Analyzing the social capital value chain in community network interfaces

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Abstract

Purpose – This work aims to probe how interface designers concerned with human-computer interaction of community networks might use the theoretical constructs of social capital and activity awareness.

Design/methodology/approach – A design model for community network interfaces is introduced that reconciles various computer-mediated communication research contributions with support for typical community network scenarios of use. Using this model, an inspection is performed on existing community network implementations (available December 2002) and then the adequacy of the model for informing the design process is examined.

Findings – Based on the insight gained through this analysis, a generic prototype and new user evaluation method are introduced that allow survey of user reaction to community network design elements under differing conditions. It is shown how results obtained through this method frame a value-chain understanding of conceptual tradeoffs.

Research limitations/implications – To demonstrate the new user evaluation method in an analysis of critical design tradeoffs, the issues of persistent virtual identity implementation and usage motivation are probed. However, the evaluation method must be validated with other issues and tested by researchers that were not part of its creation process.

Practical implications – Contributions from this paper include tools (a design model, a generic prototype, and an evaluation method) linking theory with community design artifacts, building on previous work. Evaluators now have indicators for assessing community informatics.

Originality/value – Interface designers of community networks and those interested in social capital theory will appreciate the link between practice and theory provided by this approach.

Keywords Man machine interface, Design, Interface management

Paper type Research paper

Introduction

Community networks implement technology to tie together diverse members. Definitions of community networks and related terminology can be confusing. Mynatt *et al.* (1997) describe network communities as technology-mediated environments that facilitate a sense of community (SOC) among members. One of the characteristics in their description of community includes shared geographic area, although they include other possible bases of community as well. Online communities or virtual communities describe a general gathering of interest, without the condition and organizational basis of residential proximity or the goal of affecting real-world events or interactions (Preece and Maloney-Krichmar, 2003; Haase *et al.*, 2002). Similarly, as O'Neil (2002) looks at community informatics indicators that can be used to gauge successful communication technologies, she thinks of community networks as supporting territorial communities. However, to refer specifically to geographically collocated groups of people that use technology as a complement for real-world interaction, others

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use the term community networks (Carroll and Rosson, 2001; Cohill and Kavanaugh, 1997; Schuler, 1996a, b), as we do here. Schuler's definition of community includes three aspects of membership: common residential location, "like minded" in the performance of daily activities, and a sense of belonging with a larger social unity. This definition provides a reasonable and constrained articulation of our focus, and is consistent with the conceptual concerns in differentiating SOC in place-based communities and communities of interest (Blanchard and Markus, 2002).

Toward effective community networks

Recent efforts within the research community have begun to clarify the important characteristics and questions for community networks. Mynatt *et al.* (1997) develop a set of characteristics uniquely demonstrated by network communities, which can be summarized as a multi-user, technologically mediated, persistent context for activity and realtime interaction – strongly suggesting an expectation of user identity rather than anonymity. They also describe important design dimensions that apply to community networks, which include managing linkages between real and virtual elements. They characterize "success" as supporting long-term participation, a variety of social rhythms for interaction, a sense of membership, and understanding of conventions and trust.

Carroll and Rosson (2001) raise many critical unanswered questions about community network participants, productive outcomes, impacts on community life, and effect on economic development – all probing specific sources of potential social capital and stressing the relationship between community networks and social capital production. They also note the differences in the variety of personal relationship types, again implying the need for virtual identities. The distinctive characteristics of community networks provide an opportunity to recognize and measure instances of community or collective efficacy, the perception of the members regarding the community's ability to accomplish goals.

Unfortunately, actual implementations of community networks do not yet seem to be effective in building social capital. While it has been noted that the Blacksburg Electronic Village served as a catalyst for local technology infrastructure (Carroll and Rosson, 2001), actual remedies to the crisis of community appear to be only anecdotal and relatively short lived. Carroll and Rosson also provide a summary of other lack-luster evaluations, and Schuler (1996a, b) describes some of the challenges that have consumed community networks. O'Neil (2002) also summarizes 18 evaluations of community networks, noting that five theories of outcomes can be identified: strong democracy, social capital, individual empowerment, SOC, and economic development. Other research casts doubt on the role of social capital within broader, organization-based knowledge management initiatives (Edelman *et al.*, 2004), suggesting that a better understanding of social capital "bridging and bonding elements" must be better understood for systems to be beneficially implemented.

In order to postulate shortcomings of community networks in building social capital, and to suggest improvements, we focus on two questions:

- *What design elements of community networks support production of social capital?* In other words, we want to identify key components of the community network interface that should be fulfilling this critical system function; and
- *What role should virtual identity play in a successful community network?* We suspect privacy and security concerns inherent with a persistent virtual identity may be tradeoffs with mutual trust and awareness, which seem to be prerequisites for social capital. Is a balance or work-around possible?

To this end, the next section focuses on understanding the social capital building process. Considering general support for collective activity may broaden our purview, so we also provide a review of design strategies supporting the social capital building process. This suggests a general design model for community networks, which we introduce as a representation of the value chain within these interfaces and then use to analyze several existing systems. Based on the analysis, we developed a generic prototype with design elements that may facilitate production of social capital. With this prototype, we obtained user feedback related to our question about persistent virtual identity options in a community network, framing a discussion of future work and design conception tradeoffs.

Building social capital

Haase *et al.* (2002) describe three forms of social capital that could be influenced by community networks, although their discussion is framed more generally around the internet. Network capital describes the frequency of contact with friends and other relations, civic engagement describes participation level in political activities and voluntary organizations, and SOC describes the willingness and effectiveness for mobilizing. In this recent report, they provide evidence that the internet is increasing all three forms of social capital. O'Neil (2002) provides indicators for both social capital and SOC that form a guide for evaluation. Blanchard and Markus (2002) summarize component dimensions of SOC: feelings of membership, feelings of influence, integration and fulfillment of needs, and shared emotional connection. They also summarize how each dimension is developed, for example, feelings of influence result from the process of enforcing and establishing norms within a group. Development/maintenance processes for feelings of influence include establishment of boundaries, personal investment of time, use of common symbols, status rewards, shared values, and the like. Considering these processes, it is difficult to imagine how they could be effectively accomplished without virtually expressing and interpreting self and member identity within the community network. We save a thorough analysis of the role of virtual identity for later.

Strategies for collective activity support

As we consider how community network implementations can be improved, we recognize the potential that computer supported collaborative work (CSCW) concepts may introduce. To frame this review, we extract three topics (providing a persistent history of asynchronous activity, facilitating coherent near-synchronous communication, and linking the real and virtual worlds) that were introduced earlier as important characteristics of community networks and that would collectively support all dimensions of the SOC development processes.

Providing a persistent history of asynchronous activity. Much recent work within the CSCW field has been directed toward providing common ground, the context necessary for guiding effective collaboration and complex activities. Without support for common ground, collaborators are unable to effectively assess each other's contributions or develop trust and common goals. One technique for this support is a durable artifact depicting interaction over time, such as conversation trees and threaded discussion boards, which offer the key benefits of a coherent recording mechanism and peripheral awareness of groupwork (Smith *et al.*, 2000). A persistent history of

interactions can also be enhanced with data-mining and visualization techniques, such as the Usenet patterns of participation augmented with thread-tree, piano roll, sociogram, and tree map visualizations (Smith and Fiore, 2001) – these provide a possible first-step in understanding the historical background required for deeper discussion. Researchers have also identified specific aspects of groupware systems that contribute to successful archival communication, including moderator support for focusing topical discussion and streamlined history size that eliminates repetitive discussion or unwieldy organization conducive to browsing (Whittaker, 1996). The recent articulation of activity awareness, the knowledge of group project coordination and execution that involves understanding the relationship of tasks and goals, has been found to be a useful objective for designing and evaluating interfaces that inform group members of current collective and sub-group progress and plans, historical performance, and opportunities for impromptu goal revision (Carroll *et al.*, 2003).

Facilitating coherent, near-synchronous communication. Other efforts have focused on improving computer mediated conversation interfaces to more closely match norms of spoken interaction. Te'eni (2001) argues that designers of communication support systems must balance the communication medium and message form, and offers a model for studying the communication process and selecting optimal configuration of medium and message attributes. Te'eni lists several communication strategies that can be augmented by computational solutions: contextualization, control, attention focusing, affectivity, and perspective taking. These general ideas can be useful for further probing formation of social capital through communication. In other work, Smith *et al.* (2000) summarize deficiencies of chat interfaces found in sociological conversation analysis, which include poor management of interruption and turn-taking, ambiguity in message presentation order, and awareness of real world attention focus.

While their threaded chat interface may begin to address these issues, other chat alternatives (Vronay *et al.*, 1999) provide more comprehensive indication of remote user status with a set of last line, immediate text, and keyboard activity representations associated with each chat user. This approach is consistent with Ackerman and Starr's (1995) argument for the importance of social activity indicators based on a "social facilitation" effect that describes heightened mobilization of individual energy in conditions where others are known to be active. In this area, Erickson *et al.*'s (2000, 2002) ideas about social translucence are particularly exciting and farther reaching than chat. Social translucence refers to systems that allow visibility of socially significant information, awareness of others' actions, and accountability for actions performed. Through these properties, community processes such as formation of interaction conventions, peer pressure, and imitation are supported, which allow coherent communication. Abstracting individual actions enough to preserve a sense of privacy prevents transparency, thus translucence. To implement social translucence, minimalist visualizations called social proxies depict individual activity over time and in relation to the group, providing subtle cues that convey context for activities such as participating in an auction or lecture and waiting in line (Erickson and Kellogg, 2000). Another direction seeks to prompt opportunistic interaction of web site browsers by depicting a dynamic, lexical representation of their work context (gleaned by other processing activities) and intelligently suggesting others with common situations (Budzik *et al.*, 2002).

Linking the real and virtual worlds. With the ability to monitor design elements showing near-synchronous activity information of group and community members, users may often want to keep an eye on such information while they devote most of their attention to other computing and non-computing tasks. Notification systems, particularly activity notifications, allow users to receive such information of interest without introducing unwanted interruption to ongoing tasks, often in a peripheral and ubiquitous manner (McCrickard and Chewar, 2003; McCrickard *et al.*, 2003). As we look for ways to link virtual and real world events and awareness, notification options provide answers. Basic notification systems include AOL Instant Messenger's Buddy List indicators and e-mail message status representations – users are able to learn something about collaborator actions at a glance. More advanced systems provide interactive maps that use real world metaphors to represent virtual community events. However, potential is vast, considering work being done to seamlessly integrate notification with a user's physical environment, such as Ishii and Ullmer' (1997) ambientROOM or the symbolic mappings of activity and presence information in AROMA's active wall display images (Pedersen and Sokoler, 1997), and the movement toward aesthetic and meaningful design of ubiquitous data (Hallnäs and Redström, 2002). Other work leverages wireless technology and portable client devices to extend the depth and range of notification possibilities (Kindberg *et al.*, 2002; Stathis *et al.*, 2002) and uses recommender features to provide notification of availability and easy access to group collections like NuggetMine (Goecks and Cosley, 2002).

The role of individual identity

In our survey of these strategies for collective activity support of critical community network features and social capital production, the reliance on recognition of established user identity is strong. However, as Erickson and Kellogg (2000) note, there is a critical tradeoff associated with the tension between user privacy requirements and providing persistent (and increasingly broad) visibility of their activities. Identity tradeoffs within community networks are even greater – in exchange for our privacy we expect to gain a sense of security and well-being. Walters (2001) makes an excellent argument about this community component of additive well-being, innate protection of privacy rights in communal action, and possibilities for activity translucence available through privacy-enhancing technologies (PET) such as encrypted digital pseudonyms. Especially poignant is his observation that PET designs must "contain doors or switches by which the subject may remain "reachable" provided certain conditions set by him or her are met" in order to allow the production of social capital and preserve desire for anonymity. This reinforces our research questions, motivating the need to understand how persistent virtual identity impacts the design elements of community networks and their social capital production process.

A design model for community networks

To investigate how the underlying notion of persistent virtual identity could impact the design of community networks and acceleration of social capital production, we introduce a design model that reconciles the promising internet and computer-mediated communication research contributions with support for typical community network scenarios of use. As a general design model, this conception addresses what are believed to be typical user goals and interaction intentions. Since

we are working under the assumption that the primary goal of a community network is to provide a source of social capital (Carroll and Rosson, 2001), we revisit the social capital building processes, which we cross-reference with the collective activity support strategies to reveal discrete stages of necessary user interaction facilitation.

Feelings of membership result from understanding social conventions, devoting time to group efforts, and using group symbols (Blanchard and Markus, 2002), which is best supported by notification for activity awareness and receipt of social cues necessary for visibility, awareness, and development of accountability. Therefore, activity notification is the first stage in our design model (Figure 1). Activity notification leads to social translucence (the second stage) which primarily supports the second dimension of SOC – feelings of influence. Here, coherent communication advances the production of social capital, especially network capital. SOC and increased perception of collective efficacy result, creating a collective efficacy context (stage three) if supported by a sense of history; this further inspires confidence in the dimension of integration and fulfillment of needs. The final dimension, shared emotional connection, is supported by activity notification, social translucence, and a historical context. Coupled with this, social capital can be focused into distributed community activities, our fourth stage that allows the cycle to be repeated indefinitely. Figure 1 provides a succinct statement of each stage's basic purpose and implementation expectations. This model represents the value chain of social capital – the links necessary for accumulation of SOC. Understanding the value chain can be useful for analysis of design implementations and issues inherent within each stage.

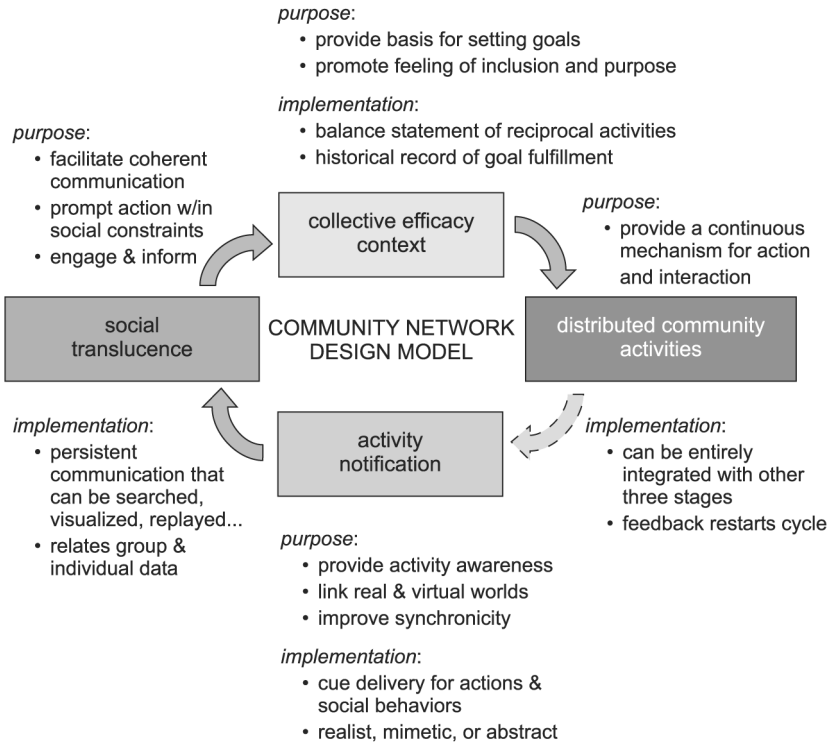


Figure 1.
General design model of a community network, highlighting four stages of social capital production

Typical scenarios of use

To simplify discussion of this model and further analysis, we focus on two scenarios which may describe the most typical community network users, one involving a "service-providing actor" and another involving a "service-demanding actor". Possible community network needs at each design model stage are reflected in Table I.

In the first scenario (scenario SP), the user asks "what can I do for my community?" with a strong spirit of undirected volunteerism and consults the community network to find out. This user is likely to be interested in learning about various issues, identifying leaders or more experienced members, fitting individual talents to community needs, and carrying out and receiving recognition for valued actions.

In contrast, the user in the second scenario (scenario SD) asks "what can my community do for me?", demanding some type of action or service that he feels he is owed. This user is likely to value feedback about his issue in the form of acknowledgement and shared interest or identification of others with similar issues. He will also value a forum that allows negotiation or planning and coordination of action.

As we use the design model to analyze existing community networks, and later when we conduct user testing on our persistent virtual identity question, we consider how the design implementations support each of these two scenarios (SP and SD). These scenarios are carried over in our user testing example later in the paper.

Analysis of existing community networks

Using our model, we analyzed the designs of six existing community networks to identify breakdowns in the social capital production process. The main purpose of this was to exercise the model itself and get a sense of how well it helps focus attention on interface elements that contribute to SOC. However, we also wanted to demonstrate a methodical review of existing systems to provide a more solid basis for a generic prototype design. The six community networks reviewed (in Dec. 2002) include: Blacksburg electronic village (www.bev.net), columbiaMO.com (www.columbiamo.com), Danbury Community Network (www.danbury.org), Davis Community Network (www2.dcn.org/davis/orgs/DCN), Hamilton CommunityNet (www.freenet.hamilton.on.ca), and Prairienet (www.prairienet.org). These six community networks were chosen to represent a wide variety of community sizes, geographic locations, and elaborateness of interface functionality. Each community network was pre-selected from a pool of sites that had been previously reviewed or cited by others researching various aspects of community network interface design. Although we did not consider their evaluations before forming our own, we thought it would be most interesting to demonstrate our design model around interfaces that already had earned research interest.

Half of the interfaces were analyzed in the context of each scenario: SP and SD. Analysis procedures invoked inspection of interface functions to assess support for each design model stage, described with a rating of "none", "low", "some", or "strong" depending on the degree that interface artifacts instantiated the purpose and implementation expectations (Figure 1). Ratings for each of the six community networks are provided in Table II. For most ratings, a brief note describes the specific artifacts that support the stage. Additionally, a column is provided to note implementation details of any persistent virtual identity.

Table I. Comparison of possible needs of two typical community network usage scenarios

	Need for…			
Scenario	Activity notification	Social translucence	Collective efficacy context	Distributed activities
Service-providing actor	Receive news items Discern important or new issues	Assess interest and activity on issues Determine general reaction consensus	See how the community's agenda may be advanced Realize how and to whom my contribution will matter most	Receive action support and continued encouragement Provide progress status
Service-demanding actor	Announce: "I have an important issue"	Obtain issue acknowledgement Create interest Identify resistance	Deconflict personal and community agenda Create or mobilize resolution goals Leverage earned reciprocity	Announce plan Coordinate group action Collect results

Note: Needs are identified according to four stages of social capital production, shown in Figure 1

Table II.
Assessment of six community interfaces to support for the stages in our general design model the question of virtual identity.

Interface	Activity notification	Social translucence	Support for... Collective efficacy context	Distributed activities	Virtual identity and persistence
(1) Blacksburg electronic village	Some; e-News e-mails, listservs	Low; forum threads	Some; usenet groups, forums, meeting archives	Low; listing of calendar events	Low; homepage directory listing
(2) ColumbiaMO.com	Low; static feature stories	None	Some; calendar, archives	Some; add calend. events, action items	None
(3) Danbury Community Network	Low; old events	None	Low; many links	Low; no support on site	None
(4) Davis Community Network	Some; DCN-News, listserv, calendar	Low; forum threads and read marking	Some; forums, calend. archives, neighborhoods	Strong; forum, add calend. event, add links	None
(5) Hamilton communitynet	Strong;GIS info, announcements, private messages	Some; "who is online?"	Some; newsgroups, Inform Hamilton	Strong; guestbook, hit counter, forms, add event	Some, forum logins, register in-person
(6) Prairienet	Some; e-mails, listservs	None	Some; e-mails, listservs, info archives	Low; mail lists	Some, authentic logon

Notes: We speculate that performance breakdown within or between any of the stages may result in a loss of effectiveness in the community network's production of social capital. Interfaces in rows 1, 3, 4 were analyzed using scenarios SP; rows 2, 4, 6 were analyzed using scenario SD

To more clearly illustrate the analysis process, we focus discussion on the Blacksburg electronic village (BEV) using scenario SP. Again, ratings for the assessments appear in Table II, but the case description below elaborates on details of the model application and conceptual process.

Example analysis – Blacksburg electronic village

The BEV community network provides its local community with information for contacting members, a large catalog of business and organizational listings, a "virtual town hall", resources for seniors, and links to area schools, libraries, and museums. Visitors can find out things to do and driving directions. However, in our assessment scenario (SP), we assume the spirit of undirected volunteerism and search for a way we can make a meaningful impact in the community.

Activity notification. In striving to become a more active part of the community, notification can quickly enhance feelings of membership. We look for mechanisms that can keep us abreast of BEV happenings during daily activities, especially those that will help us learn about issues and activities of other community members. This requirement goes beyond the main page summaries of upcoming local events – we want to be informed and reminded as events unfold. Bi-weekly delivery of Blacksburg eNews e-mails provide a start, as do community listservs (rating = some support). However, the interface lacks strong notification support such as pop-up alerts for web casts or urgent community needs, unobtrusive reminders about approaching events, chat facilities, or dynamic information delivery that would invoke impromptu, real-world interactions. As a tentative new member, push technologies like these may be welcome (although they have been found to become quickly annoying), inviting involvement and encouraging informativeness necessary for feelings of membership.

Socially translucent communication. Assuming that the BEV helped focus our interest toward particular issues (as the comprehensive catalog of organizations is wont to do), we now require support for assessing community interest about particular events and issues, gauging consensus, and understanding norms and conventions of participation. Coherent communication should be a by-product of visibility and awareness of other members' activities. In this respect, the BEV provides very little (rating = low) support. Perhaps the one feature we could find was the member statistics and list of "10 most popular homepages," however, these representations felt dated and insipid. Simple, iconic indications of others that are actively viewing the site would be a start toward social translucence, but some of the social proxy ideas (Erickson *et al.*, 2002), voting interfaces and results (such as www.cnn.com, *QuickVote*), or Amazon.com-style reviews and referrals would be most helpful. While the site claims to provide some services that might enable social translucence – small group collaboration with shared calendars, address books, project management tools, and discussion forums, this seemed to cater toward established groups rather than promoting feelings of influence or SOC with our scenario actor.

Collective efficacy context. In order for our service-providing actor to achieve the SOC necessary to adopt common goals and engage in reciprocity, they will be interested in browsing through a historical record of community activities, sensing who is responsible for what, and realizing how to contribute most effectively. The BEV community network implementation does not readily provide an itemization of existing goals, but it does allow access to a history of collective accomplishment with Usenet newsgroup servers

for 12 local groups (free for all users) and provides links to archived web casts of Town Council meetings and government documents (rating = some support).

Support for distributed activity accomplishment. As community members work toward common goals, they need to be able to receive support for tasks and encouragement from others that are aware of their progress, and provide feedback to the larger community that will earn reciprocity, rewards, or other recognition. This community network implementation provides no explicit support for this, although newsgroups or discussions forums could fill such a role. Listing calendar events do promote community awareness of distributed activities, but the overall support for this stage can be improved (rating = low).

Persistent virtual identity. A user can establish a persistent virtual identity within this community network by registering and becoming a Villager, which allows adding or updating of community, business, and organization listings and homepages. A user's e-mail address can also match the community domain, but there is no authentication of identity or association of participation-relation actions with the identity, so overall incorporation of persistent virtual identity within this community network is low.

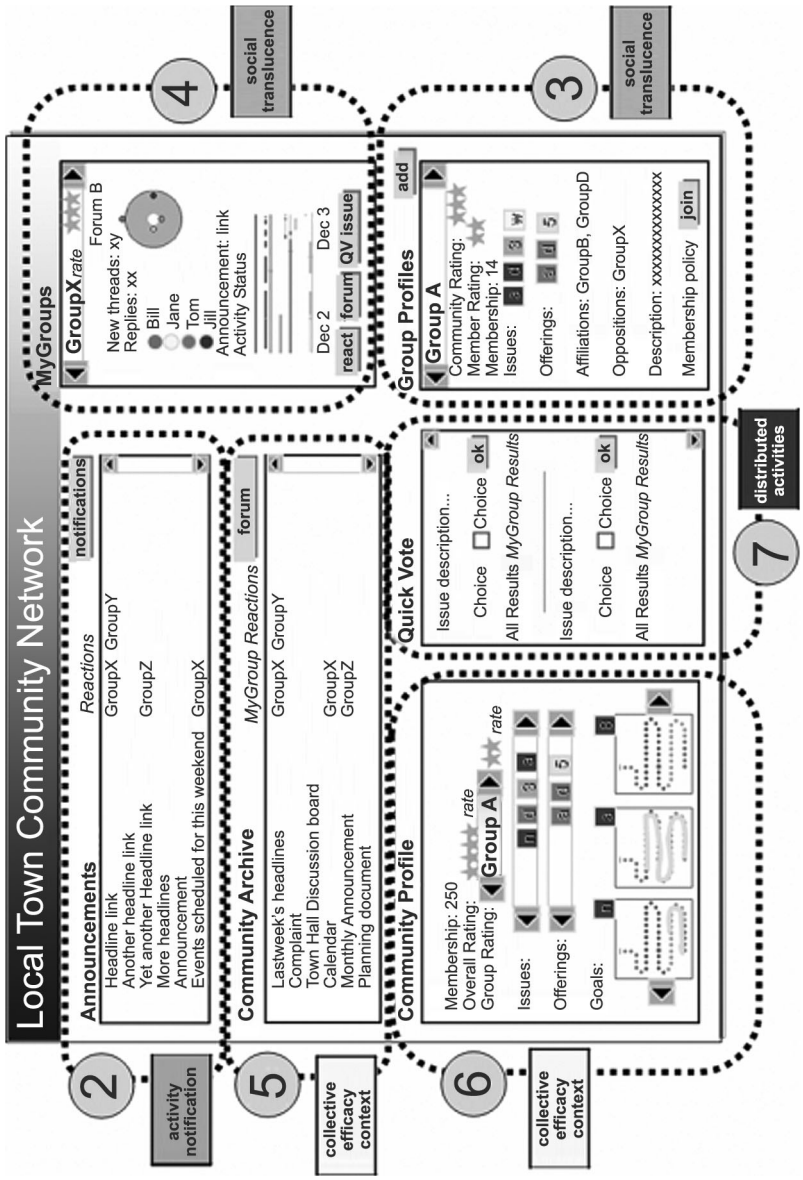
Overall, the BEV community network appears to provide some support for building social capital, although many improvements can be made. Of particular note, much can be done with leveraging dynamic activity of community members through notification and social proxies.

Other community networks

The overall results for all six community networks are provided in Table II. From this, we can see that a variety of ratings were achieved, although community networks seem to be especially weak in supporting social translucence and providing mechanisms for enacting distributed activities. In particular, Hamilton CommunityNet seemed to be the strongest, although the feature of adding links to any page found in the Davis Community Network certainly provides a lot of potential. Policies for virtual identity and user accounts varied widely – many sites include no support for e-mail accounts and require no logon at all. Other sites, particularly Prairienet, require members to use authentic usernames that can be traced back to real names. Only the Hamiliton CommunityNet appeared to enforce local accounts, since accounts could only be established in person.

A generic prototype based on our model

To further exercise our design model, we used it to develop a generic prototype of a community network. Since our design model helps us consider and refer to specific interface elements, we were able to construct an interface that includes some type of support for each stage of the social capital production process (Figure 2). The interface is purely conceptual, developed to aid our understanding of the individual and holistic impact of each feature in supporting various usage scenarios (described earlier), building and maintaining a SOC, and balancing design choices (e.g. implementation of persistent virtual identity policies). Design elements and feature groups within this prototype are meant to be entirely replaceable – perhaps a catalog of generic components for each stage would allow browsing through various implementations to select and test for ideal combinations. Once a conceptual activity design is settled on that would support all stages of social capital production, other usability concerns such as information and interaction design can be addressed in less formative prototypes.



Notes: Square labels for interface elements indicate the design model stage they primarily support. Numerical labels refer to the step in our user study during which the interface component was discussed and rated (these labels are also used as a reference in the description of this prototype). Components included in #4 and #6 are social proxies from (Erickson *et al.* 2002)

Figure 2.
Generic prototype of a community network, based on Figure 1

Design conception

Features within our generic prototype are discussed according to the social capital production stages of the design model introduced earlier (Figure 1), starting with activity notification. Before arriving at this type of interface, users of the community network would perhaps pass through a logon screen requiring an authenticated or unauthenticated username and password (these issues are explored in the next section describing the user study).

Activity notification. Support for activity notification includes two primary features: the community announcements (Figure 2 (2)) and a notification settings screen (not pictured). Once users have accessed the site, they might find a list of recent community announcements helpful. Items in the list may link to detailed stories or event descriptions, or perhaps to discussion forums. Here, users should be able to find out if others have similar needs or concerns and get a general idea of what is going on in the community. If they develop associations with groups within the community, perhaps users might want a link to group reactions for individual items in the list. There may also be a mechanism to indicate preference for receiving updates on postings within certain categories of information or information from particular people, perhaps through an e-mail message notification, a pop-up window, or a taskbar icon that subtly changes in appearance. These notifications would ensure users are updated on site changes, even if they do not visit the web site frequently.

Socially translucent communication. Two groups of features in this interface support members of the community network in comparing views, understanding patterns of each other's activity, and developing norms and accountability for action: the group profiles (Figure 2 (3)) and the MyGroups activity representation (Figure 2 (4)).

To find out what other members of the community are concerned with and discussing, users might access the group profiles. As they browse through the collection of groups registered within the community network, they may notice the group reputations, provided by the "community rating" (votes from anyone in the community) and the "member rating" (votes from only members of the group). Groups can have issues represented by icons (described by tool-tips and description links) that are important to them (e.g. the desire not to be harassed about using a crosswalk), and they can also be known for offering certain resources to the community at large (e.g. carpooling space or babysitting services). Groups may also visibly indicate opposition to the policies or actions of another group. From this part of the interface, users can join or create new groups.

Once users join a group, they may want to be aware of group members' activity within the community network. With a small graphical representation (we include those found in Erickson *et al.* (2002), they can get a sense of who else is currently logged on and participating in discussion forums. Icons represent users that are logged on or off the site (inside the circle) and convey the recency of activities like chatting within discussion forums (central icons indicate very recent activity, as inactive time passes they drift to the edges). A small timeline can also show a line for each person, representing when and how long they were logged on during a given period of time. These features should allow users to know a little bit about when group members are active within the community network and what active concerns they have.

Evidence of collective efficacy. The prototype contains two elements that should provide the historical context and evidence of reciprocity necessary for development of

collective efficacy and ultimately new social capital: the community archives (Figure 2 (5)) and the community profile (Figure 2(6)). The community archives are fairly standard within existing interfaces, typically including a list of resources that can be accessed by anyone in the community, such as a common calendar of town events, formal documents detailing plans or complaints, and permanent discussion boards on a variety of topics. Our conception differs in the inclusion of "MyGroup Reactions". If a user is a member of a group, group-owned links may also appear (e.g. to a group calendar or to document annotations), indicating related resources that are only available to members of the group or those given access permissions.

The community profile is included to help users understand how their concerns fit in with community-wide concerns. Here, they can see things like the total community membership and how the community is rated by all members or various groups. Community members are also able to see how community leaders have prioritized issues within the community that need supporting (such as a leaf-removal project or cross-walk enforcement movement) and the types of community support available to groups or individuals (such as food and clothing that has just been donated). In addition, some issues that require multiple phases to complete can be represented in terms of a progress state indicator (Erickson *et al.*, 2002).

Support for distributed activity accomplishment. Many of the elements included in the other features support distributed activity accomplishment. For example, users can post messages on group or community discussion forums, rate the community or other groups, submit requests to include issues in QuickVote (Figure 2 (7)) or documents in the community archives. Many of the notification options (e.g. associating certain events, groups, or individuals with preferences to receive e-mail, instant messages, or subtle changes to taskbar icons) provide the feedback necessary to restart the cycle, providing prompt reaction from group or community members related to a member's actions.

We expect that this model can be useful for testing how user attitudes are formed by individual interface components. We can obtain user responses to investigate how each component enhances SOC and social capital, using the indicators provided in O'Neil's (2002) work. Furthermore, we can use this model to frame other research, such as our question related to the role of persistent virtual identity within a community network.

Exemplar user study

Referring back to our original research questions, we feel our design model and generic prototype provide us with tools necessary to assess the impact of design elements on the support of social capital production – demonstrating linkages between theory and design artifacts. These linkages allow us to address specific questions related to design components within a community network – requiring new analysis techniques for assessing quality of interfaces and interface features. Such an analysis technique must help us consider the additive effect of a variety of theoretical indicators and identify breakdowns in complex interface objectives, like supporting social capital production.

The value chain analysis

Business disciplines related to strategic and operations management use the concept of a *value chain* to describe the linked set of value-creating and value-adding activities involved in product production or marketing. Fundamental activities, such as R&D or processing of raw materials, are necessary to create value, while later activities like

marketing and retailing add value to the final product. Often, many different organizations and firms contribute to these activities, so value chain analysis involves examination of the linkages and identification of key activities per organization (Shank and Govindarajan, 1993) (e.g. activity-based costing accounting). Without this type of analysis, final product value (or cost) components are rarely distinguishable by contributing value chain activities – the collective effect blends efficiencies and inefficiencies throughout the chain. While perhaps the bottom line matters most, this process is often relied on to provide focus for competitive strategic resource management and synergistic product growth. Our approach posits that the interface design community can benefit from similar analyses, especially as we consider challenges brought on by collaborative, ubiquitous, notification, and other non-traditional interfaces. Value chain analysis can provide usability insight related to the progressive effect of components in larger, more complex usage experiences.

Hypotheses

To illustrate how the value chain analysis can be used with our design model and generic prototype tools, the specific question that we focus on in this exemplar user study related to member policies for virtual identity authentication and persistence. Virtual identity policy options range from open access to a strict authentication policy that may involve a physical account issuing authority within the community (like the town library), ensuring members reside locally and account names conform to actual identity (authentic logon). Promoting trust and accountability seems to be a tradeoff for privacy and anonymity. We hypothesize:

(1) user attitude toward using community networks differs under authenticated and unauthenticated logon conditions;

(2) these differences vary between those with usage concerns relying on establishment of accountability or anonymity; and

(3) differences between groups are traceable through user perception of individual feature usefulness and appeal.

To test these hypotheses, we used our community network prototype to demonstrate eight key features sequentially (Figure 2). The features and the order of presentation were carefully selected according to the value chain model described earlier (Figure 1).

Methodology

We demonstrated our prototype to 40 participants (male, aged 18-23, with similar computing experience), obtaining feedback immediately after explaining each feature. Using a 2×2 between-subjects design, we varied logon policy and usage concern. The two logon policy treatments were an authentic logon (A) and an unauthentic logon (U) explanation of the logon screen. For each, we mentioned the different implications of the logon policy to membership validity and association of actions with real identity. We also asked participants to imagine having one of two different concerns relating to their initial community network usage as they considered the interface – a service providing (SP) or service demanding (SD) concern. SP concern participants were to act as if they were trying to find a way to volunteer within the community but were unsure how to begin. SD participants were to act as if they want to invoke authority response to vehicle vandalism incidents.

Just after learning about their concern and the logon feature, participants provided a baseline indication of their attitude toward using the community network. After each subsequent feature was introduced, participants indicated how much they like it, whether they thought it was useful, their most important concern related to it, and whether it changed their attitude about the overall community network. From these responses, we are able to conduct the most basic assessment of the social capital value chain within the interface. The posttest questions included exactly the same question as the initial question ("What is your general attitude toward using the community network?"), as well as questions that probed the effect of the community network on participation within the physical community and willingness to use the network.

Results and discussion

There are several interesting initial results. Surprisingly, our first hypothesis was not supported by answers on the posttest attitude question. However, our second hypothesis was supported ($F(1, 19) = 2.38$, MSE $= 1.1$, $p = 0.025$) : SD-U and SP-A participants (those with logon policies compatible to accountability or privacy need) liked the general idea of the community network more. In order to approach our third hypothesis, we looked at how attitude levels changed over the course of the feature demonstrations. Figure 3 shows how the value chain increased differently for each condition (sometimes decreasing), based on average responses to how each feature impacted attitudes toward the community network. A perfect set of features would increase one-point at each step. The differences between groups (note group profiles) provide a basis for reengineering.

Extensions of this approach can benefit the research community. We have shown how decomposing the system goal to key activities suggests value chain links and can reveal feature differences between design and situation variables. User evaluation should assess the holistic effect of individual links on system goals, allowing designers to understand which components are most important and which implementations should be used in various situations.

Conclusions

Based on the analysis of existing systems, the prototype design conception, and the methodological contributions to our user study, we believe that our model of social capital production is a step in the right direction toward understanding how to improve the

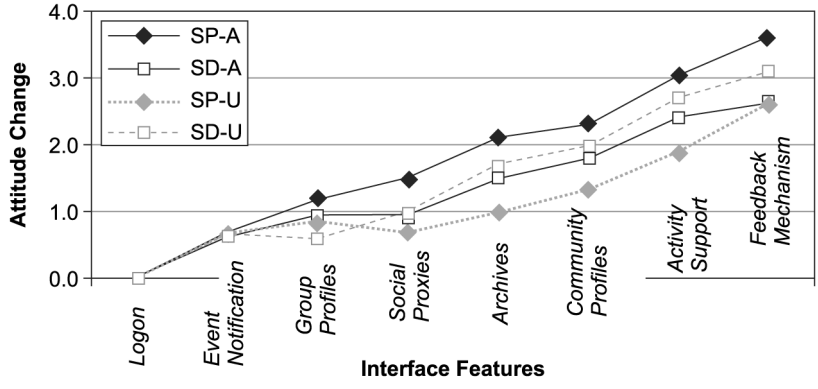


Figure 3.
"Value chain" user study analysis of the community network

design effectiveness of community networks. Our design model was helpful for identifying critical aspects of the design, and should focus feature development and usability testing in a way that will fulfill the community network's purpose – social capital.

Using the model to isolate features of an interface for progressive analysis and user feedback allows a value chain to be identified – revealing how value or the sense of worth is manifested through use. We focused on a question relating to logon policy with our initial study, but similar issues related to persistent virtual identity can be probed with this technique, allowing breakdowns in the social capital production process to be exposed. Value chaining also allows claims about features, which are already well-grounded in theory, to be related to synergistic, multidimensional concepts, such as social capital. This can help designers select appropriate interface elements, usability engineers prioritize reengineering efforts based on cost-benefit data, and community leaders appreciate specific elements of an a community network interface.

There is much to do in the way of future work. At this time, we have not instantiated or implemented a version of the generic prototype, although that is a likely next step. Certainly, we have an interest in identifying communities that would benefit from a community network designed or redesigned according to our model. Although our case studies have demonstrated an early analytical effort, we are interested in developing improved evaluation methods and criteria to complement critical incident reporting (Neale *et al.*, 2000) throughout all stages. Since our prototype can support the evaluation of many different questions, additional user testing may provide much more insight into questions about persistent virtual identity. We are especially focused on improving the design of specific interface elements, particularly those that support activity notification and enhance activity awareness. We also hope to extend our modeling process and value chaining technique introduced here to other areas of interface development.

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