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Identifying Social Computing Dimensions: A Multidimensional Scaling Study

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IDENTIFYING SOCIAL COMPUTING DIMENSIONS: A MULTIDIMENSIONAL SCALING STUDY

Completed Research Paper

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Abstract

Despite an increasing popularity, the impact and benefits of corporate social computing remain unclear. This paper aims at rigorously studying social computing tools as a new class of technology and provides a holistic definition and characterization. After a comprehensive literature review, we empirically explored the defining attributes and underlying dimensions of social computing as a whole using the multidimensional scaling (MDS) methodology. The study found that 13 representative exemplar tools differ over three dimensions: (i) their ability to support social interactions, social relations, and communities, (ii) their hedonic versus utilitarian focus, and (iii) their ability to support convergence versus conveyance of generated content. A Property Fitting (ProFit) study confirmed the interpretation of the dimensions. This provided a better understanding of this technology and allowed us to better theorize about the expected benefits and impacts of social computing on organizations, to offer guidelines for adoption and provide suggestions for future research.

Keywords: Social computing, dimensions, attributes, taxonomy, multidimensional scaling (MDS), property fitting (ProFit), Organizational benefits

Introduction

A new generation of information systems has emerged, becoming very popular on the public Internet and gaining ground inside organizations as well. These systems are collectively labeled Social Computing tools, and include tools such as blogs, wikis, social networking sites, social bookmarking and tagging, and media sharing sites. Social computing can be broadly defined as tools that facilitate collective action and social interaction (Parameswaran and Whinston 2007b).

A McKinsey report in 2008 has indicated that of nearly 2000 organizations surveyed worldwide, 34% indicated they use blogs, 32% use wikis, 29% use podcast, and 28% use social networking (Buguin et al. 2008). All these numbers are higher than those reported by the same study conducted in 2007. Corporate social computing is increasingly used by organizations to (i) manage collaboration internally in recruiting, development, knowledge management, training and collaboration across the organization, (ii) in interfacing with customers for product participation, interaction, acquisition and service, and (iii) in interfacing with suppliers and business partners for sharing expertise, participation and better integration (Buguin et al. 2008). A similar study by Forrester has also highlighted the promise of this new class of tools (Young et al. 2008). Some organizations have in fact already reaped benefits form their use of social computing tools, which they could not have achieved with traditional information systems. Reid and Gray (2007) identified some examples like McDonald's, whose CEO used his blog to better communicate with employees, or a Fortune 500 PC maker who used wiki to complement its knowledge management system. A third example is of a large professional services company (unnamed by the authors) which has used a corporate alumni social network to recruit back old employees. Bringing back these employees and their new business relationships has led to substantial cost savings and an increase in revenues. Other examples of successful implementation of organizations adopting social computing are Lockheed Martin's use of blogs and wikis which lead to widespread collaboration across divisions, and AT&T's successful use of Web2.0 for collaborative project management.

Despite these promising examples, some reports also exist concerning the difficulties companies are facing in realizing the benefits of social computing tools. For example, in the 2008 McKinsey report on Web 2.0 only 21% of respondents indicated overall satisfaction with these tools while 22% indicated clear dissatisfaction with them (Buguin et al. 2008). A 2009 McKinsey report indicated that fifty percent of early organizational adopters of Web2.0 technologies internally are dissatisfied (Chui et al. 2009). Among the impediments cited are the inability of managers to understand the new levers of change, and how value is created using social computing. Based on the above we argue that a better understanding of the unique features of social computing tools is needed. Such understanding can facilitate important theorizing about these tools and their impact on organizations, as well as our ability to provide actionable advice to organizations.

Overall, the effects of social computing on organizations remain an understudied field (Kosonen and Kianto 2008, Parameswaran and Winston 2007), with the few academic studies in existence either being too general or focusing on a single tool, like Wikipedia (e.g. Korfiatis et al. 2006) and Facebook (Ellison et al. 2007), or on a category of tools, such as wikis (e.g. Majchrzak et al. 2006), blogs (e.g. Jackson et al. 2007), social tagging and bookmarking (e.g. Damianos et al. 2007), and social networking (e.g. Smith and McKeen 2007). Moreover, almost no *theory-based* explanation of the impacts and benefits of organizational social computing currently exist, with notable exceptions being Ellison et al. (2007) who used a Social Network Theory to study the impact of Facebook, an online social network, on bonding and bridging relationships of social capital; and Klamma et al. (2007) who used the Social Exchange Theory to study incentives for using blogs in online learning networks.

The objective of this paper is to rigorously study social computing tools as a new class of technology and provide a holistic or general definition and characterization of these tools. Further we empirically explore the defining attributes and underlying dimensions of social computing as a whole. This understanding can then be used to better theorize about the expected benefits, and impacts, of social computing tools on organizations.

The paper begins with a review of the literature on social computing with a focus on the organizational context. Following is an empirical examination of social computing, using the multidimensional scaling (MDS) technique (Kruskal and Wish 1978), to identify the underlining dimensions differentiating these tools. A discussion of these dimensions and their implications for future theorizing concludes this paper.

Background

Organizational Social Computing

Of the early academic definitions of social computing is that it "describes any type of computing application in which software serves as an intermediary or a focus for a social relation" (Schuler 1994, p.29). It is the "interplay between persons' social behavior and their interactions with computing technologies" (Dryer et al. 1999, p.653). More recently, social computing has been defined as "applications and services that facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge" (Parameswaran and Whinston 2007b, p.762). Back in 1994, when the early definition was created, the software tools were simple e-mail and newsgroup systems. Today's social computing technology is more associated with the 'second generation' of the World Wide Web, vaguely labeled "Web 2.0". Web 2.0 is not a specific technology but a platform for a set of web-based services with a focus on collaboration and sharing. Examples of popular Web 2.0 based applications publicly available on the Internet are Facebook.com, Wikipedia.com, YouTube.com, del.icio.us, and web logs (blogs).

Web 2.0 applications, which have thrived in the public sphere of the Internet, are now finding their ways into the corporate sphere, the focus of this study. Besides specific applications which are developed for the corporate environment (such as IBM's Lotus Connection and Microsoft Sharepoint), the most common social computing tools in the organizational context are blogs, wikis, social networks, and social bookmarking/tagging (Chui et al. 2009). Table 1 provides a brief overview of these tools, and other common ones, and their expected organizational impacts.

Table 1: Corporate social computing examples

Tool	Overview	Potential Organizational Benefits
Blogs	Personal or corporate online journals, among the more visible social computing platforms outside and inside the organizations (Parameswaran and Whinston 2007b). Blogs can be created and maintained by employees, groups, executives, they can be used by the organization for promotions, for marketing, or for general and product-related communications (Lee et al. 2006; Efimova and Grudin 2007)	Informational benefits: getting and sharing information, journaling, problem solving, and getting and giving feedback (Jackson et al. 2007). Social benefits: engaging in dialogue, building community, communicating, collaborating, gaining perspective, gaining company pulse, networking, developing reputation and building career, and self expression (Jackson et al. 2007). Business benefit: information dissipation and public relations (Efimova and Grudin 2007)
Corporate Wikis	Web page or a collection of pages allowing users to add, remove, or edit available content. Wikis are used for knowledge sharing, internal documentation, collaborative authoring, support for work activities (software development, e-learning, project management) (Dutta et al. 2008; Parameswaran and Whinston 2007b).	Informational benefit: Easier shared editing and information exchange, access to relevant and up-to-date information (Majchrzak et al. 2006) Social benefit: Exposure and involvement in communities (Wagner and Prasarnphanich 2007) Business benefits: Employee enhanced reputation, work made easier, improved organizational processes and shared knowledge (Boulos and Wheeler 2007; Majchrzak et al. 2006).

Tagging and Social Bookmarking	Pointers to useful resources such as web site, photo, or link. Tags make up a folksonomy: a categorization system developed over time by common individuals.	Informational benefit: Resource management, information sharing and discovery, expert finding (Damianos et al. 2007). Social benefit: Social networking (Damianos et al. 2007) Business benefit: Improved awareness of corporate resources or services, improved ability to find information on the corporate intranet, increased awareness of interests and expertise of coworkers, better organization of personal bookmarks, increased ability and decreased time to search and find web resources and individuals' expertise and interests (Millen et al. 2006)
Social Networking	Interpersonal, non-hierarchical connections between individuals, business units, or organizations along which knowledge flows (Smith and McKeen 2007). Social networking allows individuals to create their profiles, to easily build, launch and share multimedia presence, and to invite others such as friends and contacts to be part of the network.	Informational benefit: Access to non-redundant information from "weak ties" (Ellison et al 2007; Granovetter 1973) Social benefit: Support from "strong ties" (Ellison et al 2007) Business benefit: Solve business problems, motivate new ways of work, legitimize cross-boundary communication, develop staff, and communicate rapidly. Go beyond the boundary of an organization, and reach customers and suppliers. Provide strategic potential by developing new relationships with customers, suppliers and partners, and a potential source of value and knowledge (Smith and McKeen 2007).
Mashup	Aggregated content from different online sources to create a new service (Buguin and Manyika 2007)	Informational benefit: Integrate content on the web and data on some backend systems in a much easier and quicker way than traditional programming (Murugesan 2007) Business benefit: Richer and improved learning and teaching applications (Auinger et al 2009)
Photos, Podcasts and Streaming Video	Shared pictures, audio and video file. A multimedia (audio or video) format of a blog (Buguin and Manyika 2007)	Informational benefit: Media-rich data higher ability to convey meaning (Daft and Lengel 1986) Social benefit: Entertainment, identification and interaction with individuals and communities of common interests, Business benefit: Education, training, awareness and knowledge distribution (Boulos and Wheeler 2007)

Social computing characteristics

Despite the growing body of literature of social computing tools, thus far there is no strong agreement on what constitutes *organizational social computing*. For example, organizational social computing is sometimes referred to as Web 2.0 in the Enterprise (e.g. McKinsey Quarterly), Enterprise 2.0 (e.g. McAfee 2006), Social Software for

Business (e.g. IBM Corporation), and more. The diversity in names is also reflected by a lack of agreement on the set of categories of applications or tools included. For example McAfee (2006) highlights six major components of Enterprise2.0: Search, Links, Authoring, Tags, Extensions, and Signals. Whereas a 2008 McKinsey Report identified Web 2.0 technologies used in organizations as Blogs, Collective Intelligence, Mash-ups, Peer-to-peer networking, Podcasts, RSS, Social networking, Web services and Wikis (Buguin et al. 2008). Finally, Parameswaran and Whinston's (2007b) list includes Blogs, Wikis, peer-to-peer (P2P) networks, social bookmarking, and social networks. Other categories include collective estimation like prediction and information markets (Chui et al. 2009). Additional categories suggested by experts during interviews conducted for this study and described later include virtual worlds, gaming sites, media sharing, micro-blogging, and social event calendaring.

A comprehensive review and compilation of the literature on social computing (e.g. Parameswaran and Whinston 2007a,b), enterprise 2.0 (e.g. McAfee 2006), social software (e.g. Bouman et al. 2007) and web2.0 (e.g. Vossen and Hageman 2007) revealed a diverse and rich set of 50 characteristics attributed to social computing tools. A summary of the findings is found in table 2.

Table 2. Characterization of Social Computing from literature

Content	The content is in general user-generated, transparent, shared, online, dynamic, rich in media and social information, easy to mash-up, with a large amount of hyperlinks and cross-references. It is scalable, grows organically and its value increases with the increase in number of participants.	Buguin and Manyika 2007; Millen et al. 2006; Parameswaran and Whinston 2007a-b; Ramos and Piper 2006; Vossen and Hageman 2007.
Source and Contribution	Source of input or contribution is individuals, including amateurs, and communities from a large and diverse scope, unbound by organizational structure. Another source of content is interactions between individuals.	Baase 2008; Chui et al. 2009; Jackson et al. 2007; Parameswaran and Whinston 2007b; Ramos and Piper 2006.
Inception and Governance	It generates bottom-up, from the grassroots, and is not imposed, top-down. It is decentralized, informal, ad-hoc, with no or low governance structure, where the ownership and control are retained by creators and users. It is governed in a democratic approach, bottom-up consensus, common understanding and agreement.	Cherbakov et al. 2007; Parameswaran and Whinston 2007a-b; Patrick and Dotsika 2007; Tredinnick 2006; Vossen and Hageman 2007.
Technology	Flexible structure, free-form, largely open-source, decentralized, lightweight, and portable. It is easy to deploy, easy to use and easy for web publishing.	Chui et al. 2009, McAfee 2006; Parameswaran and Whinston 2007a; Patrick and Dotsika 2007; Tredinnick 2006.
Purpose	To communicate, collaborate within and beyond organizational boundaries, socialize (social relations), generate and disseminate content, community formation and interactions, collective action, information sharing, building new connections, participation, and tapping into the wisdom of the crowds.	Baase 2008; Chui et al. 2009; Parameswaran and Whinston 2007a-b; Ramos and Piper 2006; Schuler 1994; Smith and McKeen 2007; Tredinnick 2006; Vossen and Hageman 2007.

While some of these characteristics apply to traditional forms of information systems, they indicate in general a departure from systems which are preliminary used for processing content generated by business processes, which are formal, highly structured, complex and adopted or imposed by upper management with a high degree of

governance. While these differences between traditional applications and social computing may provide some explanation of the potential value of the latter, a thorough study is required for in-depth understanding of such value.

The above characterization provides a good starting point for understanding social computing, however it lacks an important component. In particular, while the literature is strong on identifying the *shared characteristics* of social computing tools –such as user generated, collaborative, or decentralized– it does not provide a solid understanding of the *underlying dimensions differentiating between different social computing tools*. This gap greatly limits our understanding of such tools and our ability to theorize about their potential impact on other systems, users, and organizational factors. Moreover, it also impedes the design and development of relevant applications, sometimes referred to as social software. Thus the *objective of this study is to identify the underlying dimensions of social computing tools.* An empirical study aimed at obtaining this objective is described next.

Exploring the dimensions of social computing

The empirical study described in this section was carried out using a two-phased multidimensional scaling methodology, in order to derive the underlining dimensions differentiating between different social computing tools. We first provide an introduction of the methodology used, following with our specific research design, and a description of our results.

The method: Multidimensional Scaling (MDS)

To identify the key dimensions of social computing tools an inductive classification method, based on quantitative comparisons by respondents, was applied. The methodology adopted to identify dimensions of social computing is multidimensional scaling (MDS), which is a set of mathematical techniques aimed at uncovering the "hidden structure" of data bases (Kruskal and Wish 1978) and identify dimensions underlying respondents' perceived evaluations of similarities (or dissimilarities) between stimuli or objects (Hair et al. 1998). MDS represents the measurements of similarities between any two objects as distances between points in a multidimensional space. It produces a visual geometrical representation of subjective dimensions which are hidden within the data (Kupke 2004). Once objects are mapped, a visual inspection of the resulting spatial maps coupled with more precise techniques, such as cluster analysis or PROperty FITting (ProFit), are utilized to identify and label the groupings of objects of similar characteristics, representing underlying dimensions (Hair at al. 1998).

MDS has been selected for this study because it can be used as an exploratory technique to identify dimensions affecting behavior (Hair et al, 1998), in our case the behavior being the actual use of specific social computing tools to perform specific tasks in an organizational context, such as collaboration with team members. A second advantage of MDS is that it induces the ideal number of dimensions from the data itself rather than impose a predetermined number of dimensions. Related to this, MDS is an appropriate means of obtaining comparative evaluations of objects when the specific bases of comparisons are unknown or undefined. This is known as the decompositional or attribute-free method (Hair et al, 1998). With MDS the investigator does not need to determine *a priori* the schema used by subjects to assess the stimuli, or objects, but instead each subject independently determines which aspects of the stimuli to use in his/her assessment. The MDS algorithm then arrives at a collective schema to be evaluated by the researcher (Zmud et al. 1990). Finally, compared with other statistical procedures with similar functionality, like factor analysis or principal component analysis, MDS usually can fit an appropriate model in fewer dimensions than the other procedures (Ein-Dor and Segev 1993).

In this study the stimuli, or objects, compared were social computing tools in an organizational context. The similarity between each pair of tools was evaluated by social computing experts, using a 7-point Likert scale, as we describe in more detail next.

Study 1 - overview

This section describes the key steps in the design of the study, following Hair et al.'s (1998) guidelines as well as relevant empirical studies (e.g. Bahl and Milne 2006; Ein-Dor and Segev, 1993; Priem et al. 2002).

1. Selection of objects: the objects of comparison in this study were social computing tools. Two keys decisions concerned the selection of tools; the first being the number of tools included in the study and the second the

selection of specific tools. In terms of the number of tools included one must consider the trade-off between the cognitive load on respondents and the number of dimensions that may be inferred from the study. Specifically, when using pairwise comparison, N objects require (N(N-1)/2) comparisons. Thus a list of 15 objects for example would require a comparison of 105 pairs, which may be unreasonably demanding from the subjects. On the other hand, in MDS the number of stimuli or objects should be equal to or greater than four times the number of dimensions explored (Kruskal and Wish 1978). Subsequently, in this study the chosen number of objects was set at 13, allowing for reliable MDS analysis outcome for up to 3 dimensions, and imposing a reasonable load on respondents (78 pair-wise comparisons).

In the selection of specific tools for the study, a compiled list of social computing exemplar tools was first created, based on prior literature (e.g. Eikelmann et al. 2007; McAfee 2006; Buguin et al. 2008; Parameswaran and Whinston 2007b), online lists of web2.0 sites and categories (e.g. Business 2.0 Next Net 25; CNet Webware 100 winners), and interviews with a number of social computing experts, academics and practitioners. Identifying all relevant tools is important since any omission of objects or addition of irrelevant ones would distort the perceptual mapping or relative positioning outcome of MDS (Hair et al. 1998). The initial list of approximately 30 tools was then pared down through interviews with seven social computing experts, followed by two pre-pilot tests, and a full scale pilot test. The goal of the above procedures was to select a representative list of the parent population of social computing tools in order to get valid and complete conclusions about the dimensions (Jones and Koehly 1993). Following these procedures, the final list of tools was refined, and included the 13 tools presented in table 3.

Table 3: Exemplar tools used in MDS study

Tool	**Web Site**	**Self-Description**	**Category**
Blogger	www.blogger.com	A directory of blogs which are easy-to-use web sites, where users can post thoughts and ideas and interact with people.	Blogs
Del.icio.us	delicious.com	A social bookmarking service that allows users to tag, save, manage and share web pages.	Tagging and Social Bookmarking
Digg	digg.com	A place for users to discover and share content from anywhere on the web and where the most voted on content surfaces.	Tagging and Social Bookmarking (+Voting)
Facebook	www.facebook.com	A social network site which allows users to manage their social relations, interact with friends, share content, play games, create and manage groups and much more.	Social Networking
Flickr	www.flickr.com	Online photo management and sharing site.	Photo sharing
Google Sites	Sites.google.com	Free and easy online tool for groups to create and share web pages.	Wiki (Collaborative web creation)
LinkedIn	www.linkedin.com	Professional network of contacts and relations.	Social Networking (Professional)
MySpace	www.myspace.com	An online community that lets users stay connected with friends,	Social Networking

		meet friends' friends, share content, and create personal web site.	
Podcast Alley	www.podcastalley.com	A directory of podcasts which are audio files that users can download	Podcasts
Twitter	www.twitter.com	A service for individuals to communicate and stay connected through the exchange of quick, frequent messages about what they are doing.	Micro-blogs
wikispaces	www.wikispaces.com	A site for creating wikis which are simple web pages that groups can edit together.	Wiki
Yahoo Pipes	pipes.yahoo.com	A tool to aggregate, manipulate, and mashup content from the web.	Mashup
You Tube	www.youtube.com	A site which allows people to easily upload and share video clips.	Streaming Video

2. Instrument testing: An initial survey instrument for pair-wise comparisons was developed and tested in a pre-pilot test with six social computing professionals (academics and practitioners). The pre-pilot also aimed at evaluating the survey completion process (e.g. clarity, timing, flow) and gaining some insights on how respondents evaluate the pairs of tools. To this end, a process-tracing methodology using a concurrent protocol with neutral probing (Todd and Benbasat 1987) was applied where respondents were "talking aloud" (Boren and Ramey 2000) while they were completing the survey. The verbal process was recorded and transcribed for further analysis. Finally, the survey was also followed by a brief interview.

Based on the above, a full-scale web-based survey instrument was developed and tested again in a second pre-pilot test. In the web-based survey instrument the order of the compared tools (first vs. second) were randomized and the sequence of the 78 pairs of tools were dynamically randomized by the system. Two additional pairs were included twice to control for the quality of the responses and potential fatigue. The final pilot survey was then sent out to 100 individuals from the actual sample described below, with 17 responses received. Our analysis of the result of the pilot study showed minimal problems which were corrected, and the full scale study was sent out.

3. Respondents: The respondents to the survey needed to be knowledgeable individuals or experts in social computing who know the tools and their characteristics. For this purpose a Web2.0 community of interest at a large technology organization was chosen. The community consists of around 1,100 members from different functional and geographical areas in the organization. The advantage of the community is that its members are from various backgrounds, levels of education and expertise, rank, age, and sex. Some community members are involved in the design and development of social computing tools (also known as social software), others promote it in client organizations, while some just share the interest in learning more about it.

The final survey was sent out to the remaining 990 members of the community after excluding the 100 used for the pilot, resulting in 166 responses, of which 144 were complete and usable, for a 16% response rate. Table 4 describes the demographics of respondents. In terms of the subject matter of this study, fifty percent of respondents indicated that they are heavy users of social computing, while 40% are intermediate users and 10% are casual users. Seventy percent use social computing in the office, 78% at home, 80% for work related purposes and 64% for leisure purposes. Forty percent are involved in social computing as consultants, 40% in its development, 18% in its sales, and 15% in its technical support.

Table 4. Respondent Demographic information					
Region	N. America 77%	Europe 11%	Asia 5%	S. America 5%	Australia 2%
Sex	Males 73%	Females 27%			
Age	18-24 year 5%	25-36 year 49%	37-48 year 32%	49-64 year 14%	
Education	High school 12%	University 37%	Post graduate 51%		
Work experience	<5 years 13%	6-10 year 28%	11-15 year 23%	16-20 year 13%	>20 year 23%

Results

The MDS analysis (using SAS PROC MDS and SPSS ALSCAL functions) for 1, 2, 3 and 4 dimensions calculated a "badness of fit" (based on Kruskal's stress measure) of 0.31, 0.15, 0.09 and 0.05 respectively. A fit score of 0.15 or lower is acceptable (Hair et al. 1998). Since the badness of fit score always improves with the number of dimensions a way to determine the number of dimensions for the MDS solution is by examining the scree plot of the data for up to 6 dimensions (Figure 1). The graph shows the elbow at 2 dimensions, however the fit score of 0.15 is marginally acceptable. Therefore we elected to use a 3 dimensions solution to interpret the data with an acceptable 0.09 badness-of-fit score and R^2 of 0.92, as we describe below. The 3 dimension solution presents a better fit for the data and allows for a richer interpretation.

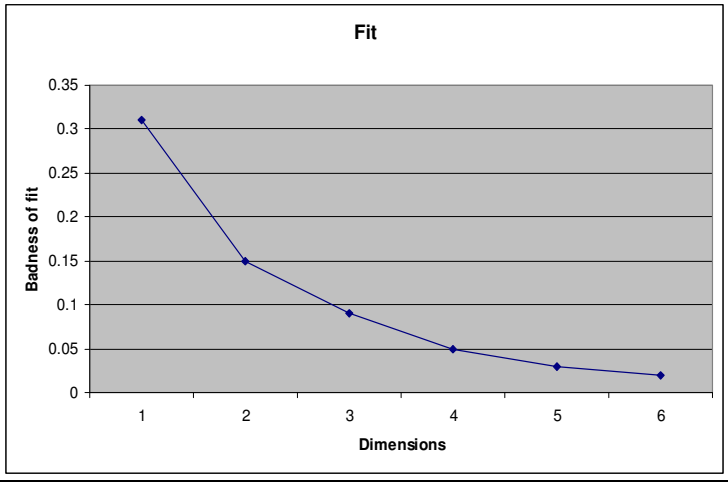

Figure 1: Scree plot of badness of fit scores

The three coordinates generated by the MDS analysis for each tool can be found in table 5, and in the three diagrams in Figures 2 to 4 below. The numbers in Table 5 represent locations along the number line. In interpreting the results of the MDS analysis each dimension is interpreted by focusing on its extreme sides (Priem et al. 2002). To interpret the MDS output for three dimensions, we initially examined the distribution of tools per dimension (table 5 and Figures 2-4), followed by a second empirical study using the ProFit method.

Table 5. MDS generated dimensions of social computing			
	Dimension 1	Dimension 2	Dimension 3
Blogger	0.40	-0.05	0.67
del.icio.us	-0.81	0.32	-1.86
Digg	-1.27	-0.15	-1.27
Facebook	1.23	0.09	0.02
Flickr	0.37	1.45	0.54
Google Sites	-0.37	-0.91	1.25
LinkedIn	2.28	-0.91	-0.42
Myspace	0.86	-0.19	0.08
Podcast Alley	-1.29	1.11	0.38
Twitter	0.99	0.22	-1.04
Wikispaces	0.07	-1.07	0.67
Yahoo Pipes	-2.05	-1.63	0.23
YouTube	-0.41	1.72	0.77
N=144			

Study 2 – overview

The identification of the dimensions in an MDS study is often a difficult task which can be done by subjective or objective procedures (Hair et al. 1998). The dimensions can be extracted by visually inspecting the resulting perceptual or spatial map, which requires a researcher's judgment. The existence of known (objective) characteristics could make the outcome less subjective. A more formalized and objective procedure is to use "PROperty FITting" (or 'ProFit'), a method, involving collecting attribute rating for each object or stimulus and then finding the best correspondence of each attribute with the derived dimensions. ProFit helps identify the specific attributes of the stimuli used by subjects in making their similarity judgments (Hair et al. 1998; Schiffman et al. 1981).

In practice, the ProFit method implies creating an additional questionnaire asking respondents to rate their agreement for each individual social computing tool on various statements concerning the tools' attributes. The significant ProFit questions used in this study are shown in table 6, and were developed based on the researchers' interpretation of the MDS results of study 1, insights obtained from the pilot study, and the transcripts of the process tracing exercise and the post pilot interviews. The ProFit survey was pre-tested with the same pilot population and was deemed appropriate. A final confirmatory ProFit survey with a total of 15 attribute questions was then sent out to the community of practice and a total of 83 responses were collected.

Result - Dimensions Interpretation

Before we describe the results of the ProFit regression we provide a brief overview of our qualitative interpretation of the dimensions. Our analysis of the results of both studies revealed the characteristics of each dimension described below. Note that our focus is on the functionality on which the different tools vary. Therefore we will not discuss some commonly agreed upon features of social computing such as user generated and owned content, or ease-of-use.

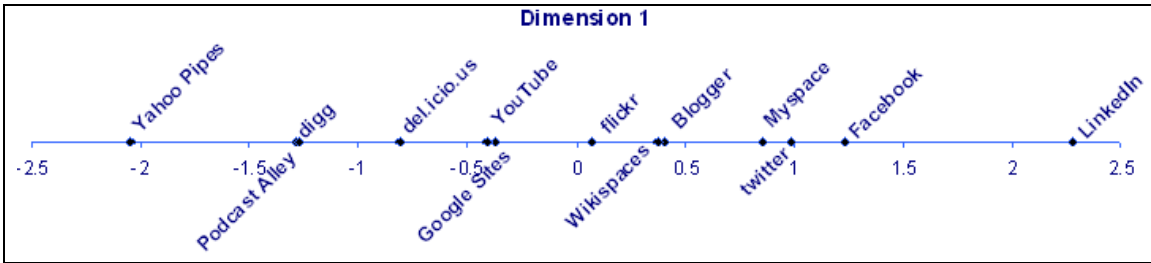

Figure 2. From Information to People Connections

Dimension 1: At first glance this dimension seems to reflect some aspect of the "socialness" of the system, with social networking tools such as Linkedin and Facebook at the extreme right hand side of this dimension and tagging and mash-up tools such as Digg and Yahoo Pipes at the extreme left. We thus characterize the right hand side of dimension 1 as creating *connections to people* and the left hand side as creating *connections to information*. Facebook, for example, a social networking tool which falls on the right-hand side of this dimension has been shown to expand its members' social network by enabling interactions with new people (bridging) and maintaining existing relationships (bonding) (Ellison et al. 2007). Overall, as we move from the left to the right along this dimension we have an increased ability to interact with others, share personal information, and access communities of shared interest. This ability is reduced as we move to the left side of the scale with stronger focus on information integration and links to non-human information resources.

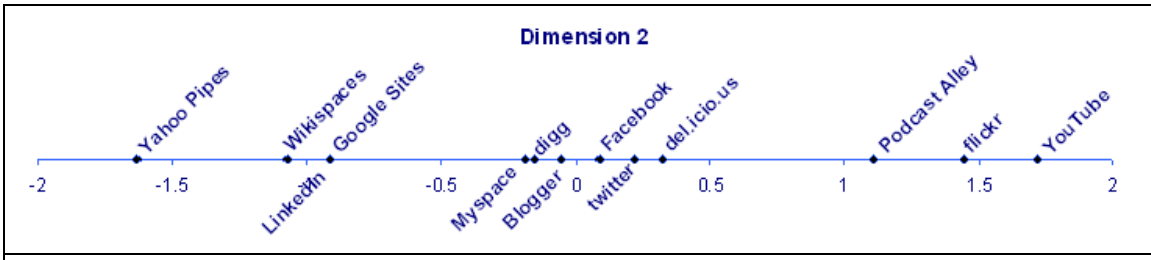

Figure 3. From Utilitarian to Hedonic Use

Dimension 2: We characterize this dimension using a hedonic/utilitarian dichotomy. First we note that tools located at the extreme right are strongly associated with entertainment (e.g. YouTube and Flickr) while tools at the extreme left are more strongly association with work (e.g. Yahoo Pipes and Wikispaces). As additional support for this interpretation consider, for example, the fact that LinkedIn, which is the social networking site more strongly associated with professional relations is located to the left of other social networking sites such as facebook and myspace which are strongly associated with friendships and social interactions. Second we also observe an improved ability of the tools to reach a wide audience as one moves towards the extreme right of the scale. For example, YouTube is a video sharing site shown to be a source of phenomenal ability to diffuse and disseminate content (Oh et al. 2008; Parameswaran and Whinston 2007b). The involvement of large audience implied by such ability can be closely associated with Hedonic use of social computing tools.

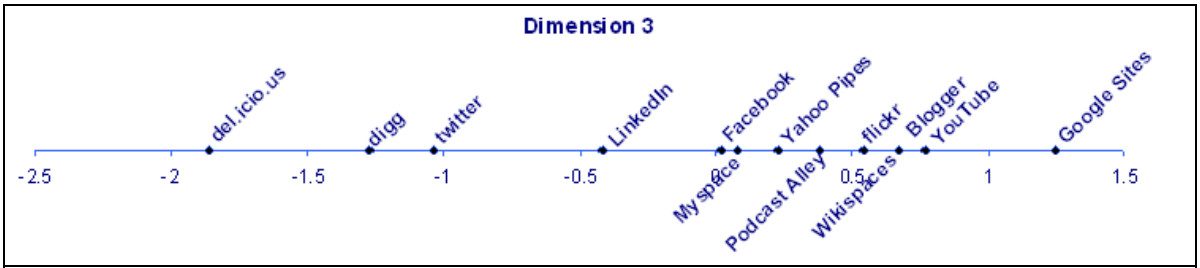

Figure 4. From Conveyance to Convergence Content Generation

Dimension 3: This dimension reflects the tool's ability to support the generation of content, with tools at the extreme right hand side such as Google Sites (a wiki), YouTube and Blogger often being associated with content generation and creativity (Baase 2008, Wagner 2004). We use a recent dichotomy offered by Media Synchronicity Theory (Dennis and Valacich 1999; Dennis et al. 2008) to characterize this dimension, suggesting that the tools on the left hand side are more suitable for conveyance of information (passing along information through tags or twittr messages) whereas tools on the right hand side are more supportive of convergence, enabling a shared understanding and provided context as well. In line with this distinction we also note that tools on the right hand side are more often associated with rich media and with collaborative work, which can support sensemaking and convergence on meaning (Dennis et al. 2008, Weick 1985).

Linear Regression and Property Vector Fitting

In addition to the above visual interpretation of the results, linear regression based on the ProFit survey was employed. The responses to the ProFit survey questions were entered as the dependent variable in each regression model and the coordinates of the tools for each dimension from the MDS outcome of study 1 entered as the independent variables (Kruskal and Wish 1978). SAS PROC TRANSREG was used to generate both the regression coefficients and R^2 (table 6) and the visual model (figure 5). For simplicity, none-significant results, including four additional attribute questions, are not reported in table 5. A test of inter-item reliability for each dimension revealed acceptable Cronbach alpha outcomes of 0.94 for the first dimension, 0.83 for the second and 0.86 for the third one.

Table 6. PROperty FITting (ProFit) regression outcome

Attribute Rating Question:		
Q7- This tool allows me to interact with other people	R^2=0.82, β=0.59***	**Dim 1 (α=0.94)**
Q9- This tool enables accessing communities of shared interest	R^2=0.68, β=0.34***	
Q10- This tool enables sharing personal information and experiences	R^2=0.60, β=0.61**	
Q12- This tool enables the creation and maintenance of social relations	R^2=0.85, β=0.81***	
Q15- This tool is more information- and content-focused than people-focused (R)	R^2= 0.70,β=-0.83***	
Q3- This tool is used mainly for entertainment purposes	R^2=0.43, β=0.7**	**Dim 2 (α=0.83)**
Q8- This tool enables the dissemination of content and reaching a wide audience	R^2=0.46, β=0.33***	
Q13- This tools is intended for a limited audience or personal use (R)	R^2=0.49, β=-0.22***	
Q1- This tool supports media-rich content (text, images, audio and video)	R^2=0.58, β=0.81***	**Dim 3 (α=0.86)**
Q5- This tool provides users with the ability to generate and share content	R^2=0.46, β=0.48***	
Q11- This tool enables collaborative generation of content	R^2=0.31, β=0.35**	
N=83, ** Significant at p < .05, *** Significant at p < .001		

The results of the ProFit regression are also graphically presented in Figure 5 below. Each vector in Figure 5 represents the alignment of each question from the ProFit survey (question labels correspond to Table 5 above) with the dimensions identified in Study 1. A closer alignment and a larger vector size indicate a better association between the attribute question and MDS dimension. For example Q15 and Q12 provide a good but opposite interpretations of dimension 1.

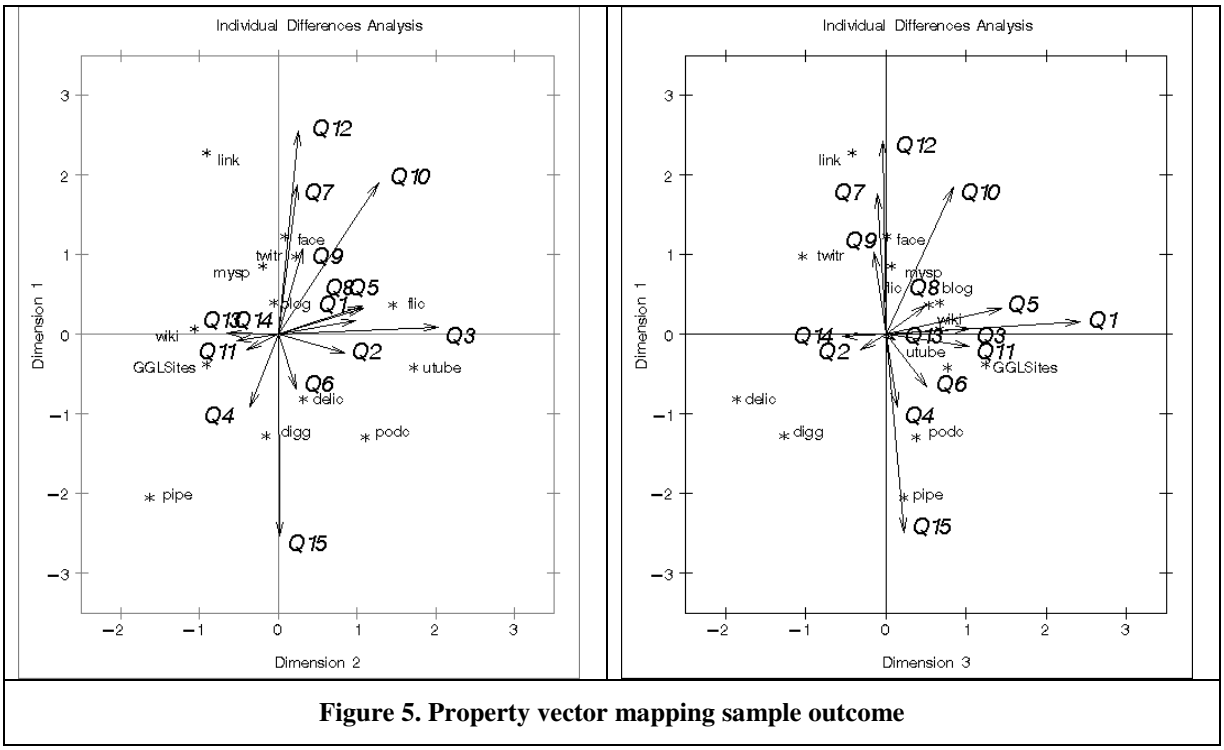

Figure 5. Property vector mapping sample outcome

The above findings from the ProFit regression provide strong support for our initial qualitative interpretation of dimension 1, confirming that the ability to create and maintain social relations, the ability to share personal information and experiences, the ability to interact with other people and the ability to access communities of shared interest, characterize this dimension. We also obtained support for our interpretation of dimension 2 having a good fit with the use for hedonic purposes, and with the intended audience of the content with Q8 and Q13 aligning with this dimension but in opposite directions. Finally, we also obtained support for our interpretation of dimension 3 having a good fit with the ability to generate and share collaborative, media-rich, content.

Discussion

Theoretical Contribution

The study described above was intended to characterize the dimensions of social computing in order to obtain a stronger understanding of this construct for use in future research and for better implementation of these tools in organizations. Our findings indicate the existence of three dimensions which we characterized along three continua – from information to people connections; from utilitarian to hedonic use; and from conveyance to convergence content generation. These findings are an important step towards the creation of a sound social computing construct for use in future research.

Building on the above findings and on existing literature we offer the following definition of social computing:

Social computing includes applications and services which generate from the grassroots, with decentralize governance, and technological flexibility. Social computing tools may be differentiated along three key dimensions: (i) their ability to support social interactions, social relations, and communities, (ii) their hedonic versus utilitarian focus, and (iii) their ability to support convergence versus conveyance of content.

We have thus far focused on providing a better understanding of social computing tools. Our objective in this paper was however to promote theorizing about the organizational impact of social computing tools.

Potential Organizational Impact

Each of the identified dimensions of social computing has the potential to provide benefits and/or drawbacks in an organizational context. To explore them we rely on existing literature such as computer-mediated communication (CMC) and communities of interest and on theories like social capital and media richness and synchronicity.

The *first* dimension found in this study is mainly about the ability of the technology to support social interactions, social relations and communities of shared interest. This has the potential to enhance individuals' social capital by enhancing social relations and mutual perceptions. Specifically, social capital is defined along three dimensions: the structural, the relational, and the cognitive. The structural dimension of social capital refers to the overall pattern of connections and interactions between individuals, i.e. whom an individual can reach and how he can reach them and is characterized by the features or attributes of the existing network ties between individuals and by the configuration of that network (Burt 1992; Nahapiet and Ghoshal 1998). Research has shown that computer-mediated communication (CMC), computer-supported social networks and online communities, which facilitate social interactions, can lead to an increase in users' social network size, formation of new weak ties, and maintenance of strong ones like friendship (Ellison et al. 2007; Wellman et al. 1996, 2001, 2006), hence enhancing the structural dimension of their social capital (Nahapiet and Ghoshal, 1998).

The relational dimension of social capital is related to the nature and quality of relationships between individuals and consists mainly of trust and obligations (Nahapiet and Ghoshal 1998). The first dimension of social computing can also enable the development of trust by the tools' ability to facilitate social interactions and manage social networks which could generate trusting relationships (Granovetter 1985; Gulati 1995; Hsu et al. 2007). Additionally, on-line participation in communities may intensify trust and reciprocity (Quan-Haase and Wellman 2002, 2004), leading to a strengthening of the relational dimension of users' social capital.

The above impact on social capital is important and social capital is considered a source of information, influence and solidarity (Adler and Kwon 2002), and has been shown to yield benefits to organizations in the form of employee career success (Burt 1992), enhanced intellectual capital (Nahapiet and Ghoshal 1998), facilitated business operations (Tsai and Ghoshal 1998) and more. Note that the above does not imply that tools located on the left hand side of dimension 1 have a low organizational impact. In fact, tools such as tags and mashups are valuable for finding information within the organization. Overall we note that organizations looking to enhance social capital and social links among their members should focus on the right hand side of dimension 1 while organizations looking to support the management of codified information should consider the tools on the left hand side.

The organizational impact of the *second* dimension is a bit more obscure, especially since there have been numerous articles concerning the negative impact of hedonic use of social computing tools (most notably Facebook) in the workplace (e.g. Boyd and Ellison 2008). Moreover, the use of social computing for "solitary recreations" draws people away from face-to-face contact and decreases the number of their strong ties (Wellman et al. 2001, 2004), ultimately reducing their social capital. Nevertheless, we foresee two important benefits to organizations: first, the ability to reach a wide audience make YouTube a valuable tool for training videos and other education activities in organizations. Second, hedonic tools can potentially increase job satisfaction and consequently job performance (Judge et al. 2001). Having fun at work may have advantages such as employee enthusiasm, satisfaction and creativity, reduced stress and group cohesiveness (Ford et al. 2003). Overall organizations should consider their desired audience and perception of enjoyment in selecting among tools along this dimension. If the organization decides to use YouTube for its marketing or instructional videos it should be aware of potential impacts of introducing a more hedonic tool into the workplace.

The *third* dimension represents the ability of social computing to support either the conveyance or convergence of content. Media Synchronicity Theory (Dennis and Valacich 1999; Dennis et al. 2008) offers several insights

concerning the organizational implications of this distinction. For example, to support team level idea generation, organizations can adopt social computing tools, like twitter or tags, that facilitate conveyance of information while tools which facilitate convergence on information, like wikis, can be adopted to support problem-solving activities (Murthy and Kerr 2003).

Limitations and Future Work

This study examined the dimensions differentiating among 13 social computing tools. While it may have been useful to include additional tools in the analysis we were limited by the cognitive load such addition would impose on respondents. Overall our selection of commonly known tools with varying purposes and features enabled us to identify three dimensions, which capture a sufficient percent of the difference among tools (i.e. our stress measures were acceptable). While some categories of social computing tools (such as social networking sites) may seem to be overrepresented in our study compared with Mashups tools, for example, we note that unlike the latter which has a well-defined and limited functionality, social networking tools vary in their characteristics, use and dimensions and hence multiple exemplars have been suggested by experts. We believe that such repetitions were eventually justified as tools varied along at least one of the three dimensions found. Finally, the somewhat low response rate of 16% is not atypical for a web-based survey. One possible reason for the low response rate is the length of the survey where respondents had to evaluate the difference of 78 pairs of tools which is a demanding task. Considering the specific methodology used – MDS - 144 responses are deemed sufficient, since in the multiple regression procedures used to identify the dimensions, the number of stimuli and not the number of judges is the effective sample size for the analysis and the basis for determining the degrees of freedom for the significance test (Jones and Koehly 1993).

This study offers an initial exploration of the dimensions underlying social computing tools. The result of ProFit study combined with our qualitative interpretation serve as an important first step in the creation of a theoretically sound social computing construct, which may then be used to understand the organizational impact of these tools. Further, as new tools and categories of organizational social computing emerge (Chui et al. 2009) a reexamination of the dimensions might be merited.

Conclusion

The aim of this study was to identify the key dimensions of social computing, an emerging and highly popular socio-technical trend. Our empirical results indicate that different social computing tools fall into three main dimensions. The first dimension reflects the social aspect of social computing with tools' varying ability to interact with others, accessing communities of shared interest, and share personal experiences. The second dimension reflects the use of social computing for hedonic purposes which could lead to the dissemination of content to a large audience versus the use of the tools for utilitarian purposes with a limited audience, and the third dimension reflects the ability to generate media-rich content. Organizations can adopt social computing tools which are high or low on different dimensions in order to achieve specific potential organizational benefits. Tools highly capable of supporting social relations, such as social networking tools which are high on dimension 1, are expected enhance the employees' social capital, specifically social network and team trust, which are valuable resources of information and support (Adler and Kwon 2002; Nahapiet and Ghoshal 1998). Tools which have a high capability for enjoyment and fun have the potential to increase employees' satisfaction but can also be a source of inefficiencies. Tools which are mainly devised for utilitarian purposes, i.e. low on the second dimension, can be useful in integrating valuable content. Finally, tools which facilitate the generation and sharing of mainly media-rich content can facilitate the sharing of tacit information within the organization.

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