International Journal of Information Management 36 (2016) 591–598

Contents lists available at ScienceDirect

International Journal of Information Management

journal homepage: www.elsevier.com/locate/ijinfomgt

Web 2.0—The past and the future

Russell Newman[a,*], Victor Chang[b], Robert John Walters[a], Gary Brian Wills[a]

[a] Electronics and Computer Science, University of Southampton, Southampton, UK
[b] Xi'an Jiaotong Liverpool University, China

ARTICLE INFO

Article history:
Received 24 March 2016
Received in revised form 25 March 2016
Accepted 25 March 2016
Available online 6 April 2016

Keywords:
Web 2.0
Web 3.0

ABSTRACT

Although it has been around for 11 years, it is still not clear where Web 2.0 will lead. This paper presents a general discussion of past and recent trends that may positively influence the direction of Web 2.0, including cloud computing and other emerging business models. In order to move forward, Web 3.0 is proposed for the next generation of work that integrates Cloud Computing, Big Data, Internet of Things and security. We also present criteria and future direction for Web 3.0 to allow all services and people can stay connected with each other.

1. Introduction

Based on our previous work (Chang, Newman, Walters, & Wills, 2016), the main objective of this research is to determine to what extent the ecosystem of modern Web companies represents an economic bubble. To that end, this paper explores the drivers of modern Web companies, their practises and business models, and what that means for the sector as a whole.

The term "Web 2.0" was defined by Tim O'Reilly in 2005, amongst other definitions, as sites and services that rely upon the generation of content by their users, as opposed to editors or dedicated content creators (O'Reilly, 2005). O'Reilly's list of acid test characteristics for a Web 2.0 service defines the sector quite well:

- Services, not packaged software, with cost-effective scalability.
- Control over unique, hard-to-recreate data sources that get richer as more people use them.
- Trusting users as co-developers.
- Harnessing collective intelligence.
- Leveraging the long tail through customer self-service.
- Software above the level of a single device.
- Lightweight user interfaces, development models, AND business models.

Apart from O'Reilly (2005), Andersen (2007) explains the definition, scope and services for Web 2.0. He focuses on ideas, technologies and implications for education which have adopted by universities to provide students virtual learning environments. Murugesan (2007) presents the overview, content and tools for Web 2.0. Hwang, Dongarra, and Fox (2013) explain that the Internet of Things can be the next generation for the Web. Whilst novel in 2005 and exhibited by just a handful of ground-breaking services, many of these characteristics have become commonplace in most services and software. Such rapid adoption has been possible due to a series of low-cost emergent technologies, which are explored later in this paper. In order to discuss the past and future of Web 2.0. This paper is structured as follows. Section 2 presents the Social Web to review the definitions and past contributions. Section 3 describes Cloud Computing services and its impacts to Web 2.0. Section 4 discusses whether Web 2.0 enters a period of stability and presents examples that can decode the future trends. Section 5 illustrates the next generation of Web 2.0, the Web 3.0 and discusses the features required to make Web 3.0 functional and successful. Section 6 concludes this paper with future work.

2. The social Web

Following O'Reilly's definition, Web 2.0 was later characterised by introducing online "links between people" in addition to the established Web's links between documents (Murugesan, 2007) that characterised the web up to that point.

Social Web 2.0 services have flourished by enabling people to connect not only with friends, family and colleagues, but also with events, interest groups, companies, brands and other entities (Rainie & Wellman, 2012). Enabling people to connect with friends and other entities enables them to receive multimedia updates from those connected entities. It also permits people to freely associate with any other entity they wish, perhaps publicly, and build a persona or profile.

* Corresponding author.
E-mail addresses: rn2@ecs.soton.ac.uk (R. Newman), ic.victor.chang@gmail.com (V. Chang), rjw1@ecs.soton.ac.uk (R.J. Walters), gbw@ecs.soton.ac.uk (G.B. Wills).

http://dx.doi.org/10.1016/j.ijinfomgt.2016.03.010
0268-4012/

Berners-Lee (2010) argues that social Web 2.0 services tie their users into their product offerings. That is, users are prevented from using their existing data on other social Web 2.0 services with ease, thus creating closed "silos" of users' social data. This is achieved by ensuring that users' data on a particular service can only be seen and utilised from that service, and not exported to other services (Berners-Lee, 2010). Users are encouraged to depend upon the service as a means of social interaction, as moving to another service becomes prohibitively difficult.

This "user tie-in" may also be generated as a side-effect of the level of use of a social service and the breadth of facilities that it offers. For instance, customers are less likely to switch to a competing social service if all their friends and connections are using their current one. Given that a social service cannot operate profitably without users, generating tie-in is an important component of social networks' business models (Berners-Lee, 2010).

Berners-Lee made these statements in 2010. In the time since, many social Web 2.0 services have developed methods of interoperating and integrating with other services. These are often manifest in:

- Federated Authentication (Jøsang & Pope, 2005)

The ability to log into Service B using one's credentials from Service A.

- Cross-service publishing (Muller, 2007; Murugesan, 2007)

Allowing Service B to publish or re-publish some manner of update on Service A, *on behalf of* the user, with their consent.

These abilities represent some opening of the silos that were described by Berners-Lee (2010). However, they may also be seen as generating further tie-in. The use of Federated Authentication increases users' dependency upon the originating service, which serves as their federated identity online (Buyya, Ranjan, & Calheiros, 2010). Cross-service publishing is another means of amplifying the effect of user-generated content, by allowing it to be re-published on multiple services.

The nature of marketing for both products and services has adapted to capitalise on the network effect of user-generated content. Marketing campaigns now typically direct people to campaign materials on social media sites, whereupon they are asked to post an update to their connected friends regarding the promotion. Such updates appear as a recommendation from a friend, rather than an unsolicited recommendation from the product owner. This encourages people to trust the materials, and pay attention to it.

3. Cloud computing services

The usage level of many social Web 2.0 services is dependent upon cycles of human activity and real-world events. The peak usage level of a social service, from a given geographic area, may be many times higher than the trough (Stone, 2008).

This creates problems for enterprises running social web services; the differences in demand between peak and trough traffic can be great, and providing capacity for both in a financially-effective way can be challenging.

In the past, companies requiring high serving capacities often addressed this problem by employing a farm of dedicated storage and computing servers, capable of handling a given level of peak traffic. However, the full capacity would only be used at peak times, resulting in increased costs during normal operating load.

Furthermore, such great investments sometimes fail to perform during the most critical of times; companies have experienced traffic peaks above the designed capacity of their server farm, and have subsequently been unable to serve some or all of their users. A couple of examples exemplify this problem.

1 UK 1901 Census Website Launch

On 2nd January 2002, data from the 1901 census of England was released online (BBC, 2002a). Demand for the site was high, as it provided a tool that anyone could use to look up information on their ancestors, with ease. News of the launch was also widespread in the media. The first three days of release saw an average of 32 million visitors per day, which was 27 times higher than the designed capacity (BBC, 2002b). Being unable to cope with this peak of demand, the site failed completely, and had to be taken offline. Eight months later, in September 2002, the site had been improved to cope with the higher levels of demand and was undergoing testing. However, the media and public interest in the site had passed, and the site never saw the same levels of popularity (Sfetcu, 2014). Under-provisioning of server capacity effectively condemned this project, at a time when predicting demand and providing capacity was difficult.

2 Nectar Loyalty Card Launch

When this loyalty card scheme launched in 2002, it was backed by email and TV marketing, with exposure to an estimated 10 million households. Those signing up online were given bonus loyalty points, in an effort to reduce demand on telephone and postal registration systems (BBC, 2002c).

Despite media coverage of 10,000,000 households, the Nectar website crashed on the first day of service with just 10,000 visitors per hour (BBC, 2002d). The objective of the Nectar Card was to amalgamate individual loyalty schemes for different retailers into a single scheme. An expensive marketing campaign raised public awareness sufficiently. However, the failure of the website meant that Nectar were unable to issue loyalty cards to thousands of people at the most opportune time to do so.

The problems created by capacity provisioning leaves both Technology/Information and Finance Directors in an embarrassing position, where their investments can be incapable of effectively performing their core business operations at the most opportune time. Thus, traditional server farms represent a large capital expense that must be paid even before a service has begun functioning, and may not be capable of scaling adequately to demand.

Storage and computing capacity can now be automatically purchased from a Cloud service reseller as it is required, providing a cost-effective solution to the problem of usage spikes. Capacity may be allocated almost instantaneously at peak times, and then released when it is no longer needed (Buyya, Yeo, & Venugopal, 2008). Companies are billed according to what they use, usually by the hour (Armbrust et al., 2010).

Customers using Cloud services are offered the advantages of the server capacity, and spared the tasks of purchasing and maintaining the physical hardware, land, cooling, and power. These tasks are the responsibility of the Cloud service, liberating customers from such overheads and setup costs (Armbrust et al., 2010).

Some of the most popular Cloud services are run by familiar companies. In addition to their other operations, Amazon, Microsoft, IBM and Google all run competing Cloud service platforms. Some companies, such as Rackspace, perform only Cloud service operations and have no other business offerings. Cloud services remain a growth area, with market revenues growing year-on-year.

For companies operating popular social web services, this removes the overhead of a server farm, converting it into a flexible cost that is adjusted according to the usage of (and therefore the revenue generated by) the product. The Cloud service profits