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SOCIAL COMPUTING: AN OVERVIEW[1]

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ABSTRACT

A collection of technologies termed *social computing* is driving a dramatic evolution of the Web, matching the dot-com era in growth, excitement, and investment. All of these share a high degree of community formation, user level content creation, and a variety of other characteristics. We provide an overview of social computing and identify salient characteristics. We argue that social computing holds tremendous disruptive potential in the business world and can significantly impact society, and outline possible changes in organized human action that could be brought about. Social computing can also have deleterious effects associated with it, including security issues. We suggest that social computing should be a priority for researchers and business leaders and illustrate the fundamental shifts in communication, computing, collaboration, and commerce brought about by this trend.

Keywords: Social computing, communities, information systems, incentive mechanisms, collaboration, reputation, security, knowledge systems, trust

I. INTRODUCTION

A large number of new applications and services that facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge have come to dominate the Web. These are variously referred to under terms such as *Web 2.0*, *online communities* and *social computing*[3]. Examples include blogs, wikis, social bookmarking, peer-to-peer networks, open source communities, photo and video sharing communities, and online business networks. Many of the popular online networks have been growing dramatically; with the most spectacular examples being *MySpace*[4] and *YouTube*, each of which attracted significantly high investments from leading players in the industry; both the growth and the high profile investments resemble events from the dot-com era.

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[2] This paper expands on comments made by this author while receiving the LEO award for Lifetime Exceptional Achievement at the ICIS 2005 conference in Las Vegas, Nevada.

[3] The term *Web 2.0* also covers applications that may not signify a social component.

[4] URLs for web sites and technologies referred to may be found in in Appendix.

It is due to the wide availability of broadband connectivity and more powerful personal computers that social computing has started growing phenomenally. Collectively, social computing represents the next step in the evolution of the Web, with great potential for social and business impact. Currently, much of the business interest in social online networks is in the fields of content distribution and advertising; however, the potential impact and opportunities for businesses extend far beyond that.

Social computing shifts computing to the edges of the network, and empower individual users with relatively low technological sophistication in using the Web to manifest their creativity, engage in social interaction, contribute their expertise, share content, collectively build new tools, disseminate information and propaganda, and assimilate collective bargaining power. Many organizations will be faced with a shift of market power to networks of consumers that critique their products and express their preferences for changes. Lightweight computational tools that can be blended together –*mashed up*- and open source software will allow grassroots innovation that can threaten existing software and launch new business models. Communities formed around specific products can hold a wealth of finely segmented demand information. Adapting to these changes can prepare organizations to anticipate new opportunities as well as respond to the threat to existing business models. Further, social computing impacts society itself, in various domains: in politics, debates on social issues, globalization, media and censorship, and may be leveraged gainfully.

Social computing represents a new research frontier for information systems. For example, it is transforming various aspects of software development:- the development process is becoming participatory and often voluntary; the type of tools used are changing, and computing is moving to a more network-centric, and less of a desktop-bound stage. It transforms the way individuals process and interact with information, rendering a much more dynamic and mobile information domain centered on individual participants who interact with it through a wide variety of devices. In the process of studying social computing, issues such as scalability, quality, security, and interoperability are important issues to be considered from the technical viewpoint. Questions about incentives and motivation for user participation in such networks, the impact on social welfare, market structure, quality and choice of products, on the ability of firms to extract consumer surplus, and externality effects will interest researchers pursuing economic aspects of information systems. As economic systems organizing production, social networks are different in various aspects from markets and hierarchies. In order to study these systems, economic models may need to incorporate behavioral aspects. The evolution, stability, and efficiency of these communities may be the target of investigation of game theorists. Social computing in general manifests more of the social aspects as compared to computing aspects. It is of interest to investigate which of the scientific theories of behavior in groups can be applied to online communities and how behavior and influencing factors change in such environments. Social computing networks interacting with a firm can lead to the firm's organizational boundaries becoming less defined; for example, product-centric communities may partially act in ways that benefit the organization, and a firm may seek to extend itself by building such communities and anchoring a business *ecosystem* of partners and user communities. Governance structures in social computing tend to be weaker and less well defined compared to organizations, and yet, in many cases, adequately effective, given the spontaneous, grass-roots nature of their growth. The factors that sustain them and ways of designing sustainable governance structures for social online networks need to be investigated. Online communities represent a wealth of demand information, as well as rich and focused channels for promotion and distribution, from the marketing perspective. In general, social computing environments present settings for data collection on a wide variety of aspects for researchers interested in online behavior of individuals, both in natural observations and for controlled experiments. It is important for information systems researchers to take the lead in charting this new domain. In this article, we undertake to provide an overview of social computing, identify common features that characterize these systems, study the potential impact on business computing and information systems, and thereby set the stage for investigations into this exciting topic.

The remainder of this article is organized as follows: section 2 provides an overview of social computing; section 3 identifies the essential characteristics of social online networks; section 4 offers a view of the broad implications of their emergence; section 5 lists potential problems associated with social computing; section 6 focuses on security in social computing; and section 7 concludes.

II. OVERVIEW OF SELECTED SOCIAL COMPUTING PLATFORMS

Blogs, (derived from *Web logs*) are the most visible of the social computing initiatives. Started in late '90s, they have come to take the world of journalism by storm, and have extended their presence into several other domains as well. Blogs may be thought of as online journals, which may be published by an individual or a small group, through the Web interface, and focused either on a single topic or a variety of topics reflecting interests of the authors. Popular blogs attract groups of users that engage in discussions using easy interfaces, and blogs often link to posts in similar or complementary blogs, thus creating networks of blogs and online communities. Blogs played a significant role in the campaigns for presidential elections in 2004, and mainstream media started recognizing and covering blogs the same year. While we have had bulletin boards, Usenet newsgroups and Internet mailing lists as discussion forums from early on, blogs are different in having more individual flavor with the authors having free speech as against a moderated group of large size, and also in using the Web interface to provide a richer experience, with ease of publishing. Blog servers such as *blogger.com* offered by *Google* or *TypePad*, and open source blogging tools allow any individual to publish his or her own blog on any topic under the sun, and for communities to be built across the cyberspace. Blogs allow each post to be tagged by several attributes, which help in customized presentation based on sorting on these tags as well as efficient archiving and searches. Blogs, especially those that contend with mainstream media, often come under criticism about the lack of editorial control and credibility issues, but have nevertheless played a significant role in impacting political events in the U.S., for example, the defeat of Joe Lieberman in primaries held by the Democratic party in 2006. In the world of business, blogs are being recognized as a useful and essential tool. "For executives, having a blog is not going to be a matter of choice, any more than using e-mail today," according to Jonathan Schwartz, COO and President, Sun Micro Systems [Schwartz 2005].

Wikipedia is an online open source encyclopedia built by aggregating so-called *wiki*s, which are tools (or instances) of collaborative authoring of tagged hypertext content, with version control and user feedback features built in. Wikis allow several users to contribute their knowledge so that a structured hypertext article on a topic can build itself from grassroots. The quality control derives from user feedback, and version control allows undoing changes and reverting when necessary. Wikis are popularly used as knowledge sharing tools and for collaborative authoring in teams. Wikipedia is the most visible instance of use of the wiki concept, being a rapidly growing and wildly popular online encyclopedia that provides primers on a very wide variety of terms and names. As with all such grassroots efforts, quality and credibility are the key issues and Wikipedia has had its share of controversy. An erroneous entry was deliberately entered into a biography on *Wikipedia* as a hoax, and its discovery led to protests [Seigenthaler 2005] and the subject of the biography, Siegenthaler, and Jimmy Wales, Chair of the Board of Trustees of WikiMedia foundation were publicly interviewed by NPR [NPR 2005]. A change in Wikipedia policy followed, now requiring contributors to register. Consequent public debate on credibility on online sources led to a comparison of *Encyclopedia Brittannica* and *Wikipedia* [Nature 2005] that found that such controversial errors were the exception rather than the rule in *Wikipedia*, and that in general, it contained about 30 percent more errors than *Brittannica*.

Peer to Peer (P2P) networks represent the highest share of community activity among all the social software platforms. An early summary of research issues and business implications of P2P networks that anticipated business and research trends in P2P networks and online communities in general may be found in Parameswaran [2001]. Comprised of nodes located at the edge of networks that engage in direct peer-to-peer communication sessions, these networks define their

own addressing schemes and facilitate sharing of resources including multimedia content, processing power, storage, and bandwidth [Parameswaran 2001]. While the term P2P is widely associated with sharing of music and movies that often involve copyright violations, its scope is far wider. Most P2P applications use their own lightweight client applications rather than work through the Web browser. Most assign identities to individual users or nodes and define lookup and communications based on these identities. The diversity and scale of the type of architectures, applications, uses and the economic and sociological research issues, as well as potential business applications render P2P networks a complex subject on its own. We may view P2P software as social software taken to the extreme, bypassing limitations of the browser interface and the DNS (Domain Name System) addressing, radically decentralized, and relying almost exclusively on collective action by users at the edge. P2P software do not merely implement Web-based interfaces, they design architectures that allow peer-wise communication and social action; that is, P2P implies communities as well as sophisticated enabling technologies. Research issues raised include incentives for contributing resources to P2P networks, designing incentive systems to restrict *free riding*, and designing architectures to enhance service quality, security, and scalability.

File sharing networks like *Napster*, *Kazaa*, *eDonkey*, and *Gnutella* are what led the growth of P2P networks; the extensive illegal sharing of copyrighted content over some of these networks lent a stigma to the P2P technologies in general. However, it should be noted that these networks demonstrated technical attributes like the scalability, robustness, and ability to use low-bandwidth links to move very high amounts of information, as well as social attributes like altruistic behavior, formation of communities, and rapid growth of networks; all of these aspects could form the basis for productive uses of the same technologies. Indeed, in other applications, which shared processing power of personal computers of users around the world, such as *SETI*, peer networks were deployed toward social benefit.

The more recent and dramatic success in file sharing networks was based on the *BitTorrent* architectures, which relied on dividing files into numerous fragments and distributing them among the peer community, thus initiating many-to-many distributions of small fragments that were pooled together to recover original content. These networks demonstrate remarkable scalability and achieve low-cost load balancing. With many-to-many distributions, and the improvement of performance with size of networks, *BitTorrent* brings about more social aspects of P2P networks to the forefront. While *BitTorrent* was used for illegal file sharing as well, its paradigm of many-to-many distributions is being adapted to content distribution in business models (such as for distributing movies by Hollywood studios, and for multimedia distribution by corporate clients) and other productive applications (such as distribution of new releases of Linux software).

While *BitTorrent* incorporates limited inducements to reduce free-riding and promote co-operation by linking download and upload rates, it still suffers from incentive issues. Free riding cannot be entirely eliminated in *torrents*; and when a user has assembled the entire file from fragments, he or she has no further incentive to stay on and contribute bandwidth. In practice, defection by such users frequently implies that torrents see activity tapering off after first few days of launch of a new network. The many-to-many distribution and distributed storage of content in *BitTorrent* and similar networks may represent a dramatically different future for content distribution, where content belongs to the network and to communities and not to individual servers or corporations.

Skype, the peer-to-peer, Internet-based voice and video communication service, represents social cooperation in bandwidth usage subverting traditional telephony; millions of users on the edge collaborate to share their bandwidth and realize service quality that is competitive with circuit-switched expensive lines, and thus undermine the usage-based pricing model of traditional telephony. The huge sum of 3.5 billion dollars reportedly paid by *eBay* for *Skype* suggests the perception of very high value inherent in user networks. (For comparison, *MySpace*, was valued at 580 million by *NewsCorp*, an investment that was returned in less than an year when *Google* offered 900 million for an advertisement deal with *NewsCorp* that was primarily targeted at *MySpace*. *Google* recently entered into a similar deal with *eBay* under undisclosed revenue

sharing terms, where the user base of *Skype* would have been highly attractive for Google to target ads).

Flickr is a popular, easy to use photo sharing service that was acquired by *Yahoo*, and it allows users to easily upload, tag, and share photos, and also to provide feedback and ratings. The tagging allows generating dynamic groups of photos ("Sunset," "Thailand," for example), and the rating system accumulates feedback to rank pictures in popularity. In a similar way, several other services allow users to share, tag, and rate photos as well as other content, including audio and video. *Google*, for example, invites Internet users to upload their video content with optional tagging, thus creating a large archive of tagged content.

Social bookmarking services allow individuals to create their tagged bookmarks in shared Web spaces, where similarly tagged bookmarks aggregate. As the mass of users increases, the collection gets more refined and rich, taking it beyond a simple link directory. It aggregates information from several users, it allows sharing of information as well as building of communities of people with overlapping interests, and it is a dynamic bookmark file where inactive or irrelevant links quickly sink due to continuous user feedback. *Del.ici.ous* is a popular example of a social bookmarking site.

Slashdot is a popular site that selects and presents technology news through a system of partial moderation, reviews, and ratings, with each news story leading to discussions which themselves are rated and reviewed; thus resulting in the state of the site at any time representing the stories and comments deemed most current, significant and insightful by a community that is deemed fairly sophisticated in technology awareness. The nature of its community membership and the relatively refined review system ensure that *Slashdot* actually has had a reputation for quality of content unlike many other social networks. The moderation system and governance structure in Slashdot is discussed later in the paper.

YouTube is one of the best known of the social software platforms. Intended for amateur users to post low-resolution video clips, it has seen spectacular growth, and has evolved into a pop-culture medium that drives rapid dissemination of popular videos worldwide. Alternative outlets for uploading and distribution of video clips exist, including Google video and numerous offshore content hosting sites; however, none has become as strong a brand name as *YouTube*. This success eventually led to *Google* acquiring it rather than competing with it.

YouTube now is an outlet not only for amateur videos, but for clippings from commercially produced video as well. For example, clips of music videos, sporting events, political speeches and public events may all be found there. In the process, *YouTube* brings in a subversive element, both in undermining censorship, and in having a political impact. In the former sense, the reach of the Internet beyond national boundaries, as well as across artificial market delineations created by content providers, allow *YouTube* to break down various barriers: the simplest examples would be in spreading coverage of sporting events which are restricted in broadcast coverage due to ownership of rights, and in bringing news stories which are suppressed by mainstream media to the attention of the public. Thus, *YouTube* breaks both formal and informal censorship, and in the process raises legal and ethical questions. In a recent case of *YouTube* subverting self-censorship of the media, a politically controversial speech by comedian John Colbert at the annual correspondents' dinner in Washington D.C. was taken offline by C-Span and others; and in a few hours the video appeared on *YouTube* circulating far wider than originally likely, and thus what was a story that very few might have known became very widely known. In a political sense, *YouTube* video archiving of television clips have been consistently used by political factions in the U.S. in campaigns; video clips from war-torn regions have been used by various interest groups; video clips of Lebanese pop singers were distributed recently through *YouTube* to convince the world that Lebanon was not a fundamentalist nation against the context of the Israel-Lebanon war.

Quality or high value entertainment is not the priority at *YouTube*; sharing of the multimedia content is the priority. Thus, clips tend to be low bandwidth and coarse in resolution. However,

even at such levels, it should be noted that it is the broadband penetration and more powerful computing devices at the edge that have enabled the growth of platforms like *YouTube*. Rather than new ideas, many of these content sharing software platforms represent ideas whose time has finally arrived with an empowered edge of the infrastructure.

MySpace, another social computing site, overtook Google as the site with most hits in July of 2006. Targeted primarily at the teen market, *MySpace* allows users to easily build, launch and share their multimedia Web presence, and invite friends who may be tagged at various levels – "hero" for example- to form social networks. Social networking sites similar to *MySpace* and targeting the same markets include *FaceBook* and *Bebo*. *MySpace* was preceded by *FriendSter*, a network whose limited scalability and lack of multimedia capabilities meant it was unable to sustain the early success.

LinkedIn is a social network for business professionals that is rapidly gaining in popularity. In essence, it takes "networking" online; allowing professionals to create their profiles, and invite their professional contacts to be part of their "network." Networks grow rapidly, and users help each other by "endorsing" them and by various referrals and testimonials, as well as by providing access to the networks of each. In effect, profiles become enhanced resumes, and the link to career improvement is made explicit by the high degree of hiring advertisements and the hiring that happens exclusively within *LinkedIn*. Beyond helping users leverage their contacts to the full, *LinkedIn* also acts as a memory for networking efforts; contacts acquired at various venues may immediately be transferred to the virtual network and put to action, taking away the burden of storing, organizing, and cross-linking contact information so that the new contact is indeed useful. Further, the network that is built around an individual can itself be indicative of the interests, skills, and aptitude of the individual, thus representing a refinement of the profile.

The wave of professionals joining *LinkedIn* and using it for hiring activity indicates the strength of a traditional way that social capital figured in hiring: recommendations and referrals from trusted contacts have been historically used in hiring. While this might lead to nepotism or corruption, recommendations can indeed serve to signal quality and may sometimes be the only way to reduce the uncertainty in hiring.

Whereas a community such as *YouTube* may thrive in rapid growth, a community like *LinkedIn* may do better by controlled growth. Rapid proliferation and open admission policies will undermine the value of endorsements and the individual networks built. *LinkedIn* is among top 300 sites in traffic, and has seen some of highest weekly growth rates in traffic in 2006 [Batheja 2005].

III. COMMON TRAITS

Several common characteristics may be observed among social computing platforms that differentiate them from traditional organizational computing and content sharing. All of these are decentralized to varying degrees. They are all dynamic with continual refinement in the content and online activity, as well as refinement in how different units of content are tagged and rated. The dynamic nature is an important characteristic in the accelerated pace of the online world where links and information become outdated quickly. This aspect also serves to accelerate dissemination of information, most dramatically illustrated by how political blogs frequently upstage news media in rapid propagation of news stories and spur political action. Traditional outlets emphasize quality with standardized procedures in place, whereas the social authoring and computing channels rely on feedback and review for quality. Traditional outlets have a top-down, predetermined structure, even when classification and tagging exist, whereas the social software channels have a bottom-up structure. This inevitably leads to some anarchy in the system. For instance, free entry and free speech may imply items of dubious quality, and divergent tags for similar themes. However, as items that are rated higher due to high quality drift to the top, and tags that are popular attract contributions of more items under that tag; thus, social interaction morphs the chaotic system into a more reliable system. Indeed some channels

exercise centralized control to varying degrees by restricting entry, or by moderating content to improve the quality of participation. Traditional systems tend to be rigid in structure, where as the social computing outlets tend to be free form and flexible in structure: the users determine the structure, and it evolves continuously. The classification schemes in a site such as *Flickr* may change unrecognizably in a few weeks' time. Traditional structures tend to be monolithic and coherent, whereas blogs and wikis use hyperlinking and cross-referencing to create a web of interconnected communities, thus catering to diverse interests of participants. Traditional computing modes emphasize firms as the organizational boundaries, with any user interaction potentially occurring as business-to-consumer commerce. The social outlets expand the organizational boundary to be much more fluid, enveloping communities of shared interests, and often spanning multiple communities, and on occasion anchored around a single individual and an associated interest group. Further, they may have no direct revenue models. Altruistic and community-oriented motivational factors dominate behavior in most cases.

SUCCESSFUL BRANDS

Blogger, MySpace, Facebook, and *Flickr* are some of the brand names that dominate their respective segments even though other platforms exist within those markets. These successes are not explained by early mover advantages and superior quality or selection of content alone. Most of the highly visible platforms have focused on the most sizable and powerful segments of the market; which in many cases would be the youth market, and in the rest of the cases, the platforms have a mainstream appeal. In both cases, simplicity and low barrier for participation enhance the appeal for the average user, and generate a participant base that is highly attractive for the advertising community. We can think of the role of platforms as being similar to the role of America Online in the early stages of Internet penetration in the U.S. market. AOL removed the technological barriers and search costs and made the Internet and Web an adventure for the mainstream user; many of the enormously successful social computing platforms make collective content creation and sharing a similarly easy creative adventure for the mainstream user. They do not have to worry about XML tags, or the right format of the picture or video, or exact alignment of the picture within a Web page, or the mechanics of translating aesthetic preferences to HTML implementations. If a user has the content, a snazzy blog or Web site or photo journal can be ready in minutes. Besides the use of easy tools and interfaces, equally important is the network-centric status of the content. The user does not have to host the content, nor obtain URLs or worry about the visibility or brand name features of their locators; *Blogger, or Flickr,* or *MySpace*, all highly visible and "hip" locators, host and publicize their content.

LIGHTWEIGHT COMPUTING TOOLS

A key feature of the new social computing trends is the use of easy-to-use, lightweight, mostly open-source computing tools. Examples would be tools such as *Ajax, Python, Perl, Ruby on Rails,* and *MySQL*. These tools lower the barrier to entry for individual users into application development and participation, as well as for small businesses into markets dominated by large software vendors. They share characteristics such as being easy to learn, access to wide range of functionality with library of modules, but without "bloat-ware" or "feature-creep" tendencies, locus of processing being centered on the client device at the edge, relative ease of use by individuals who are not sophisticated programmers, and high degree of interoperability and portability making them friendly for network deployment. It is important to note that despite being lightweight and mostly free, these tools do not compromise quality, and indeed many enterprise computing applications do make use of them in demanding environments. Their focus on doing processing at the client contributes to decentralization of the processing load and consequent scalability; and important requirement for rapidly growing online communities. Ease of network deployment and interoperability allow the processing results of individual modules to be integrated over the network in delivering enhanced value to the collective. Portability liberates users from individual platforms and allows participation based on network identities that are mobile. Interoperability allows developers to leverage existing applications, adding new functionality, or combining multiple applications to create value as in *mashups*. The production of

information has always been a process where information acts both as input and output; with the likes of mashup software, this phenomenon extends to computing, and as evident from the flurry of innovative applications leveraging Google Maps, this process can create significant value, and facilitate low cost innovation. As in the case of information production, intellectual property rights can slow down such innovation, making the inputs more costly. For the present, generous donation of APIs by innovative enterprises like Google and the open-source conventions prevalent in social computing have kept a large number of inputs freely available, fostering innovation. However, as discussed elsewhere, firms would face questions on how to protect their investments and generate revenue if they choose to yield property rights on software to communities.

The emphasis on lightweight computing tools may be seen as a shift from servers to the edge. This shift is part of a larger trend of empowerment of the edge consequent to broadband connectivity and cheaper, plentiful computing resources at the edge, which is also demonstrated in the growth of P2P networks and applications like *Skype*, which not only move the content to the edge, but also move much of the communications to the edge as well. Thus we see *content, communications,* and *computing* shifting to the edge. P2P applications such as *BitTorrent* shift content to the edge; *supernode* based applications such as *Skype* shift communications and intelligent routing to the edge; grid applications like *SETI* and a whole host of mashups based on *Ajax* shift computing to the edge.

Lightweight computing also involves a shift from more intelligent and powerful computers toward network-based computing that enhances human capabilities in both individual and social contexts. This shift downplays the effort of more and more sophisticated software to mimic human intelligence and creativity, and instead, emphasizes light, easy-to-deploy and easy-to-use tools to express and communicate human intelligence and creativity more effectively. In this sense, the networked environment is now *closer* to the user, and the users are empowered for personal expression and communal interaction. Instead of replacing human enterprise and social action, computing extends and enhances them, serving as a less intrusive means. In effect, new and easy outlets have been created for the creative and social instincts of users. These outlets also scale rapidly and reach widely to accommodate very large communities of users. Thus, while we search for the incentives for users to contribute value to online communities, we should note the fact that the technology environment facilitating scalable channels for normal human behavior is the key reason for the rise of social computing.

DYNAMIC INFORMATION SPACES

Taken together, the social computing tools and some of the applications and tools that go under the umbrella term of *Web 2.0* allow the user to create an information space around him or her. This information space may include content and applications used by him or her, as well as created by him or her; and may span a wide variety of things: e-mail, pictures, journal entries, music, video, contacts, calendar, spreadsheets, *podcasts*, bookmarks, chat transcripts, location information, or work-related content. The information space is continually refined by social interactions, which may be initiated by users or by scripts such as custom *RSS* feeds that tag and organize content and do live updating by crawling a universe of such spaces. In turn, each such space impacts spaces of others. Further, the information space is portable for the most part; unlike a Web site, or a PDA, it is not resident on a device. It resides on the network, and is activated by portable identities across a wide variety of environments: at home, work, hotspots, on the go from handheld devices. The location of activation can in turn refine the space: for example, a popular mashup (*Plazes*) draws upon physical location of the current wi-fi network the user is in to inform local contacts and peers of his or her presence; others inform the user of locally available opportunities for professional and personal endeavors. The information space is refined by taking information inputs (*podcasts*, RSS feeds, for example) and by generating information that is output to the network (blog entries, *YouTube* videos, for example). Thus, information spaces created are *dynamic, socially interactive, portable,* and *location-sensitive*.

The value to the user is immediately apparent, and so is the potential to generate value for various collectives. Equally important is the profound implications it holds for businesses in providing value to users. These spaces represent repositories of preference information, consumption patterns, social trends, market segmentation information, and opportunity for customization at very fine granularity, including location, community, and at individual levels. Organizations that find ways of creatively extracting and leveraging information from these spaces so as to provide enhanced value to the customer using the information gathered can be immensely successful. Examples would be Google's advertisements in *Gmail*, and Amazon.com's recommendation engine. On the other hand, if the intersection of the business with customer information space is intrusive or adds clutter, being exploitative without adding significant value, such efforts can fail and may drain value from the user as well as the online communities.

OBJECTIVITY BY AVERAGING

With minimal control of access and participation by diverse users, most communities still maintain a reasonable degree of objectivity on the aggregate; that includes both those that include stricter filtering and refinement mechanisms (such as *Slashdot*), as well as those that do not. This collective objectivity may not be exactly equivalent to the objectivity of content produced by a highly professional agency; for example, *Wikipedia* may have a few gaps and errors compared to *Encyclopedia Britannica*. However, the content generated tends to be sufficient, in accuracy and comprehensiveness, for most practical purposes. The additional tradeoffs are the degree of noise and the search cost to the user of filtering through the diverse opinions. It should also be noted that communities with a clearly defined point of view display objectivity only within the frames of that point of view; for instance, political blogs. Thus, the objectivity is not absolute, being dependent on the reference frame.

QUALITY

Social software sites which create knowledge by collective contributions, debate and refinement tend to generate reasonably accurate information, and often lead to better insights than academic research and expensive analyst reports. There is significant cynicism toward such sites from the communities of professional content creators – which may include traditional media, entertainment industry, academia as well as analysts; in particular, the casual nature, lack of accountability, ability to present information without rigorous exploration or verification are all criticized and pointed out as differentiators. However, the fact remains that from the viewpoint of a user, what matters is the value of knowledge created, and not how it was created. As the reputation of a social software site grows, the quality of the collectively generated content also improves, possibly due to more high-value participation and refinement. Examples would be *Wikipedia*, which provides more accuracy and refinement in knowledge today, and *Slashdot*, which provides insightful discussions on significant issues in technology and community in general.

GOVERNANCE STRUCTURES AND REPUTATION

Social computing networks are characterized by the lack of strong governance structures. Where some form of governance exists, it is realized through reputation systems in most cases. Some of the more celebrated platforms have very little by way of reputation management. Others, like *Slashdot* or *Everything2* have formally constructed reputation systems, which allow members to rate contributions from other members, and the history of ratings together determine reputation. Even with such systems in place, governance structures are weak, and it is a remarkable trait of social computing networks that they have survived and scaled well with quality of participation at levels acceptable to community members. While both theoretical research and experience from practice – as stated by administrators of networks like Slashdot – indicate that a small number of determined malicious users can significantly undermine the quality and collaborative experience,

the networks have been able to survive such attacks and command continued member loyalty as well as maintain acceptable levels of quality while growing rapidly.

Slashdot, sometimes referred to as a community of nerds, is a Web site that supports discussions on user-submitted news stories and articles related to technology, and is one of the most visited sites on the Internet, noted for insightful commentary and rapid response to events and trends in computing technology. Its reputation system is informally designed, and is the result of successive refinements in response to various problems brought about by its rapid growth.

Users submit published news stories or articles which are selectively posted by editors, and then commented on by other users. The comments are moderated by selected users who assign ratings to them on a scale and assigning labels such as informative, or redundant. Users can set filters so that only comments with a minimum specified rating are visible in any discussion thread. Users of *Slashdot* acquire "karma" points by contributing stories, by posting comments of quality, and by moderation. *Karma* is affected by consistent and regular participation over long periods of time. *Karma* points are clustered into a small set of labels (Terrible, bad, positive, excellent, for example), and points are capped once a member achieves excellent *karma*. *Karma* points serve multiple purposes, the primary intent being to weed out malicious attacks, signaled by very low *karma*, and to favor regular, quality contributors signaled by higher *karma*. In practice, the default rating of a post is reduced by low *karma*, and enhanced by high *karma*. In turn, this implies that moderators will not see the very low *karma* posts. If a high *karma* post is later moderated to be of low quality, it loses both *karma* and rating; that is, a user has to live up to his/her *karma* in order to maintain it. Redundant posts reduce *karma*.

Moderators are selected randomly from eligible set of users, eligibility being determined by long history of consistent but not excessive participation and by karma. In effect, the software scans the volume of posts periodically and assigns points to a selected set of eligible candidates for moderation based on the volume. After several such cycles, the points reach a threshold level and the user becomes a moderator. The moderator status is limited both in number posts to be moderated (five) and in time (three days). This restriction ensures no moderator can have an undue effect on the system; such a narrow interval is a tradeoff against productive moderation. But in general, *Slashdot* emphasizes the need for an "average" perspective, which is realized by both this restriction, as well as by choosing only the "average" users as moderators; those who visit the site too frequently are not considered.

Moderators are subject to meta-moderation, which is done by users selected from longest-serving members; the meta-moderation is not limited in time, or number of posts, nor does it affect karma, except for the user whose moderation is being reviewed. Meta-moderation is akin to voluntary community service. This informal system which emphasizes the average positive contributor of significant loyalty has worked very well in practice, and *Slashdot* has a justified reputation for intelligent discussions on computing related issues. *Slashdot*'s code is open source. Recently, there has been criticism that with rapid scaling up, *Slashdot* discussions have started to include some noise and redundancy. This aspect raises questions about how scalability and quality tradeoff against each other in social online networks. Nevertheless, a high degree of informative and insightful discussions may be found at this community.

The most interesting aspects of reputation management in Slashdot are its emphasis on the average member, on long history of participation, the meta-moderation, and the extremely narrow window of opportunity given to moderators. Its success in maintaining high quality despite having only an informal reputation system on the face of rapid growth and a community base smart enough to mount clever attacks, may indicate that in successful communities, social forces are at work in a beneficial way.

A more rigorous use of social computing – for example, by a business, or in academia – may require formally designed reputation systems that implement stronger governance. Such systems may also utilize digital signatures or other cryptographic tools to protect against attacks. In addition, such communities may need to add incentive systems that motivate quality participation

and minimize free riding, possibly using rewards and penalties. The design of governance structures based on reputation that can sustain various types of social computing platforms would be one of the more important research directions in taking social computing from being a popular trend to a productivity enhancing tool for society, businesses, and academia.

IV. THE WEB IN TRANSITION

The usage of social software tools by individual participants transforms Web pages from being static documents to front-end interfaces for computing platforms. Thus, from being a global information repository, the Web is in transition to becoming a global computing infrastructure, thereby beginning to realize the vision of a distributed computing platform. The key difference with mainstream distributed computing initiatives would be that they tend to be centralized in allocation of tasks, resources and control of membership, while the current trends are decentralized to an extreme degree, introducing high levels of unpredictability, spontaneity, innovation, and scalability into the system.

The transformation also implies the browser transitioning from a document interface to a computing interface. While various application software systems have used the browser as front end so as to enable universal and uniform access, the social software and Web 2.0 trends go beyond that, as in many cases the browser itself becomes the locus of computation. This transition could represent the beginning of a series of changes in the desktop computing environment the culmination of which can profoundly change the market structure. While desktop operating systems have been adding more and more features, most users spend most of their computing time on a limited number of applications. In trying to be all things to all users, operating systems and applications on desktop lead to more and more clutter and wastage of resources. On the other hand, browsers and portals are adding simple, functional *widgets* that allow most users to perform their routine tasks without hassle and with added features of the ability to share, automatic archiving, and portability. As these widget collections become more self-sufficient coherent bundles, they can start rendering the operating systems and application suites redundant, relegating them to the role of being the substrate. Today, widgets exist as independent bundles (*Konfabulator, Google Desktop*, for example), as part of operating systems (*Mac OS X*, for example), as well as portal-based, portable, network-centric tools (Google's calendar, notebook, spreadsheets, Apps for domain). When a customer is able to seamlessly transition from editing a document on the home computer, to editing it on a PDA, to working on it at a friend's home or public library, we may find significant segments of the market willing to switch to the lightweight online applications. Ironically, the claim "Network is the Computer" may be more credible if made today.

An expansion of the role of the browser, or any form of widget-bundles, may be interpreted as the evolution of the portable information space around the customer into a portable *computing space* around the customer. Such a change can shift the positioning not only of operating systems and application software, but also of devices themselves, as they may be preferred in the form of network appliances that act as neutral platforms. These prospects offer significant opportunities as well as threats to organizations in the IT space.

AGGREGATORS

With the abundance of content feeds generated by social computing applications, a new set of applications have emerged that exploit the interoperable, tagged format of these feeds to select and combine feeds according to customer preferences. These aggregator tools further disrupt notions of the static Web document as well as portals. Each user can mix and match feeds to create individualized portals, as well as change the appearance and contents of Web pages they visit to suit their tastes. As aggregators threaten to render browsers irrelevant, some browsers have moved to integrate such features; so also operating systems like Mac OS X. This trend can obviate the need for the browser as the primary interface to the networked information and computing universe.

A SHIFT TO THE EDGE

Social computing initiatives largely reflect the increased resources for computing and connectivity available at the edge of the Internet. These include broadband connectivity, continuous connectivity through a variety of channels including wireless, faster client devices with more memory and storage, as well as a host of easy-to-use development tools available in the public domain. In this sense, social computing may be perceived as part of a larger trend over the Internet of computing and communications shifting to the edge of the network. Edge users are more empowered in terms of access, tools for content creation and sharing as well as creation of and participation in online communities, computing power to run more client side tools, storage to hold more content as well as increased awareness of the possibilities of the information infrastructure. We visualize this trend as gathering further momentum and the edge taking on much more importance in the future. In such a scenario, access providers at the edge, including Internet Service Providers (ISPs) mainly, and possibly corporate and academic networks, may take on more enhanced roles compared to the current trend of service analogous to utilities. The ISP can anchor communities at the edge and may provide enhanced tools to implement various types of interactions and governance structures. ISP may take on the role of auditing reputations as a neutral third party, facilitating more robust reputation, and identity management. Tremendous improvement in performance may be obtained by the ISPs choosing to cache content at the edge and use the broadband capacity to the fullest extent. Caching can be made more sophisticated by distributed storage across multiple servers, and, in the extreme case, by using peer-to-peer networks of user devices to store cached content. Such a step would make storage more scalable and less expensive, while using the idle resources at client nodes. Even when users are not directly involved, ISP may use P2P configurations of its own servers spread around its market for caching content. Caching content locally can be the precursor to ISPs entering content provision in addition to providing access. In case of bandwidth-hungry multimedia, such initiatives would significantly boost the user experience and cut down on the load imposed on the Internet. The ISP may take advantage of content distribution protocols like *BitTorrent*, and initiate many-to-many distribution protocols where content is divided into numerous fragments and stored around the network, and members download various fragments from many nodes in parallel, thus enhancing efficient use of connection links, in a scalable, less expensive manner.

This type of enhanced role will allow the ISP to build richer relationships with customers, providing them with more value, raising switching costs and as a result, being able to extract more revenues. Indeed, such a transformation would significantly ameliorate the key problem that ISPs face in the potential for being relegated to the level of utilities, with content providers taking the benefits of increased user activity online. Indeed it is this problem that ISPs try to deal with in fighting net neutrality.

The enhanced ISP may take on other certification/audit roles as well; one prime candidate is security. For a certification model where ISPs play a key role in ensuring local Internet security, see Parameswaran [2007].

V. POTENTIAL DISADVANTAGES

Various aspects of social computing can have negative consequences as well. Social software raises the possibility of malicious or criminal communities which can use the anonymity, fault-tolerance, robustness, and low cost of online communities to build very effective platforms for interaction, communication, and knowledge sharing, while flying under the radar. Controlling against such communities may be done by individual service providers that host platforms or provide connectivity to participants, and the certification scheme mentioned earlier may be used to signal service providers' propensity to monitor and control for such activity. Governments and law enforcement may enlist the help of providers in curbing malicious online communities.

The empowerment of individual users at the edge is the key factor enabling social software initiatives. Such empowerment goes beyond mere connectivity, being reliant on broadband

connectivity, as well as on more abundant computing resources at the end nodes. The clear implication is that individuals and societies that do not have access to these resources will have to wait for participating in the new trends. Social software initiatives do not merely represent access to a new set of tools for playing online; they are means to creating economic value, and in many cases, provide value to the participants themselves. When such activities have a restricted scope within society, it is likely to exacerbate the digital divide; and in this case, it is a divide not only between those with connectivity and those without, but also between different levels of connectivity.

The rapid growth of the Web had led to discussions about information overload and search costs due to the noise and information clutter created by numerous Web sites, consequent rise of content navigators and content review systems that signaled quality and reputation. Social software poses the same problems at a more substantial level, since its essence is empowering individuals to create rich content. Content creation with a social platform such as *Blogger.com* involves neither technical skills, nor the material costs of operating a Web site. The ease of entry leads to proliferation of blogs, wide variation in quality, and difficulty of sorting them out and identifying preferred outlets. A few services that provide metadata about blogs have become popular, such as *blogrolls*, *Technorati*, and sites that track permalinks. In the case of the Web, the emergence of an outstanding search engine in *Google* ameliorated the problem significantly, as the search results were good enough to make *Google* the reliable content navigator. Tools of similar reliability for the world of social platforms do not yet exist, and the design of effective recommender and navigator models for the world of social computing is an important research issue today. In sorting out the Web, relevance of pages to search topics, and *Page Ranking* (which signified the extent to which pages were cited by or linked to by others) were used to reduce noise; in the social platforms, reputation and trust will be key determinants; and links in between different sites tend to be mutual, repetitive, and exhaustive so that a ranking system based on that alone may not have equal significance as with the Web.

Today, in each subject domain, the few blogs (or other platforms) that have established a reputation for quality tend to do better with proliferation of content outlets. The user faced with a vast set of choices gravitates to the small set of well-known names; in turn, this implies that newer entrants often serve only small communities of direct acquaintances and rely on word-of-mouth publicity to grow beyond that. The established players anchor large networks, commanding significant power. In turn, citations from them can immediately enhance the visibility and reputation of new entrants. The strong influence over networks of loyal readers leads to various means of leveraging that influence with significant economic impact: placing advertisements (*blogads*, for example), or recommending specific products. Such recommendations are often carefully selected to match the preference profiles of the community, and not appear blatantly exploitative. In addition, many outlets claim that defraying costs, rather than profits is the purpose of advertisements. The power to mobilize communities (for example, in letter-writing campaigns), the increased visibility and reputation that can be leveraged in mainstream outlets (for example to write books and columns, participate in panels, conduct lecture tours), and signaling of expertise and quality that can enhance prospects of a parallel career (such as journalism, consulting, politics, arts, academia) are often more attractive than the revenue from ads. Nevertheless, the size of the networks involved implies the potential for significant incentives to be at play, which can mediate the extent to which networks promote each other. The rise of market power and economic incentives for individual participants, amplified by network effects, can distort the welfare effects of social computing.

Another concern that collective creation of content may be overrun by noise and clutter as it scales rapidly with negligible barriers to entry is disputed by the evidence from *Wikipedia*. As *Wikipedia* has grown, its quality has not suffered. The closer critical gaze on the accuracy and quality of its content in the mainstream media and the higher degree of participation from increased visibility, may indeed have led to improved quality, owing to faster corrections of errors and omissions and more comprehensive views.

Communities tend to attract audiences with similar interests within the domain of focus. When communities proliferate within the same subject domain, there is significant overlap in topics discussed or worked on, opinions expressed, and content linked to; so much so that a collection of communities within any given subject domain may evolve into an "echo chamber" that reinforces the collective viewpoints and biases of the communities and repeats the same content in various guises. Political blogs are an excellent example for this. A user searching for content related to a particular issue will find the same news stories, commentary and quotes on hundreds of blogs and discussion sites. Thus, within segments, significant convergence may occur, which can render user search wasteful. More importantly, these echo chambers frequently exclude viewpoints that do not conform to the established view**;** divergent viewpoints get linked to fewer and fewer times and fade out of the focus of the community. The effect of this can be a fragmentation of information in the universal sense; communities of similar interests cluster together and echo similar viewpoints and feed on sympathetic content, while excluding dissenting or diverging content. Audiences that increasingly rely only on their communities for information can become insulated from reality and the collective bias of communities can become more strongly pronounced. From a social viewpoint, the net outcome is not desirable here. In this context, a case may even be made for conventional media that attempt to present a balanced perspective by providing representation for different opinions.

Besides fragmentation of information on the collective scale, the proliferation of information and interaction channels can lead to fragmentation of an individual's attention and consequently erode the value of information as well as interactions. At any given moment, a digitally connected individual may be receiving multiple information channels, and may be engaged in more than one social interaction. The result could be less focus on any individual information source or social interaction, and in general, degradation in the ability for processing information and fostering rich social relationships.

Some of the impacts of social software on customers can have potential drawbacks for firms. Social computing erodes brand loyalty, replacing it with loyalty to the community and peers. Customers trust their peers more and tend to become more independent and critical in their assessment of product offerings. Further, they will demand more customization and expect firms to be more open to participative design incorporating customer feedback in product development. The successful firms will see these as opportunities rather than as drawbacks and adapt their product development and marketing efforts to the new order by leveraging their own participation and promotion of communities.

VI. SECURITY IN SOCIAL ONLINE NETWORKS

NETWORK SECURITY

Security is a significant issue in social computing today. Security issues in this context may be classified into network and social issues. Network security issues in social computing extend from cyber security problems in general; with some pronounced vulnerabilities due to the nature of the environment as well as some of the tools. Given these platforms are highly decentralized, weakly governed and encourage easy access, the risk of malicious activity is significant. Further, many of these environments facilitate and rely on exchange of multimedia content, which are potential carriers of viruses and other threats. This aspect is aggravated by the ability of social networks to rapidly disseminate content to very large number of users. Posting a video clip on *YouTube* can lead to its spreading around the world within a few hours. On peer-to-peer networks that allow music sharing, this aspect has been effectively exploited to undermine illegal sharing by injecting corrupted content into the network. Platforms which enable processing at the client, using resources like *Ajax*, create a computing platform on each client browser. These constitute potential launch pads for zombie attacks that could generate distributed denial of service (DDoS) attacks on a wide scale. Innocuous looking Web pages visited by users may contain code fragments that can initiate attacks from the client device.

Essentially, *Web 2.0* tools that rely on client-side execution of code have procedures running on the client browser and accessing resources from the server, which are then processed to generate various results. This level of access to a server resource granted to a public domain executable whose source code is visible, and access universal, is a potential nightmare in terms of security. The hacker with easy access to the source code embedded in pages may manipulate the database queries or URLs contained there to gain access to other resources at the server and thus mount attacks on the network at the server side.

We may classify the network security issues into those that involve potential losses to the community and/or its members, and those that involve the Internet in general being affected by security problems originating in social computing platforms. In the former category, the high degree of sharing of content, the trust, and the high incidence of less-security-enlightened users are all factors that increase concerns about viruses and worms spreading around online communities rapidly. The same factors do contribute to social computing platforms serving as origin for malicious content to spread across the rest of the Internet. This aspect is compounded by the vulnerability to being exploited as launch pads for DDoS attacks, mentioned previously. The former factors are all social factors, which cannot be easily altered without changing the nature and value proposition of the communities themselves. Hence, it becomes critically important that the firms hosting or sponsoring such communities should have ample technological safeguards in place to keep the environment relatively sterile. When users observe a difference in security profile for different communities – for instance, participation in one leads to receiving much more spam – they are likely to migrate to the more secure one. The providers require some way of signaling to the users their security profile and the level of investments and commitment they make to security. One way of achieving this would be participation in a certification mechanism, such as described in [Parameswaran 2007].

CRIME AS A SOCIAL PHENOMENON

As social environments are created online, many of the social phenomena from the physical world show up in the online world. Crime is one among them. In Web sites highly popular with children and teenagers – such as *MySpace* – criminals masquerading under other identities have been a problem on the rise. The concern has been strong enough to lead schools to ban *MySpace* access and for many parents to seek to filter it; however, both bans and filters continue to be easily defeated. In the same way that young users willingly trust and share information in online communities, adults frequently end up being victims of identity thefts or confidence tricks online as well. While it is possible to recognize these as expected phenomena in any social environment, the lack of controls and the anonymity offered by cyberspace makes these far more vulnerable to crime, as well as dangerous in potential consequences.

Today, this type of security threat is being met by institutions such as schools and libraries banning access to certain communities like MySpace, and parents monitoring such access as well; however, these bans, monitoring, and filtering are all being easily defeated by users with freely available tools. Indeed, it is up to the platform sponsors themselves to recognize the issue of crime, and put in safeguards; in the long run, this will help with their business. A similar certification model as suggested in the case of network security may be relevant here as well; wherein a neutral certifying authority may offer certification status to platforms which binds them to maintaining certain levels of security. The measures to be deployed here, as well as the metrics to characterize the security profile, will be quite different from the case of network security.

VII. CONCLUSIONS

Social computing platforms have opened an exciting new dimension to the Internet. They take the information infrastructure beyond a channel for communication and commerce to an environment for organizing human endeavor, facilitating social interactions, and empowering creativity. The new, more user-friendly tools and applications popularized by social computing reduce

technology dependency for the average user in participating in the information revolution, thereby empowering Internet users. Social computing holds promise of significant transformational and disruptive power in business, computing, in realms of collective action like politics, creative enterprise like film-making, and in content and entertainment fields like interactive distribution.

As part of changes wrought by social computing, the Web browser is evolving into a personal computing interface. Computing itself is moving from servers to the network, and more into client devices at the edge. Within the networks, new applications bring in more decentralization. Decentralization leads to more innovation at the edge among grass roots users in content creation, computing and in electronic commerce. More fundamental changes may be beginning in operating systems becoming unbound from desktops into network-centric, portable computing environments made up of widgets. Mobile information spaces surround users, whose identities may converge across platforms and applications. Such information spaces also appeal to businesses and customers, the former being enabled to assess preferences better and more dynamically, and the latter deriving enhanced value from more customization and bundling. These information spaces themselves may be evolving into portable computing spaces as the next step in social computing. Corresponding changes occur in related segments; for instance, ISPs evolve into providers of content, value added services, and converged content and entertainment. Social computing introduces different levels of user classes, lending more relevance to issues like net neutrality, differentiated service, and digital divide.

The disruptive potential of social computing holds opportunities for both research and business related to information technology. This paper reviewed some of the new business opportunities that arise from social computing. Its potential extends beyond business into other realms of organized action, including popular movements on various causes and global issues like economic iniquity or sustainability, both by virtue of its ability for tremendous reach and for harnessing collective information inputs. Research on social computing can draw from a varied set of disciplines. For IS research in particular, it represents an opportunity to be in the lead in interpreting and guiding this trend into fully realizing its potential. This may include guiding business ventures, expanding theoretical basis of IS research by drawing from more disciplines, and contributing to some of those disciplines by exploring how fundamentally new things such as in incentives for collaboration may be observed in social computing.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers, who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

> 1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
>
> 2. The contents of Web pages may change over time. Where version information is provided in the references, different versions may not contain the information or the conclusions referenced.
>
> 3. The authors of the Web pages, not CAIS, are responsible for the accuracy of their content.
>
> 4. The author of this article, not CAIS, is responsible for the accuracy of the URL and version information.

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APPENDIX

Table 1. Selected Social Computing Platforms

NAME	URL	Description
Wikipedia	http://www.wikipedia.org	Multilingual, free-content online encyclopedia
Gnutella	http://www.gnutella.com	Highly popular online file sharing network which hosts approximately 2.2 million users.
EDonkey	http://www.edonkey2000.com	Decentralized peer-to-peer file sharing network used primarily to exchange audio and video files and computer software
Napster	http://www.napster.com	The first decentralized P2P file sharing program to become very popular; moved into legal sales of content after running into problems with IP law.
MySpace	http://www.myspace.com	Interactive social networking Web site. Users can create networks of friends, personal profiles, blogs, music, videos and photos
YouTube	http://www.youtube.com	Enables users to upload, view and share video clips freely.
BitTorrent	http://www.bittorrent.com	P2P communication protocol for file sharing.
Skype	http://www.skype.com	P2P Internet telephony network which has high quality and a huge customer base.
Blogger	http://www.blogger.com	Blog creation and hosting

		service run by Google
Flickr	http://www.flickr.com	Interactive online photo sharing Web site with tagging that grew rapidly in popularity and was acquired by Yahoo.
Bebo	http://www.bebo.com	Social networking Web site supporting pictures, messages or blogs
Friendster	http://www.friendster.com	Social network service based on the Circle of Friends technique for networking individuals in virtual communities.
LinkedIn	http://www.linkedin.com	Social networking site focused on professional networking and is playing an increasing role in hiring
FaceBook	http://www.facebook.com	Social networking Web site originally developed for university students
Orkut	http://www.orkut.com	Internet social network service run by Google
Everything2	http://www.everything2.com	E2 is a collaborative Web-based community consisting of a database of inter-linked user submitted written material.
Slashdot	http://slashdot.org	Technology related news Web site which features user submitted and editor evaluated current affairs.
Del.ici.ous	http://del.icio.us	Social bookmarking Web service for tagging, sharing and discovering bookmarks

Table 2. Glossary of Selected Computing Tools and Terms

Name	URL	Description
Ajax	http://ajax.asp.net	Web development technique for interactive Web applications
Podcast	http://www.podcast.net	Media file distributed over the internet using syndication feeds for playback on portable media players and personal computers.
		Free application platform for

Konfabulator	http://widgets.yahoo.com	Mac OX and Microsoft Windows. Now known as Yahoo! Widgets
Python	http://www.python.org	Multi-paradigm programming language which has a fully dynamic system and uses automatic memory management
Perl	http://www.perl.org	General purpose programming language used for a wide range of tasks including system administration, Web development, GUI development etc
Ruby on rails	http://www.rubyonrails.com	Web application framework which aims to increase the speed and ease of Web development
MySQL	http://www.mysql.com	Multi-user, multithreaded SQL database management system with more than 10 million installations

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