be defined using features that it incorporates. These features that it is integrated with, could be looked at from a technology point of view or based on the social impact it creates (Linh, 2008). When Web users need to choose an application, there are several factors that a Web user usually keeps in mind, some of those would be: simplicity of navigation, financial cost, existence of real social network and their interaction with the site, compatibility with people who are also actively engaged in participating in the site, the site's visual appearance, the amount of user options and privacy protection features. Also it becomes vitally important to assess the site's offerings with regard to quality and quantity of available applications. These include privacy settings, the possibility to generate and manage content and the degree of aptitude of the programmers (Isaías et al., 2009). There are a number of Web services or applications (for example, User reviews/Evaluation, Wiki, Blog, Content Sharing, Open source software adage, P2P/free download, RSS, Mashups, Podcast, Tag Clouds, Social bookmarking, Wikinomics) that are considered to be key concepts in Web 2.0 that represent the core fundamental blueprint of Web 2.0 applications and how it functions. According to Chawner, such applications have been moulded into four diverse roles that the consumer/ Web user play, with content as the focal point. These patterns of adoptions are categorized as Content Creator where the consumer plays a proactive role of actively

creating new content in varied forms; Content Consumers, where the role of the consumer is more passive, in which the Web user reads the content created by other people; Content Commenter, where again the Web user takes in an active role by commenting on the content created by other people, but does not take the initiative in creating new content and lastly as Content Collector, the content awareness role, in which the Web user take appropriate action either by bookmarking web sites, or by subscribing to web- based fees from blogs, content sharing sites or other such forums (Chawner, 2008). These diverse modes of application adoption in the form of contents have grown on to become the face of Web 2.0 for the current generation of Web users helping them categorise technology on a broader sense without the need of fully understanding the intricacy behind it.

Such Web 2.0 applications therefore would enable Web users with little technical knowledge to construct and share their own media and information products (Harrison & Barthel, 2009). The popularity of Web 2.0 applications demonstrates the assertion that, regardless of the level of technical knowledge, users can use technologies in a manner that was hitherto impossible. Such change has been made possible through collaboration, pooling knowledge and constructing content that they share with each other, which is subsequently remixed, redistributed and re-consumed (Harrison & Barthel, 2009).

2.3 Critical Success Factors of Web 2.0

Web 2.0 as a technology has strived to provide a productive balance between both, the organizational as well as that from a users' perspective. Organizations offer applications in form of services, by granting users access to sites and find mutual benefit from it. Organizations through this procedure attract more and more visitors, and users that see other related users with whom they can effectively interact (Isaías et al., 2009). Several business models have been constructed that are tangential to the Web 2.0 phenomenon (Isaías et al., 2009). The Web has seen the emergence of few completely new business models which did not seem feasible at first but have made a mark now as successful pioneering businesses. These would include models introduced by Netscape that focus on creating a community, Amazon and e-bay that focus on online marketplaces, and Yahoo and Google that help searching information through advertising supported sites (Lassila & Hendler, 2007). These business models generate revenue for the organization enabling its sustainability, further enhancement and development (Isaías et al., 2009). Furthermore, Web 2.0's Critical Success factors relate to its framework of architecture that addresses vital elements of the platform's success. Any website's usability and popularity would be intrinsically connected to the presence of these factors. In other words, these critical success factors (such as User's Critical Mass Figures (c.f. Isaías et al., 2009; Cifuentes et al., 2009); Ease of Use of Component (Abbott, 2010; Isaías et al., 2009; Remenyi, 2007); Availability of content to justify User's Access (Abbott, 2010; Isaías et al., 2009); Availability of User Content Development tools (Isaías et al., 2009; Blum et al., 2008; Blas et al., 2009) and alternative Revenue Models (Isaías et al., 2009; Hinchciffe, 2006; Harrison & Barthel, 2009)) represent the indispensable means to achieve Web 2.0's objective, regardless of the nature of the platform. Another important aspect that needs to be kept in mind is that all critical success factors are user centric, built keeping in mind the user expectations and capture Web 2.0's interactive essence (Isaías et al., 2009).

2.4 Advantages of Web 2.0's Adoption

O'Reilly (2005) offered a broadly adoptive insight into Web 2.0 applications as "those that make the most of the intrinsic advantages of that platform" (O'Reilly, 2005 quoted in Chen, 2008) which are delivered across to the consumers/Web users in the form of software with constant up-gradation that is calibrated to suit the changing market expectations. This would enable more and more people to adopt it, consume and remix data from multiple sources, while also creating data open to be edited by other Web users, building networks through architectural participation and going beyond the symbolism of web 1.0 by providing rich user experiences (O'Reilly, 2005 cited in Chen, 2008). To illustrate how the applications embedded in Web 2.0 technology translate into adoptive benefit for the Web user, we have a brief glimpse into a few core advantages rendered by Web 2.0 in the table 3.

Advantage	Remarks/Source
Cost Effective	Provided as a service and not a package, providing economy of scale. (O'Reilly, 2005); Service, not a packaged software. (O'Reilly, 2005 quoted in Myhill et al., 2009)

User Scalability	Control of unique, hard-to- recreate data sources that enhance as more people are engaged. (O'Reilly, 2005); (Tim O'Reilly, 2005 quoted in Myhill et al., 2009); Uses recommendations or information from anonymus contributorts. (Isaías et al., 2009); (Morato et al., 2008); and More dynamic interaction between clients and servers. (Harrison & Barthel, 2009)
Compatibility	Applications adoptable on a gamut of devices. (O'Reilly, 2005); (Morato et al., 2008)
Flexibility	Use of open source or use web users as co-developers. (O'Reilly, 2005); (Morato et al., 2008); and Decentralization of publication. (Mahmood & Selvadurai, 2006)
Light weight User interface	Simple UI, development and business model (O'Reilly, 2005); (Tim O'Reilly, 2005 cited in Myhill et al., 2009); (Harrison & Barthel, 2009); Long tail which allows small groups of individuals to benefit from key piece of the platform while fulfilling their own needs (Miller, 2006 cited in Aharony, 2009); and More engaging webpages and applications (Harrison & Barthel, 2009).
User Interaction Dimension	Easiness to interact with the web (Morato et al., 2008)
Decentralization of publications	Web 2.0 assist the people to add contents for Collective Intelligence (CI) (Mahmood & Selvadurai, 2006).

Table 3. Advantages of Web 2.0.

Most of the advantages listed in the table 3 demonstrate the versatility and usability that applications in Web 2.0 carry forward as benefit to Web users. Benefits like user scalability (Isaías et al., 2009), decentralization of publication (Mahmood & Selvadurai, 2006) and compatibility of adoption (Morato et al., 2008) as listed in table 3 largely represent the futuristic liberalization trends that have been derived from exploiting Web 2.0 applications.

2.5 Shortfalls and Barriers of Web 2.0 Technology

2.5.1 Shortcoming of Web 2.0 Technologies

With the emergence of any new technology comes the transition from research work to actual practical use and from standards to deployment, all of which impose a time delay. This migration period can sometimes be quite long, as shortfalls in technology creep in which are further compounded by changing expectations of people. Application developers and manufacturers are reluctant to implement products until they see a market forming, but the market does not form by itself until there are enough applications at its disposal. The lag therefore typically depends on how soon vendors hear the demand from users and can get the prototype applications across to them (Hendler, 2008) and may result in the shortcoming of the technology itself. The major drawbacks that Web 2.0 has seen over the course of time are: Applications developed focusing human comfort making data confusing (Isaías et al., 2009; Morato et al., 2008); lack of intelligent Web servers to avoid bottle necks (Blum et al., 2008; Bojars et al., 2008); no appropriate support for RIA UI design (Preciado, 2005 cited in Preciado et al., 2008), lack of central authority (Morato et al., 2008; Hsieh et al., 2008); security and privacy challenges (Tahamtan et al., 2010), offer Poor query possibilities - lack of generic data representation (Bojars et al., 2008), and overload of scattered information with uncertain quality has long been perceived as major problem (Abbott, 2010).

2.5.2 Barriers to the Current Web 2.0 Technologies

Sometimes even if the new technology meets expectations of the population at large, there are probabilities that these technologies may face hurdles from external environment which may limit the technology in presenting results which might not be at its optimum and hinder performance of the technology as a whole. It is these scenarios which often become a barrier for the technology requiring constant research and development effort to overcome them. The prominent barriers that Web 2.0 has been faced with currently are (1) Constant iteration cycle of Change and Updates to services (Anderson, 2007); (2) Ethical issues concerning build and usage of Web 2.0 (Anderson, 2007); (3) Most Web 2.0 services established in the precepts of "free economy" and free community (Isaías et al., 2009); (4) Transient technological or social fashions (Abbott, 2010); (5) Interconnectivity and knowledge sharing between platforms across community boundaries are still limited (Abel et al., 2007; Chan et al., 2009); (6) Since Web is an open medium, there has long been a question over the credibility of the websites and the information it holds (Adams, 2010); and (7) The challenge facing

the web is to make sure that all web developers and web designers follow accessibility guidelines in providing descriptions that optimize access to all web users especially the one with disabilities (Remenyi , 2008).

When Web 2.0 is compared to the next generation of the Web, Web 3.0 offers a generic infrastructure for interchange, integration and creative reuse of structured data, which on a holistic approach would help in overcoming some of the aforementioned limitations that Web 2.0 technology has been facing (Bojars et al., 2008).

3 Features Incorporated in Web 3.0

From a humble beginning as a methodology used as machine interpretable data through the new generation software, 'Web 3.0' also known by its pseudonym as Semantic Web, has matured itself into a set of standards that support open data formats whilst at the same time processes information that emphasizes information rather than mere processing (Lassila & Hendler, 2007). The main idea behind the semantics in Web 3.0 was the creation of Web content by not using natural language but a form of script that could be understood and gauged by software agents in order to allow them to find, share or integrate information much more easily and efficiently, meeting the first stepping stone towards intelligent applications (Kristaly et al., 2008).

As indicated earlier, the focal aim of the Web 3.0 technology is to assist the web users to contribute information in ways that computers can understand, process and exchange. These developments in Web technology would enable the Web application to perform tedious tasks like collating information from varied sources and assist users to search relevant information according to their needs efficiently (Mahmood & Selvadurai, 2006). This nature of versatile offering by technology in the past few years has prompted a growing interest in the new generation of Web, as indicated by the rapidly increasing number of semantic markup available on the Web, the number of organizations starting to carry out research and development activities in the area and by the number of Web 3.0 applications which now exist. All these developments indicate that Web 3.0 is mirroring the same growth of the Web in the early stages of its evolution, a strong signal that Web 3.0 is likely to become another technology phenomenon (Motta & Sabou, 2006).

The availability of Semantic markups would open up novel possibilities to develop smart, web based applications and functionalities. As Motta & Sabou (2006) suggest just a brief glance into the 3rd generation of the Web has shown Semantic Web applications that support intelligent data aggregation and presentation, semantic search, automatic annotation, question answering and Semantic Web browsing. Web 3.0 would bring additional properties that would include micro formats, natural language search, data mining, machine learning, recommendation agents and artificial intelligence technologies which would emphasize the importance of machine facilitated understanding of information. This in turn would provide a more sophisticated and lucrative user experience (Strickland, 2009 cited in Myhill et al., 2009).

From a technological view point, Web 3.0 is an amalgamation of Web technology and Knowledge Representation (KR), which is sub structure of artificial intelligence (AI) (Lassila & Hendler, 2007). This merge is basically concerned with constructing and maintaining models of the world which enable reasoning about themselves and their associated information (Lassila & Hendler, 2007). At the same time, the scope for application development is expanding exponentially, for example W3C has started an initiative dubbed the Ubiquitous Web, understanding the benefits of expanding the Web's threshold far beyond desktops and laptop computers to other devices and situational spaces (Lassila & Hendler, 2007). Many established companies are also taking a plunge into the Web 3.0 technologies which include companies like Mondeca, a European enterprise which are into information integration; Ontoprise, a German company into ontology-related tools. Big industry players like Oracle, Microsoft and IBM are also getting into this space (Hendler, 2008).

4 Discussion

The discussion presented so far in this paper showed that Web 2.0 has many features for those using it as a platform to run businesses as well as the users who would interact with the various applications

that Web 2.0 offers. Nevertheless, these discussions also highlighted a few shortcomings of Web 2.0 platform that were creating barriers for organisations and end users alike. Table 4 demonstrated how these shortcoming and barriers of Web 2.0 can efficiently be dealt with, by the features that are incorporated in Web 3.0. For example, aspects of the limitations of Web 2.0 like applications developed focusing on human comfort (Isaías et al., 2009) are countered by features like Use of the Folksonomy concept (Abel et al., 2007) and Use of Semantic Web (Mahmood & Selvadurai, 2006) which are the integral features incorporated in Web 3.0, and barriers like lack of Interconnectivity (Abel et al., 2007) are countered by features like off-line communication (Boulakfouf & Zampunieris, 2008) and Universal Accessibility (Mahmood & Selvadurai, 2006). These features incorporated in Web 3.0 enable inference that can be recommended on the structural framework of Web 3.0 industry and its future applications.

Limitations of Web 2.0	**Possible Solution in Web 3.0**
Source/Remarks	**Source/Remarks**
Applications developed focusing human comfort (Isaías et al., 2009): The technologies behind the applications are developed in forms which are human oriented, making data confusing for machine users thus making the mechanization of tasks complex	**Use of the Folksonomy concept (Abel et al., 2007): Where core data evolves over time by tagging resources and groups and by grouping resources and (re-) arranging them. Tagging done by users-folks and results in a collection of concepts-taxonomy that is called folksonomy**
"The lack semantic cues, and metadata in HTML content, its re-purposing for formatting and presentation, the lack of keyboard access"	**Use of Semantic Web (Mahmood & Selvadurai, 2006): Aims to assist the web users to contribute information in ways that computers can understand, process and exchange.**
Most Web 2.0 services established in the precepts of "free economy" and free community (Isaías et al., 2009): Access to most of the information is free and software is open leading to services facing revenue challenges.	**Interoperability (Mahmood & Selvadurai, 2006): Promote open (non-proprietary) computer languages and protocols to avoid market fragmentation.**
Lack of intelligent Web servers to avoid bottle necks (Blum et al., 2008): When 3rd part service building blocks are accessed by the mash-up clients directly	**3-tier Web application to 2-tier conceptual model for web 3.0 applications (Boyer, 2008): The Server tier is augmented by web services or ATOM publishing protocol to allow direct communication and interaction with the client tier.**
Lack of modelled and methodologies to support the RIA UI design (Preciado, 2005 sited in Preciado et al., 2008): Do not support systematic adaption from web 1.0 UI's to Web 2.0 UI's	**Use of RUX-method (Preciado et al., 2008): A model driven method for the systematic design of RIA UI's adapting existing HTML based web applications.**
Lacks Central authority that organizes and standardizes the way that web is managed (Morato et al., 2008)	**Creating of semantic resources with common domain knowledge (Morato et al., 2008): Semantic Knowledge should be expressed in documents written in a web language oriented to knowledge modelling like RDF**
Security and Privacy challenges (Tahamtan et al., 2010): Brought about by the disclosure of personal/organizational information on Web 2.0	**Model-View-Controller pattern (Abel et al., 2007): Consisting four basic layers: Aggregation, Model, Application logic, Presentation.**
Offer Poor query possibilities (Bojars et al., 2008): Lack of generic data representation	**Multi Ontology systems (Motta & Sabou, 2006): Systems assume that they operate on a large scale Semantic Web, characterized by huge amount of heterogeneous data, which could be defined in terms of many different ontologies**

Information Overload (Abbott, 2010): Overload of scattered information with uncertain quality has long been perceived as major problem	**Assistive Services (Tahamtan et al., 2010) : By analyzing the existing content, some templates and structures should be established and suggested to other users for common contents**
Constant iteration cycle of Change and Updates to services (Anderson, 2007): Sheer speed with which development take place and the ever growing range of ideas and services may be disordering to those engaged with the Web 2.0	**Authoring tools (Boulakfouf & Zampunieris, 2008): Kind of a platform inside a platform itself. An online system from which we can create elaborated content which adheres to compliances of standards, being user friendly, interoperability and media and file support.**
Ethical issues concerning around the build and usage of Web 2.0 (Anderson, 2007): Newer technologies and services on Web 2.0 start to show their limitations in terms of respect for privacy and copyright	**Interoperability (O'Reilly, 2005): Paradigm shift on Intellectual property protection from All Rights Reserved to Some Rights Reserved.**
Interconnectivity (Abel et al., 2007): Interconnectivity and knowledge sharing between platforms across community boundaries are still limited	**Off-line communication (Boulakfouf & Zampunieris, 2008): Would alert the learner with a user friendly notification when an incoming private message appears on the server side.**
Inefficiency of the information sharing systems in Web applications	**Universal Access (Mahmood & Selvadurai, 2006): Make information contribution and exchange available to all people, irrespective of their hardware, software, network infrastructure, language and geographical location.**
Reliability of Web sites and contents within them (Adams, 2010): Since Web is a open medium, there is long been a question over the credibility of the websites and the information it holds.	**Use of the Folksonomy concept (Motta & Sabou, 2006): Scale as important as data quality, Compliance with web 2.0 paradigm**
Universal Accessibility (Remenyi , 2008): The challenge facing the web is to make sure that all web developers and web designers follow a accessibility guidelines in providing description that optimizes access to all web users especially the one with disabilities.	**Use of the Folksonomy concept (Lassila & Hendler, 2007): Provide an organic, community driven means of creating a structured classification vocabularies.**

Table 4. A Calibrated View Obtained from Literature of the Shortfalls and Barriers to Web 2.0 against the Features that Might be Incorporated In Web 3.0

5 Conclusions

The purpose of this paper was to conceptualise the evolution of Web technologies from a user perspective. Based on inference from existing studies, the paper attempted to identify the architectural characteristics of Web 2.0 and the direction that the next generation (Web 3.0) of Web applications would meld itself into. As such, from the synopsis gathered through the comprehensive literature review performed in the study, the following salient points could be inferred: (1) The varied definitions centred on a single concept of Web 2.0 can be placed in following three categories: technology centric, business centric or user centric spaces; (2) The most important aspect that the literature on the framework of Web 2.0 highlights the concept of harnessing collective intelligence of the Web users through adoption of user generated contents; (3) The one single feature binding all or most of the Web 2.0 applications discussed in the literature is the 'Social Web' aspect of all the Web applications in focus. The applications are moulded into diverse roles that the consumer/ Web user plays on this Social Web, with content as the focal point, forming the most critical factors that have made Web 2.0 the success as we see it today; (4) User Scalability features where decentralization of publication is highlighted as the most important advantage brought about in Web 2.0 applications representing a futuristic liberalization trends; (5) The literature analysis also suggests several shortcomings in the current (Web 2.0) Web applications that revolve around lack of intelligent Web servers and services that it offers; (6) The most common barrier faced by most Web applications in Web 2.0 is the connectivity aspects offered by it; and (7) The majority of the features incorporated in Web 3.0 aimed at countering the limitations and barriers of Web 2.0.

By highlighting these key points, this paper has contributed to existing literature on Web 2.0 and in particular the limited literature on Web 3.0. The paper has shed more light on some of the characteristics, shortcomings and barriers to Web 2.0 adoption and how Web 3.0 may bridge existing gaps in Web 2.0. From a practical stance, the paper may help Web development companies as a frame of reference to structure their architectural framework both in terms of the technological space that needs to be explored and also the business model that needs to be put in place to coincide with the Web user expectations of future generations (Web 3.0) of Web applications.

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