Towards Effective Evaluation of Digital Community Information Systems

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Digital Community Information Systems (CIS) are increasing in both size and scale. These systems help people obtain community information (CI) for the myriad situations that arise in everyday life. As these systems migrate to the online environment, increasing complexities and scale provide the impetus for improvements in system design. System re-design, however, relies on the effective evaluation of digital CIS. Despite the plethora of evaluation frameworks from the systems, organizational, and information retrieval fields, minimal research has directly addressed the issue of digital CIS evaluation. Following a selective review of digital CIS and evaluation approaches, a layered evaluation framework is proposed to guide the evaluation of digital CIS.

Community Information Systems

Studies of information behavior indicate that everyone, at one point or another, requires information for solving problems associated with daily living (Dervin, 1976; Chen & Hernon, 1982; Durrance 1984; Harris & Dewdney, 1994). Sometimes this information is basic, such as where to find quality childcare in a local community; other times, this information is augmentive, like finding interest or activity groups. In some cases, this information is crucial such as where to find a homeless shelter or food assistance.

Libraries have long recognized that access to this kind of information is an essential component of daily life and an important part of localized information services. Community information (CI) can be defined as that which helps people with everyday problems and facilitates civic life. Thus it includes information about healthcare, financial assistance, housing, transportation, education, child care, recreation, community events, etc. (Pettigrew, 1996). Durrance (1984) describes CI as comprising three components: human service, citizen action, and localized information content. Historically, library staff "identified, organized, and managed large files of data about their communities" (p. 329) with the goal of meeting everyday information needs of community residents.

With the development of networking technologies that enable community networking, librarians experimented with porting their CI to the online environment with the idea of increasing access to CI. Armed with research that indicates only a fraction of community residents utilize physical library resources, librarians created new experimental CI systems for increasing access and use of CI. These new digital CIS varied widely from hypertext versions of the "vertical file" to sophisticated electronic CI databases. Available online to the public, librarians believed their systems could (a) provide CI to individuals not currently using the library; (b) extend access times to current library users; and (c) expand the awareness of the scope of CI available for particular communities.

For this paper, digital community information systems (CIS) refer to organized collections of CI in the hypertext environment. Descriptively, digital CIS share many common characteristics of digital libraries including: (a) a set of electronic resources and associated technical capabilities for creating, searching and using information (Borgman, 1999); (b) the fact that they are constructed, collected, and organized by (and for) a community of users, and that their functional capabilities support the information needs and uses of that community (Borgman, 1999); (c) they contain content that is more than a set of pointers (e.g.,
bibliographic information) to other material but contains some “full-form online material” (Bishop & Star, 1996); and (d) they contain content in multiple formats (Bishop & Star, 1996). Despite these similarities, digital CIS in general may differ from conceptions of digital libraries by lacking some more advanced functionality and in some cases the scale of content and extent of systematic organization. Digital CIS encompass a range of online CI systems that arise out of a spectrum of community contexts.

The literature of evaluation in digital libraries is discussed as a “close cousin” to the evaluation of digital CIS because (a) some issues clearly overlap and (b) this overlap is a useful grounding to construct form out of a void of literature on the evaluation of CI systems.

Challenges for Evaluation

In a nationwide study of digital CIS, Durrance and Pettigrew (2002) revealed that 73% of information professionals involved in developing and maintaining digital CIS were unsatisfied with available evaluation tools. Respondents indicated that current approaches to evaluation fail to determine the impact or effectiveness of digital CIS systems. While suggested approaches of evaluation are available for more traditional library services (e.g., Van House, 1987; Saxton, 1997; Hermon & Alman, 1998) they are inadequate for understanding digital CIS, where distributed operation and use is not necessarily located in traditional information centers (e.g., libraries). This is exacerbated by the scope of information and services offered by digital CIS, which is substantively greater—and less well understood—than the more defined nature of specialized digital services such as Online Public Access Catalogues (OPACs) or digital reference services. Additionally, while evaluative studies of community networking projects have been completed (Schuler, 1996; Bertot & McClure, 1996), they tend to focus on measuring infrastructure and technology access. Such approaches to evaluation lack in their ability to analyze the information behavior of users and their interaction with the dynamic variety of information artifacts, structure, and organization found in digital CIS.

For both digital CIS and digital libraries, key questions remain as to what and how to evaluate. Because these questions remain unanswered, “evaluation has not kept pace with efforts in digital libraries, has not become a part of their integral activity, and has not been even specified as to what it means and how to do it” (Saracevic, 2000, p. 351). Many of the same difficulties that exacerbate existing problems involved in evaluation of digital libraries, have parallels in digital CIS evaluation. These are grouped into three major challenges.

The first challenge in the evaluation of digital CIS derives from the fact that these systems are operational. The structure, appearance, and organization of the content is continuously changing as information providers modify content, re-organize the relationships of information artifacts within the ‘corpus’, and modify the formats of their information artifacts. Evaluators do not have the luxury of halting the system to run laboratory tests that control for variables and are easily replicated.

Second, multiple layers need to be considered together to provide an integrated understanding of the operation, use, and impact of digital CIS. “There is much, much more to evaluation of IR than evaluation of a variety of algorithms, and procedures...in particular, it should be realized that evaluations of IR on the processing level...are also restricted to its own level and thus have a serious blind spot” (Saracevic, 1995, p. 141). In subsequent work, Saracevic (2000) specifies layers of IR evaluation for digital libraries including the social, institutional, individual, interface, engineering, processing, and content layers of the system.

The third major challenge for the evaluation of digital CIS is the diversity of its content. Information in digital CIS has no standard type, format, or structure. Arms (2000) discusses how digital libraries go “beyond such simple digital objects; they include anything that can be represented in a digital format. The digital medium allows for new types of library objects, such as software, simulations, animations, movies, slide shows, and sound tracks and for new ways to structure material. Computing has introduced its own types of objects, including spreadsheets, databases, symbolic mathematics, and hypertext. Increasingly, computers and networks support continuous streams of digital information—notably speech, music, and video. Even the simplest of digital objects may come in many versions and be replicated many times” (p. 225). Evaluation of digital CIS must also account for such multiplicity of representations and information content.

Why View Access to Digital CIS as an IR problem?

The complexities of digital CIS also make it difficult to choose appropriate approaches and methodologies to use when conducting evaluations. For instance, the systems approach may seem like a perfect match for the complexity inherent in digital CIS. Rasmussen, Pejtersen and Goodstein (1994) and Pejtersen and Rasmussen (1997) offer a layered approach for both system design and evaluation that includes a framework of evaluation from goals to methodological issues. Kling and Elliot (1994) introduce the concept of “organizational usability” defined as “the ways that computer systems can be effectively integrated into the work practices of specific organizations” (p. 148). Used to analyze digital CIS, this could be applied as an evaluation framework for understanding the creation,
organization, and use of digital CI by organizations within the target community. The MIS Management Information Systems) literature (Hamilton & Chervany, 1981; Serafeimidis & Smithison, 1996) provides candidate frameworks from which to analyze the functions of digital CIS as general IS systems through an analysis of operational, maintenance, and change processes.

The approach advocated here, however, is to view the evaluation of digital CIS through the lens of an information retrieval (IR) process. Research into the substance and impacts of digital CIS indicates that the entire range of community stakeholders—from everyday users to information providers—view matching individual needs for information with available CI content as the primary goal of digital CIS: “past studies suggest that equitable and easy access to information about local resources can help people deal with the myriad of situations that arise through everyday living” (Pettigrew et al., in press). These are the same reasons that initially stimulated librarians to begin to collect CI. Through their contact with library users, they began to notice that information needs existed for local CI that was inaccessible because it was uncollected, unorganized, or used inappropriate language. (Durrance, 1984). However, the match between information need and information resources is a complex phenomenon. Pettigrew, et al., (in press), for example, found that “the situations for which users sought digital CI were complex and usually required multiple pieces of information.” IR is the appropriate perspective from which to view the scope and depth of these questions. Ultimately, these are questions of information interaction, transfer, and retrieval.

Narrowing the search for evaluation frameworks to IR does not necessarily solve the problem for digital CIS evaluation. Many approaches to evaluation exist even within the tradition of IR. In a comprehensive review of the evaluation of IR systems, Harter and Hert (1997) include a wide ranging discussion of the evaluation methodologies employed on experimental and operational systems, the analysis of users and stakeholders of IR systems, and layers of system evaluation. In the field of IR, advocates for technical analysis of algorithms and infrastructure, interface design of IR systems, and user studies are represented.

In addition, there is increased understanding within the IR community of the need for formative evaluation. As opposed to summative evaluation that is conducted at the end of a project often to assess a system’s effectiveness in terms of its specification and design goals, formative evaluation “occurs as the process or product develops, with the intent of assessing and often changing that process in real time” (Harter & Hert, 1997, p. 52). Work by Twidale (1993) indicates that no system design can anticipate the unexpected ways that users will interact with systems, an important characteristic to improving the use of systems. Formative evaluation is better suited to capture and represent this phenomenon to inform system design than summative evaluation.

Despite the diversity represented within the perspectives of IR evaluation noted above, the approach is not without bounds. Obviously, there are limits to which elements can be analyzed and how many contextual factors can be considered. Because the perspective of IR is ultimately focused on the matching of information needs with available information resources, all analyses of users, institutions, social contexts and interactions are guided by this focus. This is in contrast, for example, with the field of social informatics (e.g., Bowker et al. 1996; Kling, 1999) that analyzes these phenomena as subjects in and of themselves1. In short, users, institutions, social contexts, and interactions are all analyzed from the standpoint of trying to inform the design and operation of digital CIS to improve the ability of community residents to find and use CI.

Responsibility of digital CIS Designers and Evaluators

Digital CIS have evolved from both formal and informal CI systems. They are heavily reliant on the knowledge and expertise of information professionals familiar with community constituents. Digital CIS have benefited greatly from the personal commitment of information professionals and their willingness to find ways to capitalize on local information resources. The increase in scope, scale, demand, access, and use of digital CIS, however, means that supporters of digital CIS can no longer rely exclusively on the goodwill and capable skill set of direct-service personnel. A more comprehensive framework is needed to allow designers, evaluators, and direct-service staff to work together to ensure the effective development and maintenance of digital CIS. To participate effectively in the evaluation framework proposed below, involved personnel have three responsibilities.

First, the primary responsibility of designers and evaluators is to understand what measures have been tried before in evaluating IR systems. For instance, the measures of precision, recall, and relevance have long histories and have issues that are well documented in the research literature of information science (Lancaster, 1979; Stefano, 1997; Jones & Willett, 1997). Cooper (1973) suggests that “utility” be used as a measure of IR effectiveness stating

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1. This does not mean that the analyses of social informatics researchers can or should be ignored when considering the evaluation and design of digital CIS. To the contrary, their research into important social interactions and critique of technology systems can inform evaluation from an IR perspective. However, evaluation must move beyond such analyses and make the next step toward improved system design.
that an “information system ought to be evaluated on the basis of how useful it is to its users” (p. 367). Tague-Sutcliffe (1995) has developed the concept of “informativeness” based on quantitative measures that are another way to measure effectiveness in IR systems. Satisfaction, used heavily in both IR and non-IR evaluation has been suggested by Applegate (1993) as an important measure to consider. Darlymple and Zweizig (1992) studied users’ experiences with IR systems and are concerned with the affective measures and outcomes of IR system interaction. Error analysis (Tonta, 1992), missed opportunities (Wildemuth & Moore, 1995), and frequency of external access (Lancaster, 1995) have all been suggested as helpful in evaluating IR systems. Usability, which is defined by Dzida (1996) in terms of effective performance of a user task can also be applied to IR systems (Van House et al., 1996).

Second, designers and evaluators must have an understanding of the limitations of the approaches tried in the past. For instance, a common response in the practice community when called upon to evaluate information systems is to default to either a purely technical approach (i.e., come up with quantitative measures of operationalizing metrics such as informativeness, precision, recall, etc.) or to focus exclusively on measures of user satisfaction. Each of these approaches have limitations that can detract from evaluation. For instance, while a focus on user satisfaction might be appealing as a measure of an information systems’ effectiveness (after all, what could be more informative than user opinions) satisfaction has some serious limitations. For example, Nass et al. (1997) has shown how even sophisticated users treat many systems as social actors, complete with biases and perceptions that associate social roles. These have potential to influence measures of satisfaction and potentially skew results. Revealing similar problems, Pettigrew et al., (in press) note that many of the users of digital CIS internalized the results of their system use, either blaming or praising themselves depending on whether or not an IR interaction was successful. It is the responsibility of both designers and evaluators to understand these limitations of particular approaches and measures.

Third, designers and evaluators must recognize that the evaluation of digital CIS is an ongoing iterative process. “Evaluation should be a dynamic process; that is, a continuing design refinement through the design process itself” (Rasnussen et al. 1994. p. 211). This is particularly true in the case of digital CIS because as noted above, it is an operational system that cannot be halted for laboratory-style summative evaluations. Additionally, user-centered evaluation methodologies must account for changes in community dynamics including changes in population trends, dynamic information providers, and shifting user needs. Evaluation should be embedded in the design and redesign process continuously throughout the system lifecycle. This understanding can lead to carefully constructed evaluations that position themselves to track changes longitudinally.

### Introducing A Framework for Evaluation of Digital CIS

A central research challenge lies in better design and evaluation for ordinary use by ordinary users and, more basically, in how to accomplish these goals. The future is not out there to be discovered, it has to be invented and designed.

(Computer Science & Telecommunications Board, 1998, p. 3)

The diversity of approaches reviewed above implies that there is still no satisfactory answer or consensus on how evaluation should be done. This lack of consensus coupled with the fact that most digital CIS are relatively young exacerbates the difficulties of evaluation. Many of the approaches derived from theoretical research are not easily implemented with operational systems. For example, choosing measures for precision or recall requires significant expertise and implementing specific metrics such as “informativeness” require intense computational resources. More worrisome is that even in the case where many resources are available, it is not clear how these approaches can inform the design of CIS.

On the other hand, digital CIS exist in the here and now, and the urgency of appropriate evaluation methods to inform system design and service delivery of digital CI is widely noted in the practice community. Without credible frameworks to guide evaluation, information professionals “have difficulty conducting informed analysis (e.g., to determine resource allocations, system improvements, etc.), miss opportunities to expand, improve important services, or build collaborations to increase the utilization of CI.” As Durrance and Pettigrew (2002, p. 124) further explain: over time, a consistent lack of data about CI can negatively affect longer-term issues including future strategic decisions or decreased funding opportunities.”

This paper is a call for balance between the theoretical frameworks and practical systems. Digital CIS are being developed, deployed, and maintained at a pace that has outrun evaluation methodology. At the same time, new research into the phenomena of digital libraries and decades of research in IR do provide some resources with which to begin. Durrance and Pettigrew (2002) note the themes of this integration: “a convergence of several conditions has begun to influence the way [information] professionals such as librarians think about evaluating their services. These include demands for public sector accountability coupled with an increased realization that current tools are inadequate, advances in scholarship and
thus the emergence of viable models, and the recent commitment by governmental agencies to adopt new approaches designed to determine service impacts” (p. 124).

Proposed here is a working framework for a user-centered evaluation of digital CIS. The framework is designed to identify key issues within specific dimensions of digital CIS that can be feasibly evaluated. It is a layered framework that (a) acknowledges that many factors affect the IR process; (b) provides flexibility to use a variety of methods of inquiry (both qualitative and quantitative) that can be modified according to the context; and (c) provides a set of concrete phenomena to investigate based on current research of digital CIS. Examples to support the framework are drawn from Durrance and Pettigrew’s work on digital CIS (c.f., 2002; Pettigrew & Durrance, 2001; Pettigrew et al., in press).

Layers of Proposed Evaluation Framework

Saracevic’s (2000) notion of a layered framework of evaluation is used as a point of departure for the evaluation framework. To be applied to digital CIS, Saracevic’s (2000) layers are adapted to reflect the nested layers applicable to the seeking and use of CI. Because digital CIS is currently organized around a particular geographic community, the “social level” has been transformed into the label of community. The institutional level is transformed into the layer of information provider to encompass the specific role of CI providers. The individual level is broadened into the category of user to allow for the concept of organizational users, such as traditional CI centers including libraries, community-based organizations, and information referral centers as well as individual community residents. The interface level has remained in an interface layer with similar issues and impacts as noted by Saracevic (2000). Content is the final layer noted in this framework. Each of these layers represents an area of evaluation relevant to the retrieval of CI from digital CIS. While not mutually exclusive, they do delineate basic domains of analysis.

Figure 1

Layers of Evaluation Framework for Digital CIS

Figure 1 illustrates a conceptual understanding of the layers of evaluation. Each of the domains of analysis are nested within one another but they all converge at the bottom center of the figure, the evaluation itself. The figure intends to illustrate that a particular factor influencing the retrieval and use of CI from digital CIS may manifest itself in one or more of the domains. This can potentially require different methods to understand the way a particular influencing factor plays out in that domain. Complementing this idea, however, the figure also illustrates that evaluation is only interested in these domains to the extent that influencing factors to retrieval and use of CI from digital CIS exist. This is the focusing characteristic of the evaluation framework.

Community Layer

The community layer of the evaluation framework represents the geographic community in which the digital CIS resides. The creation and use of content occurs primarily within the bounds of the geographic community. The importance of understanding the context within which systems operate is well documented in LJS literature (Vakkari et al., 1997; Wilson & Allen, 1998; Wilson, & Hoglund, 2001a & 2001b). Recent work on digital libraries highlights the importance of context to the work of evaluation. “For digital libraries to be truly useful, designers need to first understand the larger context that determines their information needs and purposes for using the DL, that is, the context of the users’ work; the individual user’s specific work tasks; his or her information acts (including information searching, analyzing, repackaging), and, finally his or her DL use” (Van House et
al., 1996, p. 2). For the community layer, this means that an evaluation of digital CIS must take into account the needs of a community (e.g., community analysis), the dynamics influencing either the use or non-use of CI, and interrelations between formal and informal systems of CI resource distribution. Essential to the community layer is an understanding of critical issues identified by Bishop and Star (1996) of (a) shared and distributed knowledge; (b) the ecology of online and offline resources; and (c) the social nature of the digital CIS infrastructure. Important questions at the community layer include: Where does the digital CIS fit within the information network in a community? What are the limitations to what it can offer? Are these services duplicated elsewhere? What helpful information “niche” does the digital CIS fill in the ecology of available information resources? What is important for the community to know about itself? How can the digital CIS promote help-seeking and problem solving in the community?

Information Provider Layer

The information provider layer concerns the people and organizations responsible for the identification, creation, and formats of content. The operational definition of CI (see above) encompasses a broad scope of information content and formats. Durance and Pettigrew (2002) note that recognizing community-based information providers played a crucial role in the development of effective CI services: “In the early 1970’s public librarians...applied [information] skills to the community’s disorganized, disparate information that was squirreled away in many locations. In doing so, they came into contact more fully with governmental units, nonprofit organizations, and service providers than ever before” (p. 16-17). The success of digital CIS relies upon a community’s awareness of who has important CI to share and what potential gaps in CI often arise through contact with community residents. Essential to this process is the imperative that information providers are aware of the information needs and the ways in which this information can facilitate help-seeking at the community level. The developers and administrators of digital CIS must provide effective mechanisms to facilitate the content from knowledgeable information providers in a highly distributed context. Key questions at this layer become: How are digital CIS informed by key information providers in the community? How does the digital CIS incorporate important CI from nontraditional or “lay” information providers into its system? How do digital CIS translate information available through community-level providers into substantive CI that individual in the community can use and understand? Once important CI is identified, is it transformed into an information artifact and represented within digital CIS in a way that community residents understand?

User Layer

The user layer in the evaluation framework is directly concerned with the ways that people use digital CIS systems. The importance of the user-centered approach to system design has been well documented (Dervin & Nilan, 1986). The primary issue to analyze in this layer is the characterization of the help-seeking or problem-solving process. For example, what problem solving behavior do community residents currently engage in that could potentially be facilitated by CI? How are these currently being supported or inhibited by the design of digital CIS? Dervin’s (1992) sense-making approach provides excellent methodological support for answering these questions. The study of these users should be focused on the understanding of the larger processes within which the use of digital CIS is embedded. For example, our research indicates that community residents turn to digital CIS because it (a) offers increased availability to content for those with access to the online world; (b) provides important information at the appropriate level of granularity for the geographic community; and (c) incorporates important elements such as trust, coverage, and ‘objectiveness’ that is not necessarily present in commercial services.

At the user layer of analysis, the evaluation framework is concerned with the following questions: What brings users to digital CIS? What barriers do potential users experience preventing them from engaging digital CIS for IR purposes? Do users have a cognitive understanding of the digital CIS that allows them to discern appropriate use of digital CIS? In what ways can digital CIS facilitate the retrieval of information through refinement or increasing awareness of users’ information needs? How do digital CIS facilitate problem solving of a particular community’s residents?

Interface Layer

The interface layer in the evaluation framework is concerned with how well digital CIS supports the user activity via system interaction. Since digital CIS are made available over the Internet, community residents will most often access digital CI using a basic web browser. Questions in this layer of analysis include: How well can users view the available information? Do digital CIS support the appropriate range of browsers and access speeds that meet the expectations and resources of the community residents? Is there a need to support additional interface components within the digital CIS itself? Are there additional “markers” or navigational aides that help the user retrieve information in the hypertext environment? Do users clearly understand when they are viewing the content of an organized CIS and when they are viewing content hosted on some other part of the Internet?
Content Layer

The fourth layer of the existing evaluation framework is the content layer. This includes identifying key issues associated with content scope and accuracy (Marchionini et al., in press; Marchionini & Crane 1994) in addition to how well information is collected, represented, organized, structured, and managed (Saracevic, 2000). The value of content in digital CIS is determined by its ability to meet everyday user needs. By definition, CI must facilitate the larger process of help-seeking and information problem solving. Therefore, the content must be relevant to these embedded processes and the information behavior in which community residents engage.

Because the corpus of any digital CIS is ultimately a socially constructed artifact they will reflect communities’ social structure. They are not immune to the pressures of biases that are present in community situations. Analysis at the content layer must ensure that the CI is easily accessible, understandable, and comprehensive enough to be viewed as a valuable information resource of the community. The content of digital CIS must be broad enough to adequately represent patterns of community-wide information needs while maintaining enough depth and specificity to meet the information needs of individual community residents’ everyday situations. Many of these issues are not dissimilar from those discussed in the collections development literature (Evans, 2000). Questions in the content layer of evaluation include: How well does the content of digital CIS fill information gaps in the community? Does content reflect the full spectrum of community resources and services? How connected are the information providers to the content residing in digital CIS? In what ways does the content of digital CIS help community residents utilize community-level resources? How well does the content augment existing information services?

Discussion

Several issues need be considered before implementing our proposed digital CIS evaluation framework. These issues are discussed under the broad headings of methodological considerations and emerging phenomena in digital CIS.

Methodological Considerations

The layered evaluation framework does not specify a particular set of research methods. While each layer must be addressed, the evaluator can choose specific methodologies to employ in one or more of the layers. Sometimes, one method of inquiry may be able to inform the analysis in multiple layers. For example, basic access statistics that reveal usage patterns of digital CIS inform the evaluators about an aspect of the user domain, but it might also inform the domains of community by indicating that the current ecology of information resources usually consulted are unavailable in certain times and so the digital CIS is seen as a backup information source for information access outside of traditional access times. Similarly, an analysis of content might reveal that the digital CIS has overlooked a particular segment of CI needs and further need assessments are required to better understand a new segment of users or situations that stimulate potential digital CIS access.

Regardless of the methods used to implement an evaluation, great care must be taken to ensure that the data collected is both systematic and representative of the phenomenon under investigation. Regarding qualitative research methods, Patton (1990) states that “the validity and reliability of qualitative data depend to a great extent on the methodological skill, sensitivity, and integrity of the researcher...generating useful and credible qualitative findings through observation, interviewing, and content analysis requires discipline, knowledge, training, practice, creativity, and hard work” (p. 11). The same is true of quantitative methodologies. Minimizing the noise of invalid responses, statistical errors, and bias are critical to a successful evaluation (Babbie, 2001) (Maxim, 1999).

Bishop et al. (2000) provides an excellent overview of data collection methods that were successfully applied to the DLI I initiative at the University of Illinois, Champaign Urbana. Techniques included interviews, observations, focus groups, usability tests, transaction log analysis, and surveys/polling between September, 1994 and May, 1998. Such triangulation, or use of multiple collection methods ensures a more complete view of the research phenomenon (Janesick, 1994) which is particularly important given the complex nature of digital CIS. Informative works on evaluation (Patton, 1997), qualitative methods (Denzin & Lincoln, 1994), and general quantitative methods (Maxim, 1999) all indicate the importance of triangulation to the research process. Evaluations must rely on multiple methods to reveal the reality of each of the domains involved in digital CIS. Ultimately, “evaluation research considers the interactions of complex phenomena—including people and reaches conclusions through chains of inferences supported by data rather than direct measurement” (Marchionini, 2000, p. 6).

An area for future research will be the development of new constellations of techniques that reveal substantive criteria by which digital CIS can be judged. Strategic use of existing methods are needed to answer the questions associated with the layered domains of analysis making up the suggested evaluation framework. Questions that remain include: Which combination of inquiry methods reveal the richest data? Can data collected for evaluation of digital CIS be standardized? What level of comparison is advisable when using data collected from one digital CIS in the evaluation of another digital CIS?
Emerging Phenomena in Digital CIS

A central question has emerged during our current research projects in digital CIS: What specific phenomena should surface throughout the evaluation? The layers of the evaluation framework and the methods discussed above answer the where and how of the evaluation process. The critical question of what exactly to attend to in an evaluation remains. For example, conducting focus groups with community residents may identify important community issues but not necessarily how they relate to the IR of digital CI. Similarly, a basic examination of user artifacts such as transaction logs, usage statistics, and surveys may not penetrate the significant issues affecting information access and use of digital CIS. Conducting a study on access issues involving digital libraries, Bishop (1998) confirms this difficulty: "measuring and interpreting access and use data within a digital library is complex, however, and the lack of standard metrics across systems make it especially difficult to develop explanatory frameworks related to digital libraries" (p.1). What are evaluators to examine? What phenomena should evaluation instruments be designed to capture?

Our research indicates that an emergent characteristic of successful digital CIS are the systems’ specific enabling qualities. Successful digital CIS are recognized not as systems that have content and features with potential to help community residents, but rather systems that people repeatedly use to support help-seeking and problem solving in everyday life. Pettigrew and Durrance (2001) note emerging enabling characteristics of digital CIS which include the ability of community residents to engage in comparing, connecting, describing, direct and explaining, promoting, relating, trusting, and verifying information behavior. By documenting the use and outcomes of these activities, evaluations can begin to build substantive cases for a substantive appraisal of system effectiveness.

Future research may also reveal additional information behavior phenomena that are becoming essential to the use patterns of digital CIS. As these patterns emerge, researchers should carefully note the behavior and identify the components of digital CIS that support them. These patterns of information behavior can be used as a basis for categories of evaluation. This also opens the door to allow more consistent evaluation of a spectrum of digital CIS, which are embedded in communities that vary in size, heterogeneity of the population, and other available information resources. Identifying specific information behavior phenomena relevant to all access of digital CIS allows the evaluator to focus on important evaluation criteria that applies to all digital CIS and not distracted by non-relevant system differences.

Conclusion

The proposed evaluation framework for digital CIS guides evaluators through a layered analysis resulting in specific outcomes. These outcomes are then aggregated to provide a complete user-centered evaluation of digital CIS. The community layer is primarily concerned with the community-level context in which digital CIS reside. The information provider layer is concerned with the identification and representation of community service providers. The user layer is concerned with the effectiveness of digital CIS from the perspective of community residents. The interface layer is concerned with the basic interfaces through which users access digital CI. The content layer is concerned with the quality, scope, and organization of the digital CI.

The layers and their accompanying issues for consideration in the evaluation framework provide evaluators with specific guidance for the design of more comprehensive evaluations of digital CIS. Note that no particular methodologies are specified as methodologies are context-specific and should be carefully selected to reveal the most important dimensions of digital CIS within the community in which it is deployed. The only requirement of the evaluation framework is that multiple methods need to be used to triangulate to ensure an accurate evaluation. In most evaluations, a mix of qualitative and quantitative methodologies will be used.

An important factor in the success of digital CIS will be the patterns that emerge through ongoing evaluation projects. Our research has revealed that it is possible to begin to develop relevant indicators of impact for digital CIS. Evaluators should continue to substantiate the role that digital CIS play in everyday information behavior. Such efforts should result in filling the remaining gaps in evaluation methodologies. We believe that the evaluation community is on the cusp of understanding the general questions surrounding the specific value dimensions of digital CIS. The patterns are beginning to develop. The comprehensive evaluation framework organizes these key indicators of impact which are beginning to form the core knowledge about the effectiveness of digital CIS.

In sum, digital CIS should be evaluated from the perspective of IR. While methodologies from other approaches in systems, organizational, or MIS theory may be incorporated into the evaluation framework presented here, evaluations are focused on the access and use of digital CI. As a user-centered evaluation framework, it supports the effective design of digital CIS to provide critical information links in the help-seeking and problem solving processes of residents in local communities.
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