Building Sustainable Community Information Systems: Lessons from a Digital Government Project

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ABSTRACT
This paper introduces a rationale for and approach to the study of sustainability in computerized community information systems. It begins by presenting a theoretical framework for posing questions about sustainability predicated upon assumptions from social construction of technology and adaptive structuration theories. Based in part on the literature and in part on our own experiences in developing a community information system, we introduce and consider three issues related to sustainability: stakeholder involvement, commitment from key players, and the development of critical mass.

Categories and Subject Descriptors
H4.3 **[Communication Applications]**: Bulletin Boards, Computer Conferencing; H5.2 **[Information Interfaces and Presentation]**: User Interfaces – *User-centered design*.

General Terms
Design, Human Factors.

Keywords
Community networks; participatory design.

1. INTRODUCTION
New technologies make it feasible and in many cases practical for individuals, groups, and organizations to collaborate in the development of joint information systems. In fact, over the last three decades of evolution, few applications of information technology have stimulated so much interest on the part of so many. Collaborative information systems are attractive to users because they make it possible to find information from diverse sources in an easy and efficient way. Such systems make good sense for information providers because it becomes possible to attract a larger audience than a solitary effort might otherwise be able to command and to pool resources to achieve certain economies in scale and technology expense. The advantages of collaborative computerized information systems have been widely recognized, but this has been particularly the case for those with the goal of making community information more available, accessible, and oriented toward community development.

Computerized community information systems are diverse in form and, over time, have come to be known by many different names, including community bulletin boards, civic networks, community networks, community information networks, televillages, smart communities, and Free-Nets. They have been initiated by many different sponsors, including government organizations at the federal, state, and local levels, academic organizations, libraries, and ad hoc groups of citizens that may or may not later transform their enterprises into not-for-profit organizations [7]. With respect to longevity, these projects have come and gone, only to be replaced by newer and more sophisticated manifestations of the same basic information sharing capabilities.

Consistent with the evolution of technology over the last thirty years, Kubicek and Wagner [14] analyze the historical trajectory of community networks to understand how these applications have evolved over time based upon their animating ideas, the zeitgeist of the time, the state of technology access, and the kinds of services such applications make available. Their analysis makes it possible to see that there has never been a standard for design or operation when it comes to community information systems. Instead, each such project has been very much a social experiment, born of a cluster of varied ideas related to the general theme of using technology to promote the development of vibrant geographically-based communities.

Since there has been no standard to follow, each instance of computerized community information system can be seen as an experiment in accommodating the tensions between access to hardware/software infrastructure, design of the particular application or system, user needs, and the initiating and ongoing resources that support these efforts. These projects can be resource intensive; thus, a variety of institutional actors have lent their financial support particularly over the past decade. The successive rounds of funding for community technology projects by the Department of Commerce's National Telecommunications and Information Administration (now called the Technology Opportunities Program) is a case in point. The Digital Government Program of the National Science Foundation has

provided support for such ventures, as have many private foundations and technology corporations. From the perspective of funding organizations, the nature of the experiment at the heart of CCINs is essentially this: how to build applications that achieve their civic goals, that provide services perceived as valuable by their users, and that can command continuing support from the community beyond the horizon of initial funding. From a purely academic perspective, the more general question centers on, as Venkatesh [28] has put it, the "lifecycle" of community information systems. More specifically, we wish to know how such systems "originate, stabilize, and change in their sociohistorical context" (p. 339).

We do not have extensive knowledge about the extent to which community information systems achieve their goals, endure over time, or the conditions that facilitate effectiveness and sustainability. However, based on what we do know, it is apparent that such enterprises are fragile. Perhaps the closest we have come to a standard or model is the relatively extensive set of experiments in community networking in the 1990s called Free-Nets, which were fashioned after the public broadcasting system and intended to serve their localities by providing access to wide-area computer networks and information about the community. Founded in 1989, the National Public Telecomputing Network, an umbrella organization for Free-Nets, went bankrupt in 1996. After successive decreases in the cost of computing equipment and Internet access, and the development of the World Wide Web, many Free-Nets went out of business [14]. Studies of community networks funded by the federal and state governments also suggest that community information systems have difficulty enduring beyond their initial funding [26] [21].

In this paper, we introduce and consider conditions that facilitate the sustainability of computerized community information systems. We base our discussion in part on our own efforts to develop a community information system called Connected Kids in Troy, New York, a project that began in a formal sense in 1999 and continues today. We begin by presenting a theoretical framework for posing questions about sustainability based on the social construction of technology and adaptive structuration theory. Drawing on the literature as well as our experiences, we introduce and discuss three issues we believe to be critically related to sustainability: stakeholder involvement, commitment from key players, and critical mass.

2. THEORETICAL FRAMEWORK

All computerized community information systems are designed, although whether researchers and participants understand the significance of design and its relevance to sustainability varies from context to context. In some cases, where community networks have originated as the indigenous creation of technology-savvy citizens, it may appear to researchers that the design of the information system is a natural expression of community development unfettered by theoretical considerations. However, in other cases, design is taken more seriously and treated as an element that can be purposefully controlled in order to achieve particular kinds of effects.

In either case, we argue that the material form, functionalities, conceptual configuration, and impact of technology is shaped by the uses, goals, interests, and ideologies of those who participate in its development and others who use it following development. In the literature addressing the social construction of technology, this argument is frequently illustrated by showing how users appropriate new technologies for their own purposes, which may be contrary to those of designers (see e.g. [15] [25]). However, we take this position one step further by suggesting that community information systems, and information and communication technologies more broadly, reflect the interests, orientations, and indeed the naïve social theories of their designers, as well as being shaped ex post facto by their users [8]. On this basis, we have argued that academic researchers need to become involved in the process of technology design as a way of exploring how to improve the design of technology and as a way to test social theory, including communication, information, and democratic theory. However, our position suggests that users of information systems must also be included in their initial conceptualization and design in order to develop systems that reflect users' needs, goals, and values. This leads quite naturally to creating interdisciplinary (e.g. computer scientists, information scientists, social scientists) application design teams that provide for participation by community members; it is in such collaborative arrangements that sustainable community information systems may be designed.

The social construction of technology argues that technologies are shaped by both designers and users and suggests that information system design be undertaken collaboratively by those implicated in both the technical and social conceptualization of the system. However, issues of sustainability ultimately focus on reproduction of the system. Once designed, information systems must be deployed, and once deployed, they must be re-enacted on a routine basis by their users to be sustained. Adaptive structuration theory is one of the most fully developed theoretical perspectives for understanding how new technologies come to reproduce social structures or to generate structural change in particular social contexts. DeSanctis and Poole [4] base their work on structuration processes originally described by Giddens [5].

Giddens [5] suggests that technologies in organizations either reproduce existing social structure or change social structure by virtue of the kinds of structures that are instantiated when social actors use technologies. Structure consists of rules and resources that actors draw upon to produce social behavior. For DeSanctis and Poole [4], social structures are physically incorporated in new technologies in two complementary ways. First, technologies embody rules and resources embedded in the form of particular material capabilities, functionalities, and features that comprise a variety of behavioral options to be used in constructing social action. Second, the "spirit" of a technology, also considered to be a property of the technology, expresses the values and goals that are brought to bear upon the tasks the technology was originally intended to accomplish. Together the features and spirit of a technology comprise its "structural potential," or the range of possible actions that users can draw upon to constitute or reproduce social structures in technology use. Orlikowski [17] disputes a portion of this conceptualization, noting that, according to Giddens [5], structure has a "virtual" rather than material existence, and thus can never be physically incorporated into technology. Instead, "[w]hile a technology may be seen to embody particular symbol and material properties, it does not embody structures because those are only instantiated in practice" ([17], p. 206) and, if reproduced, are systematically repeated over time.

Orlikowski's [17] point is that users may draw upon only some of a technology's features, and may do that in ways that depart substantially from the original conceptualizations of designers. In essence, users "enact" technology in their collective, systematic, and routine use of a technology, reproducing some of the technology and some of its associated structures through practice. Orlikowski's [17] term "technologies-in-practice" references the idea that as users engage selectively with particular technological features, particular structures, or sets of rules and resources associated with the technology, are selectively reconstituted. Thus, a technology-in-practice is a "repeatedly experienced, personally ordered and edited version of the technological artifact, being experienced differently by different individuals and differently by the same individuals depending on the time or circumstances" ([17], p. 408).

Applied to sustainability, our questions center on the conditions under which users "appropriate" the system. For community information systems, there are generally two kinds of users—information providers and information consumers—and, of course, the same individuals may play both user roles. Thus, our questions become: Under what conditions do users collectively and routinely draw upon and apply particular features of a community information system? When do they reference the way their system "should" work in order to construct a shared perspective about community action? Through regular and routine enactments of technology in regular use, users reproduce the rules and resources or structures of community life that are instantiated in technology use. This is not to say that "unfaithful" appropriations, or those that are out-of-line with the spirit of the technology, cannot occur; but it is to say that it is unlikely they will sustain a community information system.

3. FACTORS RELATED TO SUSTAINABLE COMMUNITY INFORMATION SYSTEMS

We begin our discussion of factors related to sustainability by distinguishing between the effectiveness and the sustainability of computerized community information systems. Community information systems are designed and advocated with many goals in mind, some of which focus on traditional issues of community development, such as decreasing unemployment, stimulating economic growth, improving health and social welfare, and others focus on building social capital, or enhancing interest and participation in government decision making processes. The issue of effectiveness addresses whether such systems are achieving the goals for which they were designed. Sustainability, on the other hand, addresses whether the information system is able to endure past its initial launching phase, whether it is used and reproduced by its intended audience, and whether it can continue to attract resources beyond those obtained for initial development and deployment. Clearly these two concepts are not irrelevant to each other, but neither are they the same. It is possible that questions of sustainability logically precede those of effectiveness, but there may also be important relationships between effectiveness and sustainability.

Sustainability has long been a consideration in the development of information systems. Indeed, the failure rate of new IT applications in the public sector has motivated significant interest in addressing the issue of sustainability and speculation about the extent to which participation in system development is related ultimately to system adoption and use [10] [11]. More specifically, government services are increasingly out-sourced to not-for-profit organizations that may not be experienced in collaboration [3]. Information technology makes it possible for organizations to collaborate in providing information but whether or not such collaborations actually take place is more than a technical issue. The development of any information system, and particularly collaborative systems, requires organizations to change, in a very real way, some of their routine modes of operation and incorporate new behaviors. Scholl's [22] research finds that stakeholder involvement and the commitment of senior executives to be highly related to the integration of e-government projects into business process change for government organizations. Stakeholder involvement has long been acknowledged as a key element in the construction of community information system, although applied to this context rather than that of traditional hierarchical organizations, the idea bears further scrutiny. We have also seen the commitment of key executives playing a role in our own development work. We discuss each of these two ideas at some length below, and add a third: development of a critical mass of users.

3.1 Stakeholder Involvement

Our work was motivated in part by Schuler's [23] invitation to academic researchers to collaborate with communities in building community networking projects. At the time, it was fair to characterize our institution's hometown, Troy, NY, as a "digitally divided" community. Our experiences suggested that new technologies and their potential seemed to be of interest to the members of the community (see [9]). But many community and government organizations lacked access to hardware and network connections as well as the expertise needed for using this equipment. It seemed most likely that we would need to do more to generate interest in the development of a community information service in order to stimulate participation from likely stakeholders in such a project.

Connected Kids was conceived in Fall 1999 in the course of discussions among Troy City Government representatives on the topic of how new technologies might usefully be employed to provide services to the community. At the time we learned that the mayor sought to reinvigorate the City's office of youth services and had speculated about whether these technologies could be used to provide one of that office's primary and most popular functions, which was to disseminate information about resources and programs sponsored by not-for-profit organizations as well as those sponsored by Troy's own Department of Recreation. It seemed clear to us the World Wide Web might indeed be used for such purposes. Thus, Connected Kids was conceived as both a digital government project as well as a community information system. We received initial assurances that the City would administer the information system after it had been successfully designed and deployed.

Connected Kids began with sensitivity to the need for stakeholder involvement, particularly that of participating organizations that we hoped would be information providers. We were aware that the "best way to kill a community network," was to fail to involve the community in system development [24]. We took seriously Gygi's [6] prediction that the degree of community involvement

and the extent to which the project represented community interests and participation would likely affect political and economic outcomes. Thus, although our project began initially as a collaboration between academic researchers and government administrators, we moved quickly to invite community organizations to participate at an orientation meeting in February 2000 and held a series of focus group discussions in October 2000 in which we explored with representatives of participating organizations how such an information system might be conceptualized to best meet their information needs. In Fall 2001 and Winter 2002 we undertook a series of participatory design sessions in which representatives of participating organizations were introduced to portions of a system prototype based on their previous contributions and asked to describe their experiences and suggest improvements. Finally, as we designed interfaces in Summer and Fall 2002, we again consulted with representatives of participating organizations in user testing sessions. By Fall 2003 and Winter 2004, we had demonstrated the system and trained numerous representatives of participating organizations, who reportedly found our interface pages easy to use. However, these same organizations were not spontaneously—or frequently—entering information about their programs or activities for youth.

Based on contributions from our collaborating organizations, the design of Connected Kids reflected much of the best wisdom about community information systems: the system could be used to both create and easily update data [2] [13]; we had involved end user groups (kids and their parents) in the design as well [27] [12]; and the system focused principally on information deemed crucial by our participating organizations, information that we expected had the capacity to be integrated into the routine lives of the communities they serve [21]. Further, access to technology lost its urgency as an issue, since it is no longer the case that our participating organizations lack access to networking technology.

Thus, we did not attribute our problems with data entry to system attributes. Instead, we considered the suggestion by Scott and Page [18] that "sustainable technologies are processes (authors' emphasis); they are not products." In traditional hierarchical organizations, lower levels of stakeholder involvement may be sufficient for system acceptance. However, a community information system requires that members of the community contribute information and it must be seen to be in their continuing interest to do so. In Fall 2004, we have sought to create a quasi-formal governance body to administer the project, a Connected Kids Advisory Board, recruiting representatives from 10 organizations (from among the most influential) to commit to guiding the short-term future of the project (approximately 1 year) as we transition to system deployment in Spring 2005. Our Board has now met for several months, and it remains to be seen whether this vehicle will foster a sufficient level of system participation, perhaps ownership, to sustain Connected Kids through deployment and beyond.

3.2 Commitment from Key Players

Scholl [22] finds that support from key executives is critical to incorporating e-government projects into an organization's business processes, and our experience underscores this finding. In fact, we would expand the range of individuals likely to be considered "key." Not only are senior executives important, but so also are others in the organization that have any significant job-related association with the information system under development. Application development projects take place over potentially long periods of time and involve many different individuals in many different roles. Job occupants in the public sector may be comparatively stable, but they are not permanent. Those who champion an application development project may not be around when it is time to deploy the system.

What is generally not recognized when academic researchers undertake technology projects in organizational contexts is that they may need to become the primary advocates for deployment of the project. This is not a typical role for researchers, who may with ample justification see their obligations confined to simply performing the research or developmental work on the project. However, researchers who seek to develop sustainable products may find themselves required to situate the project politically within the organization or group of organizations for which it was originally intended. They may in fact be the only individuals who can play this particular role.

In the case of Connected Kids, we secured commitment from both the mayor and deputy mayor of Troy, along with, of course, that of our primary organizational liaison. We continued to work for quite some time, reporting regularly on progress to our liaison, without realizing that this individual was getting progressively involved in turf battles with another technology-oriented actor in city government. As our liaison's influence within city government eroded, so also did support for our project without our awareness. Once we understood what was happening, we acted quickly, and luckily in sufficient time, to re-establish the importance of the project with the mayor and deputy mayor. From that point hence our primary liaison was the deputy mayor. Unfortunately, mayoral administrations come and go, and the administration that was our primary government partner was voted out of office in November 2003. Within six months all the individuals who had any primary working relationship with our project were gone, and we faced the need to re-create commitment with a new mayor and deputy mayor, a process that took considerable time and that has delayed implementation by nearly a year. Of course, this is not something we could have prevented. However, it is interesting to note that our new liaison with city government is an individual who had worked in city government under both administrations.

3.3 Critical Mass of Users

Ultimately, for a community information system to endure, it must establish a significant number of regular users, who enact the technology for at least some of the purposes for which it was originally intended, and in so doing, reproduce community structures that are instantiated in the technology. In our case, this means bringing an audience of end users to the system who are interested in information about youth that is disseminated through it. Connected Kids is in many respects similar to an electronic "public good" [20], that is, a product established through the contributions and for the benefit of a set of actors that also has the effect of benefiting other users.

In our case, the system was designed by and for youth organizations, which serve as information providers. We have sought to show how these organizations may appropriate the technology and accomplish what Bannon and Griffin [1] suggest, which is to use the technology as a means to "further their own

ends" (p. 48) rather than as an end in itself. However, the added value of a collaborative information system is that in bringing an audience to information distributed by one organization, that audience is also available to peruse the information of other organizations. Thus the overall effect is to increase the cumulative size of the audience for all involved. Further, the external user audience benefits from the ease of accessing information from a wide variety of organizations that all provide services for youth.

Patterson and Kavanaugh [19] argue that the pro-social benefits of a public good are achieved when the system achieves a critical mass of users. In our case, this would equal the number of users that information providers consider to make it worth their continuing efforts to input information about their activities. As Markus [16] points out, the number of users will depend on the diversity and value of the information available through the system. Thus, sustainability is dependent on the reciprocal interdependence of both information providers and information users. Both information in the system and use must achieve critical mass, and this must happen relatively soon after deployment.

Our strategy is to bring both of these activities together in time. We have asked the Connected Kids Advisory Board to develop a marketing campaign that will accompany the deployment of the system and they are currently embarked on this activity. Bolstered by the participation of RPI and the City of Troy, we seek to attract a large external audience to experiment with the system. Advisory Board members recognize that the success of the marketing campaign depends on the presence of considerable amount of high quality information in the system, and have committed to providing it. In this way, we seek to jumpstart a virtuous circle in which sufficient quantities of information and use reciprocally reinforce each other creating a critical mass of information providers and consumers.

4. CONCLUSION

Poised for deployment, Connected Kids enables us to test a range of expectations generated by this set of considerations regarding sustainability. Within the next year, we should be able to assess relationships related to stakeholder involvement such as those between factors such as perceptions of involvement in system design and administration; actual participation in system design and testing activities; and perceptions of ownership with outcomes such as the extent of data contributed to the system, perceptions of commitment to the system, and significance of organizational resources devoted to participation. Further, we should be able to assess relationships between the perceived amount and quality of information in the system and end user satisfaction, likelihood of returning to the system, and interest in becoming more involved in system activities. Of course, we will continue to be able to comment anecdotally on what we have learned about the politics of technology diffusion in public sector organizations.

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