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Social Informatics: A New Perspective on Social Research about Information and Communication Technologies[1]

ROB KLING

ABSTRACT *Social informatics is the body of research that examines the design, uses and consequences of information and communication technologies in ways that take into account their interaction with institutional and cultural contexts. This article draws upon some 25 years of systematic, analytical and critical research about information and communication technologies (ICTs) and social change to illustrate key ideas from social informatics research.*

Keywords: electronic journals, information and communication technologies, intranets, networks, social informatics.

Introduction

We are in a new era of computerization, one in which networked computer and communications systems are becoming part of the daily life of a significant fraction of the public.[2] Allowing public access to the Internet in the 1990s was arguably the most pivotal public policy choice that stimulated the rise in networked computing. High levels of symbolic support from the Clinton–Gore White House, as well as the enthusiasm of business, entertainment and technology journalists about 'information superhighways' helped to popularize interest in the new capabilities. Widespread Internet use has also stimulated substantial developments in different areas of potential application, such as electronic commerce, distance education, electronic publishing, digital libraries, and virtual communities.

These developments have stimulated substantial speculation about the social changes that could arise should Internet uses become widespread. Would electronic commerce, as illustrated by Amazon.com and eBay, erode the markets for physical stores? Could distance education help most people who desired higher education and who could not attend a place-based college or university to have new opportunities for a sound, inexpensive, and convenient education at home? Would widespread distance education become commonplace and rapidly erode the demand for 'place based' colleges and universities.[3] Would electronic journals develop rapidly as low-cost alternatives to increasingly expensive print journals.[4] Would digital libraries erode the demand for 'brick and mortar' libraries? In turn, if so much social activity shifted from face-to-face place-based settings to on-line forums, would community life erode?

These are important questions to be asking now, especially when there are major

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opportunities to shape the forms of these network-enabled activities. Unfortunately, much of the writing about the social changes that these new information and communication technologies (ICTs) could catalyze has relied on over-simplified conceptions of the relationship between technologies and social change.

There is a substantial amount of analytical and empirical research about ICTs and social change that could better inform these kinds of discussions. Unfortunately, the research articles are scattered in the journals of several different fields, including communications, computer science, information systems, information science and some social sciences. Each of these fields uses somewhat different nomenclature. This diversity of communication outlets and specialized terminology makes it hard for many non-specialists (and even specialists) to locate important studies. It was one impetus for coining a new term—social informatics—to help make these ideas accessible to non-specialists, as well as to strengthen communication among specialists. 'Social informatics' is a new working name for the interdisciplinary study of the design, uses and consequences of information technologies that takes into account their interaction with institutional and cultural contexts.[5]

Social informatics (SI) defines the topic and fundamental questions, rather than a family of methods. SI has been a subject of systematic analytical and critical research for the last 25 years. The research has developed theories and findings that are pertinent to understanding the design, development, and operation of useful information systems, including intranets, electronic forums, digital libraries and electronic journals. This article discusses some key ideas from social informatics, and includes numerous references to help interested readers readily locate more comprehensive resources.

Early Research in Social Informatics: Alternatives to Deterministic Impact Studies

Through the 1970s and 1980s, much of social informatics research focused on organizations because they were the major sites of computerization. It is only in the last few years that many people who are not technical specialists have computer systems for home use.

In the 1970s and 1980s, often the questions about computerization were phrased as deterministic impact questions. What would be the impact of computers on organizational behavior if we did X? What would be the changes in social life if we did X? Will computer systems improve or degrade the quality of work? There is a number of studies in which people try to answer this last question, whether work life would improve for clerks, for engineers, for managers, and so on. The questions were often phrased in very simple, direct terms, namely 'What will happen, X or Y?' The answer was, sometimes X, and sometimes Y. There was no simple, direct effect. Much of the character of changes depended on the relative power of workers. For example, clerks fared less well on the average, than professionals. Sometimes secretaries, who are the aristocrats of the clerical class, were able to have greater improvements in their work lives than were the people, primarily women, who were doing transaction processing in the back rooms of banks and insurance companies. Occupational power played an important role in mediating and shaping the way that computerization restructured workplaces.[6]

Another question examined was the extent to which computerization drove organizations to become more centralized. There were major arguments that computer systems would enable upper-level managers to have more detailed information about the operations of their workplaces, and that organizations would become more centralized. Others argued that the growing use of less expensive computer systems would shift control to lower-level managers and thus decentralize organizations. Many people

wanted to know: 'Well, which is it? Is it X or Y?' Some studies found that ICT (information and communication technology) use led to some organizations centralizing, and other studies found that ICT use led to decentralization. Many of the arguments were engaged in a form of 'Is it X or Y?' and based upon a simple concept that has not been substantiated in reviews of the careful studies.[7] The repeated failure of predictions is one of the important findings of social informatics research.

Today some analysts discuss ICT in social life in deterministic ways. Claims such as, 'The Web means that the public will get better information than ever before' or 'University courses on the Internet will soon eliminate most "placed-based" colleges and universities'. As an alternative to these kinds of statements, students of social informatics ask contextual questions such as, 'When will the World Wide Web enable the public to locate "better information"? Under what conditions? Would this information be available only to those who currently have the ability and financial means to use computers, or will changes take place to make the information available to all that desire it? What will the various user groups be seeking in this technology?' There is a large body of research about 'IT impacts' that reports the consequences of computerization depends upon 'the context' in which systems are developed, implemented and used.[8]

Social informatics researchers would ask about the conditions under which people will seek on-line courses. Are they students who are not near the appropriate university for the degree or course they are seeking? What would the demand be for on-line courses by younger students that would value the social experience of living on or near campus? Are these students willing to forego the many experiences on a campus such as athletics, student organizations, etc.? How would the lack of these affect the overall quality of a degree? Would on-line courses be viable for people seeking education in fields that require expensive specialized laboratory equipment? Would the course content and credential criteria be of the same quality as placed-based education? Social informatics researchers would also ask about the life circumstances that could lead millions of people who now seek courses and degrees in 'in place' colleges to abandon them for on-line courses and degree programs.

These contingency questions contrast with strong claims about on-line courses replacing place-based universities that are made by pundits such as Peter Drucker. This conditional inquiry illustrates the ways that social informatics researchers frame questions to develop an analytical understanding of information technologies in social life.

Some Key Ideas of Social Informatics

Social informatics research has produced some useful ideas and findings that are applicable to many kinds of information technologies and shed interesting light on these dilemmas of Internet use. The concept of 'computerized information systems as social technical networks'[9] is one such idea that helps us understand the character of new electronic information spaces, such as discussion lists, GroupWare, electronic conferencing systems, and e-journals. The concept of information technologies as 'socio-technical networks' helps to address limitations of deterministic impact analyses. We will introduce the concept and then develop it with several different examples.

Information Technologies as Socio-technical Networks

To set the groundwork for 'socio-technical networks' we will start with a general concept, one that ICT in practice *is socially shaped*. In standard (non-social informatics) accounts of ICT and social change, it is common to hear of information technologies character-

ized as tools. Questions are raised about their 'social impacts'. In the 1970s, several colleagues and I studied local governments to help us understand the 'impacts' of computerized information systems on the nature of work, client relationships, and possible redistribution of power within organizations. Our views of the character of computerization and how to conceptualize ICTs were refined as an outcome of this research.

We found that local governments selectively adopted and developed different types of information systems, depending upon their form of internal organization. In some cities a professional city manager's office or a central finance department exerted strong control over information systems developments. In these cities, the information development staff was often centralized, and responsible for projects in various departments. In contrast, other cities were much more decentralized. Many departments, such as police and planning, controlled their own computer systems and their own information systems development staffs. The systems were designed to help departmental managers better understand and control their functional areas. American local governments organized their technical staffs in different arrangements, and created different ICT policy regimes for systems developments, reprogramming and operations. They created different governance structures for regulating and directing their commitments to ICT. Professionals and managers who were seeking new information systems or changes in existing systems did not deal solely with computers; they had to mobilize an organizational system as well. These structures tended to reinforce preexisting social relationships (i.e. 'reinforcement politics'). We called this combination of equipment, people, governance structures, and ICT policies 'the local computing package'.[10]

Computing packages differed from one city to another. Some were configured as centralized formations and others were decentralized, and often more heterogeneous. The configurations were determined by the distribution of power within specific city governments. They were socially shaped. In turn, we found that the local computing configurations influenced the mix of information systems in a city, and the ways that 'similar information systems' were configured. We also found that the local mix of information systems and their uses in city decisions, such as annual budget hearings, helped to reinforce the relative organizational power of the groups that exerted most control over the local computing package. During the course of conducting this research in the 1970s, we shifted from viewing ICT as 'having impacts', to an appreciation that 'the impacts' of ICTs were socially shaped.

These socio-technical concepts have been applied in subsequent research about the character of ICTs in other organizations. Examples include manufacturing, newer technologies, such as desktop computing in the 1980s and electronic journals in the 1990s, and larger scale social settings, such as scientific communities and wired cities. Some of the ideas that developed from the socio-technical networks approach are summarized in Table 1.[11]

Before we discuss some applications of the socio-technical network model, it helps to explain one highly intertwined socio-technical interaction network model.[12] This model seems especially helpful in understanding electronic forums including conferencing systems and electronic journals. The characterization of the computing package separates equipment (or technology) from social relationships and resources.[13]

In the 'highly intertwined model', technology-in-use and a social world are not seen as separate—they co-constitute each other. The model is 'highly', but not completely intertwined, because its adherents do not insist that this intertwining of technical and social elements is universal. Rather, it is commonplace, and a good heuristic for inquiry, especially with complex technologies. References to technologies and social entities, and

Table 1. Conceptions of ICT in organizations/society (adapted from Kling and Lamb, in press)

Standard (Tool) Models	**Socio-technical Models**
ICT is a tool	ICTs are socio-technical networks
Business model is sufficient	Focus on social units, such as organizations, in a context that includes their relationships with other organizations, customers, regulators, etc.
One-shot ICT implementation	ICT implementations are an ongoing social process
Technological effects are direct and immediate	Technological effects are indirect and involving different time scales
Politics are bad or irrelevant	Politics are central and even enabling
Incentives to change are unproblematic	Incentives may require restructuring (and may be in conflict)
Relationships are easily reformed	Relationships are complex, negotiated, multi-valent (including trust)
Social effects of ICT are big but isolated and benign	Potentially enormous social repercussions from ICTs can be simultaneously benign, neutral and harmful for different groups.
Contexts are simple (a few key terms or demographics)	Contexts are complex (matrices of businesses, services, people, technology history, location, etc.)
Knowledge and expertise are easily made explicit	Knowledge and expertise are inherently tacit/implicit
ICT infrastructure is fully supportive	Additional skill and work needed to make ICT work

the interactions between them, are largely for analytical convenience. For example, one might say, 'Indiana University is using web-boards to support class discussions when the participants are not in-class together'. Indiana University and its classes would be treated as 'social forms' and 'web-boards' as material 'information technologies'. In the 'highly intertwined model', the web-boards may be used as an example of socio-technical networks. Certain social relationships are inscribed into the web-boards when they are used, such as access controls for who can read or write onto them. They also constitute in their supporting social protocols about legitimate content (to what extent are jokes or advertisements allowed in a specific class's web-board).

Similarly, Indiana University in Bloomington can be seen as co-constituted with diverse technologies.[14] Its routine operations rest on a complex set of building technologies, heating/cooling technologies, food acquisition and preparation technologies, and information and communication technologies. Without this technology today, we would have approximately 35,000 students, 1,500 faculty and 2,000 staff milling around in disarray in the forested hills of Bloomington. In contrast, the Indiana University of 1880 with about 300 students and a few dozen faculty was workable with much simpler technologies than those that are required for the much vaster contemporary university. Any means to record information about enrollments, courses, requirements, etc. would require some kind of ICTs, however crude. In this sense, an organization such as Indiana University is made not just of people in social relationships, but also of diverse technologies. In fact, one can interpret many of the discussions of Internet-supported distance education as efforts to make course studies more feasible by universities by changing their ICT infrastructures and pedagogues.

The highly intertwined socio-technical model seems especially useful for understanding the social shaping and 'consequences' of ICTs which foreground communication between individuals or groups. Even a less restrictive social shaping model raises cautions about simple claims about 'ICT's impacts'.

Socio-technical Interaction Networks: The Vitality of Electronic Journals

The use of the Internet to support scientific communication is one of the major shifts in the practice of science in this era. It has generated numerous experiments and significant discussion. In the scientific communities these communications include informal e-mail, the communication of conference programs as they shape a concise outcome, the sharing of preprints, access to electronic versions of journal articles, and the development of shared disciplinary corpuses. These communicative practices are becoming more important in many fields, although they are rarely the central communications media. However, only a few analyses take sufficient account of the ways in which the social dimensions of publications, such as the design of electronic journals, influence their use.[15]

One common approach to conceptualizing new media forms such as electronic journals, on-line newspapers, electronic forums, Web sites, and digital libraries emphasizes their information-processing features. This enables authors and readers to communicate more directly without the mediation of libraries or expensive publishers. The socio-technical approach explained below views these new forms as mixing together technological elements and social relationships into an effectively inseparable ensemble.

From a technological information processing perspective, new media—such as electronic journals,[16] databases, preprint servers—are said to reduce the costs of communication, expand the range of people and locations from which materials are accessible, and generally speed communications. According to this view, as scholars in all scientific fields work with data, and communicate both formally and informally with other scholars, all of these electronic media forums should be adopted and used fairly uniformly. Differences in value would rest upon the differences in technical architectures. For example, readers would be more likely to read electronic journal A, rather than journal B, if journal A added more informational value. An elaborate set of cross-links between articles, or including more extensive sets of data and graphics would entice readers to journal A.

Even the strongest proponents of electronic journals agree that technological design alone is not sufficient to insure a good quality journal. There is a strong consensus that the quality of a journal's scholarly content is important in making it viable, but there is substantial disagreement about the means of attracting high-quality materials. All the proposals and counter-proposals for attracting high-quality authors rest on social analyses of a journal, rather than purely technological analyses. For example, one aspect of electronic journals commonly discussed is the role of peer review.[17] There are many ways of organizing peer reviews, but each strategy for selecting reviewers and translating their assessments into feedback for authors and publication criteria for the journal is a social process. These social processes are supported by communication media; electronic media may facilitate or inhibit specific ways of organizing reviewers, reviewing and editing.

The value of a socio-technical analysis can be illustrated by contrasting the design and functioning of two different electronic journals: *The Electronic Transactions of Artificial Intelligence* (*ETAI*) and *The Electronic Journal of Cognitive and Brain Sciences* (*EJCBS*).[18] Superficially, the two scientific electronic journals have much in common. Each is hosted on a Web site, relies upon peer review to select high-quality articles, and posts articles for public pre-review before they are accepted or rejected for formal publication. Both

journals were established in 1997 and have had about three years of activity to establish a publishing pattern. These two journals are especially interesting in the ways that their designers envision attracting authors to submit high-quality articles, and to insure that only high-quality articles are published. Between 1997 and 1999, the *ETAI* accepted 58 articles for publication, while the *EJCBS* has only 6 articles posted for review, and none accepted. The technological publication system for each journal functions effectively. The differences in their success rest on their design as socio-technical interaction networks.

In brief, the ECCAI (European Coordinating Committee for Artificial Intelligence) announced the *ETAI* with Professor Erik Sandewall, a pioneer of artificial intelligence research in Scandinavia, as its Editor-in-Chief. An annual paper edition of the articles, without the discussion, is published by the Royal Swedish Academy of Sciences (KVA). The ECCAI also appointed a five-member policy board of active researchers to oversee the journal's operations. Researchers publicly comment on, and discuss specific articles with their authors before submission for a more private peer review. In brief, the *ETAI* was not conceived only as an electronic forum that linked authors and readers. It was socially networked into an elite European scientific community, as well. Since it was field-specific, it also attracted authors and readers who often knew each other's research, knew each other personally, and who met at workshops and conferences.

In contrast, the *EJCBS* was set up by a post-doctoral student at a minor research university. It has no editorial board and is not endorsed by any scientific organization. Its scope is to include the following fields: anthropology, artificial intelligence, bioinformatics, biomathematics, biophysics, cognitive psychology, complexity theory, electrophysiology, epistemology, ethology, evolution, linguistics, neuroanatomy, neurobiology, neurochemistry, neural networks, nonlinear dynamics, and the theory of automatons. Anyone who reads an article that is posted for evaluation can rate it on five 5-point scales, such as 'How significant is the problem discussed in the paper?' In contrast to the *ETAI*, which was 'socially networked' as a communication forum to engage a well-defined scientific community, the *EJCBS* is disconnected from any identifiable scientific communities. Its broad scope, which seems to invite participation by thousands of scholars, only attracted three authors (who submitted six articles between 1997 and mid-2000). Its electronic network doesn't energize a social network.

The concept of socio-technical interaction networks can help us provide an understanding of the differences between WWW sites and digital libraries that are highly used or little used. As technological systems, they are collections of software, data (text, picture files, etc.), links, and metadata (indices, etc.) that run on networked computers. As socio-technical interaction networks they are composed of:

- people in various roles and relationships with each other and with other system elements;
- support resources (training/support/help); and
- information structures (content and content providers, rules/norms/regulations, such as those that authorize people to use systems and information in specific ways, access controls).

We can also inquire about the importance of their content for various constituencies, who is authorized to change content, how that matters, etc.

Many questions help us connect technological artifacts in a lively way to a social world. As a design practice, a 'socio-technical approach' also requires a discovery process that helps designers effectively understand the relevant lifeworlds and workworlds of the people who will use their systems.[19]

How Social Context Matters: Intranets in Action

One way to illustrate a contextual inquiry of ICT in social life is to discuss some studies of the ways consulting firms have adopted and used computerized documentary systems. One major consulting firm, identified by the alias Alpha Consulting, bought 10,000 copies of Lotus Notes, documentary support system for their staff in 1989.[20] Lotus Notes is superficially similar to an Internet-like system with bulletin boards and posting mechanisms and discussion groups and electronic mail for organizations. Depending upon how Notes is used, it can act as an e-mail system, a discussion system, an electronic publishing system, and/or a set of digital libraries.

Alpha Consulting is an international consulting firm with thousands of employees worldwide. About 10,000 of them are located in the United States. Their vice-president of information systems believed that Lotus Notes was such a powerful technology that it would sell itself. The main thing to do was to rapidly roll it out to the consulting staff, and let them use it to find creative ways to share information.

He was concerned that his firm employed thousands of consultants in different offices all over North America. Even when they work on similar problems, they rarely share their newest solutions with consultants in other cities. They had no easy way of sharing their growing understanding of the problems they were solving with their clients. Could the firm's line consultants use some kind of communication and computerized information system to store what they knew, and share it?

The first test was with the ICT staff. They tended to use Notes; they found it interesting; and they actively used it for sharing information about their own projects. Alpha Consulting's tax consultants in Washington, DC was another group that used Lotus Notes. These tax consultants studied the behavior of the Internal Revenue Service and the US Congress, and disseminated tax advisories to Alpha Consulting offices around the country about shifting changes in tax legislation that might affect their clients. These tax consultants made substantial use of Lotus Notes to broadcast their tax advisories.

The line consultants were supposed to become Lotus Notes' primary users. The vice-president of Information Technology felt that Notes was so revolutionary that people didn't even have to be shown how to use it; examples could even stunt their imaginations. He believed once the consultants had an opportunity to use it that they would simply become more efficient and creative with Notes. Researchers found that the senior line consultants, who were partners in the firm, tended to be moderate users. The more numerous junior line consultants, called associates, used it least. They often seemed uninterested in learning how to use Notes, and readily gave up if they faced early frustrations with Notes. Here we have a pattern of different groups in an organization with varied degrees of use in Notes. How can we explain such differences?

One explanation focuses upon the incentive systems in the firm. A good place to start our analysis is with the associate consultants and the partners. Alpha Consulting—and many other large consulting firms in North America—reviews its consultants through a demanding promotion system. The associates are reviewed every two years, for 'up or out' promotions. In the first few career reviews at major consulting firms, about half of the associates are fired. However, many associate consultants want to be promoted to the status of partner. Consultants who are promoted to the status of partners can expect annual incomes over $300,000 at these major firms. Partnerships are the golden ring that these firms use to motivate their associate consultants.

The associates are valued for their billable hours, and were effectively required to bill almost all of their time. 'Billable hours' means they have a client account to charge for

their services. As they become more senior, their ability to attract new business becomes more critical. Lotus Notes, the revolutionary technology, was not provided to them with a 'training account' to bill their time to. Consultants who wanted to use Notes had to have an account to charge their time against, and the initial learning time was in the order of 20 to 30 hours. In 1991, many consultants billed at about $150 an hour. Each consultant had to find a client who would be willing to pay $3,000 to $4,500 for them to learn a system whose value was not yet clear to them, but could be revolutionary. Many had trouble justifying that amount of expenditure to any of their clients at the time that they were participating in the Notes rollout. There was a major question about what would the consultants actually do with Notes after they learned how to use it. Consequently, relatively few associates saw value in Notes; there were no exemplary demonstrations showing them how other successful line consultants used Notes.

On the other hand, the partners had substantial job security (which was similar to university tenure). They could afford to experiment with Notes. They were more willing to invest some time to explore, often using e-mail, occasionally developing and sending memos, and so on. This case study contradicts the popular 'Nintendo generation' explanation: 'In the future, we don't have to train people about computing, because the Nintendo kids (or the Net kids) will learn quickly'. In this case, generally, younger consultants had less incentive to learn Notes than did the middle-aged and elderly partners.

What about the ICT staff and the tax consultants? These groups had a certain advantage in their forms of job security. Many of the ICT staff were technophiles, and were willing to work with an interesting new application. Lotus Notes has been helpful for people who can invest time in learning how to use it, especially when they have joint projects and major motivations for communicating, for documenting work, for sharing memos, and so on.

The tax consultants, who were located in Washington, DC, had a significant incentive to show that they were visible and valuable in the firm. In their case salary did not give them an incentive. It gave them protection. Lotus Notes allowed them to broadcast their visibility. It gave them the ability to electronically publish their advice and make it quickly available to many of the consultants who needed timely tax information. They hoped this would enhance their visibility. Notes would help them show that the Washington office was not just an overhead, but an important contributing part of the firm. Organizational incentive systems were not part of the original marketing story of Lotus Notes. The interesting information processing features enabled by Lotus Notes were emphasized in numerous stories in the business press.[21]

An organization with different incentive systems might use Notes very differently. The way that some consultants use Notes at Ernst and Young (E&Y), another major consulting firm, is in contrast with the practices at Alpha Consulting.[22] In brief, E&Y created an organization (Center for Business Knowledge) whose charter was to organize E&Y's consultants' know-how in specific high-profile areas. By 1997, E&Y had developed 22 distinct social cross-office networks of consultants with expertise in certain industries, organizational reforms, or technologies that were a focus of E&Y's business.

Each network was assigned a half-time person to codify in Notes databases the insights from specific consulting projects, to prompt line consultants to add their own insights, and to edit and prune a project's discussion and document databases. In some cases, they were assigned to develop topical 'Power Packs' in Notes—a structured and filtered set of on-line materials including sales presentations and proposal templates. Davenport observed that these 'knowledge networkers' understood their network's domains and that these were short-term assignments for line consultants.

In this case, E&Y designed a human organizational 'intelligence system' for sharing insights, ideas, and materials in specific topical areas. Lotus Notes served as an information support system—a medium for storing, organizing and communicating these materials.

Taken together, these cases illustrate varied consequences of Notes' use in large consulting firms, not one fixed effect. Varied consequences in different settings is common in this body of research. Our job as researchers is not simply to document the various consequences of computerization, but also to theorize them.[23] Different organizational incentive systems for professionals is one way to conceptualize a key concept that helps to integrate some of these seemingly disparate cases.[24] It is possible that the way that Notes is used at both Alpha Consulting and E&Y have changed since the studies that inform this article were written. Our point here is not to praise E&Y and to criticize Alpha Consulting. Rather, it is to understand how their behavior can help us develop evidence-based concepts that help us to predict (or at least understand) variations in the ways that people and groups use information technologies.

One key idea of social informatics research is that the 'social context' of ICT development and use plays a significant role in influencing the ways that people use information and technologies. Thus, 'social context' also influences the consequences for work, organizations, and other social relationships. Social context does not refer to some abstracted 'cloud' that hovers above people and ICT. It refers to a specific matrix of social relationships. In the cases of Lotus Notes described above, social context is characterized by particular incentive systems for using, organizing, and sharing information at work. Groups within Alpha Consulting and E&Y have different incentives to share information about the project. Also how they use or avoid Lotus Notes.

The case of E&Y also illustrates an important idea of conceptualizing the design of computer and networked systems as a set of interrelated decisions about technology and the organization of work. Unfortunately, thinking and talking about computerization as the development of socio-technical configurations, rather than as simply installing and using a new technology, is not commonplace. It is common for managers and technologists to discuss some social repercussions of new technologies, such as the sponsorship of projects, training people to use new systems, and controls over access to information. However, these discussions usually treat all or most social behavior as separable from the technologies, whereas the E&Y case suggests how a more integrated socio-technical view is critical. We will amplify this key idea with additional examples.

It is also possible to revisit the cases of Lotus Notes use in consulting firms to examine their design as socio-technical communication systems within the social networks of the firms. One major difference between Alpha Consulting and E&Y lies in E&Y's creating new social groups with a responsibility for collecting, organizing and disseminating information for which Lotus Notes could be a helpful medium.

How Work Process Matters: Designing Usable Documentation Systems

Social informatics approaches have been applied to some issues that are of particular concern to designers of digital libraries in working with documentary systems. How do people work with documentary systems? We know that certain visions did not come about, such as the early 1980s vision of the paperless office. It is intriguing to speculate why one of the hot items in a 'paperless office' is a laser printer. Why are laser printer sales rising steadily—and faster ones, more colorful ones—if the direction of development is to abandon paper? There is a conceptual disconnect here.

Careful studies of professional and clerical documentary work find that many people

engage in complex activities, annotating documents and comparing them. Just as an editor compares two versions of a paper or a book chapter to see what the changes were; or integrating them, for instance in assembling a long report.[25] The screen space of the more common 14-, 15-, or even 17-inch displays are too limited. To compare two full-page manuscripts, it helps to put them side by side. That would require about 24 inches of display. Today 24-inch displays are too costly for most offices. While the costs and overall mass of large-screen monitors will decline in the next few years, paper has other virtues. Those who work with multiple documents mark them up with quick annotations and diagrams that are more difficult to do with word processors. They can also work with the paper in many locations. Paper is simple and versatile.

For certain transaction systems, such as airline reservation systems, the move to paperless transactions has been workable. It reduces operational costs in re-issuing new tickets and people make few additional notations on their tickets. In contrast, people who are doing analytical work with manuscripts have found paper to be an extremely durable and useful medium, for a variety of reasons. Some of the value of paper is based on comparing and working with documents side by side. It is partly a real estate issue, and partly a portability issue. Documents can be moved around an office, or taken off-site quickly and easily without needing a running computer.

Paper plays important roles in some places where we do not think it is in use. An interesting example is in civilian air traffic control systems. The movie version of air traffic controllers shows them staring at bright green displays. In real life they do depend upon computer displays. They also keep track of the planes that they are monitoring on little pieces of paper, which record flights, flight vectors, and speed, among other things. Because they divide their work by air space, when the plane moves from one scope to the next, they pass the paper over to the next person responsible. Gary Stix[26] examines (a) the nature of the work and communication via paper strips, and (b) IBM's efforts in 1993 to automate it. Stix reports that IBM had a database with 65 fields—a little complicated for real-time control! The project has since been abandoned by the FAA in the United States, at a cost of several hundred million dollars. But the FAA will continue to develop upgrades, because the computers on which the air traffic control system runs are aging, and it is hard to get spare parts, technicians, and so on.

This 'work-oriented view' of how people work and use computer systems in practice is not always inspiring. Many people work hard, and they do many interesting things, but their work with information technologies is not streamlined. Professionals, for example, often work across media, across technologies, and across social boundaries in ways that new, computer-based systems do not readily integrate. Their workspaces can appear messy and the workflow cumbersome, even when they have good computer systems to help with part of their work. Social informatics is one sustained way of understanding these issues in ways that do help improve the workability and design of systems and information services for various workers and the public.

A Socio-technical Approach to ICT Infrastructures: Public Access to Information via the Internet

There are numerous examples of the use and value of the Internet in providing new kinds of communications to support a cornucopia of human activities in virtually every profession and kind of institution. In the United States the professional and middle classes have found the Internet useful for communication, examples being government agencies, forms of shopping, tackling investments, maintaining ties with friends and family via e-mail, and as a source of entertainment.

There are also many examples where the Internet enables the middle-class public to

have better access to important information.[27] In the United States the public is beginning to turn to medical sources on the Web, to get alternative answers on the Internet, in discussion groups and so on, and sometimes bypassing the medical establishment.

Some people seek either alternative medical advice or information about issues that their doctors do not deal with very well. Surgeons, for example, may be good at doing very skilled surgery, but they may not be very good for giving people an understanding of what it takes to go through the recovery process. People sometimes find that certain Internet sources can be extremely helpful as either alternatives or supplements. This is simply a hypothesis, but there is anecdotal evidence that the Internet provides an alternative communication means for many middle-class people to bypass the medical establishment. Anecdotal evidence suggests that doctors vary in their responses to their patients feeling better informed, and sometimes challenging their advice—from encouragement to annoyance. What kinds of changes in systematic patient–doctor relationships may result is yet unclear.

In the United States, Vice-President Al Gore promoted networking for libraries, clinics, and schools, by arguing that if they are wired together, their use will improve public education and enable substantially improved public services. How to transform such networks into meaningful social support systems that involve changing professional practices as well as technologies remains unanswered.

While many people install additional phone lines for on-line computer use, affordable telephone service and Internet service providers (ISPs) are available in urban areas.[28] Access to ISPs, and even a basic telephone service, is more problematic in many rural areas. In 1995, about 28.8 million people in the United States 16 years and over had access to the Internet at work, school or home; 16.4 million people used the Internet and 11.5 million of these people used the Web. About 80% of these people used the Internet at least once a week. However, about 182 million people 16 years and over did not have access to the Internet.[29] A 1997 nationwide household study found that computer ownership and e-mail access were rising rapidly—about 94% of households have telephones, 37% have personal computers, 26% have modems, and 19% have on-line access.[30] The numbers of people with Internet access continues to rise rapidly.[31]

It might appear that limited technological access is the primary roadblock to expanded Internet use. 'Technological access' refers to the physical availability of suitable equipment, including computers of adequate speed and equipped with appropriate software for a given activity. Scenarios of 'ordinary people' using the Internet often assume that computer support is easy to organize, and that access to information and services is not problematic.

In contrast, 'social access' refers to know-how, a mix of professional knowledge economic resources, and technical skills, to use technologies in ways that enhance professional practices and social life. In practice, social access—the abilities of diverse organizations and people from many walks of life to actually use these services—will be critical if they are to move from the laboratories and pilot projects into widespread use where they can vitalize the nation and the economy. Social access should not be viewed as an 'add on' to a technological structure. Many systems designers have learned, for example, that a well-designed system does not simply tack on to a 'computer interface' after its internal structure has been set in place. The design of human interfaces and internal structures are linked to systems that effectively support people's work and communication.[32] In a similar way, social access is integral to the design and development of systems and services that are to be widely used.

Some analysts do not view social access to the Internet for 'ordinary people' as

problematic, since they believe that access costs will rapidly decline and the public's computing skills will continue to rise. In this view, time and markets will resolve most access issues. In contrast, I believe that social access to the Internet is likely to prove vexing for many people, based on what careful studies of computer use and Internet use have shown us.

Although about 50% of US households had a computer by the year 2000, organizations have been the major sites for adopting networked information systems, especially as implementers of advanced technologies. There are few studies of computer use in households. In one careful study of 'ordinary households' in HomeNet, researchers found that using the Internet is too hard for many 'ordinary people':[33]

> Over 70% of the households called the help desk. Calls to the help desk represented the behavior of some of the more sophisticated users. Less sophisticated users dropped out once they hit usability barriers. The kinds of problems logged by help desk staff included problems in installing phone service, configuring the telecommunication software, busy signals (users often blamed themselves!), buggy software, inexperience with mice, keyboards, scroll bars, terminology, radio buttons, and menus. Yet, in our home interviews, we noted there were many more problems participants had not called about.
>
> We thought that as everyone learned how to use the computer and what the Internet could do for them, the influence of their initial computer skill would decline with time. We were wrong. Even after a year of experience with the Internet, participant's initial computer skill still constrained their Internet usage. This result held across different gender and age groups.

These findings serve as a cautionary note about our expecting the North American public to rapidly form a 'network nation'. One intriguing finding of the HomeNet project is that families with adolescents made much more use of the Internet than those without. We suspect that many of these teenagers became critical 'on-site' technical consultants for their parents.

In fact, a recent large-scale study reports a widening gap of Internet use within the US population:[34]

The 1998 data reveal significant disparities, including the following:

- Households with incomes of $75,000 and higher are more than twenty times more likely to have access to the Internet than those at the lowest income levels, and more than nine times as likely to have a computer at home.
- Whites are more likely to have access to the Internet from home than Blacks or Hispanics have from any location.
- Black and Hispanic households are approximately one-third as likely to have home Internet access as households of Asian/Pacific Islander descent, and roughly two-fifths as likely as White households.
- Regardless of income level, Americans living in rural areas are lagging behind in Internet access. Indeed, at the lowest income levels, those in urban areas are more than twice as likely to have Internet access than those earning the same income in rural areas.

For many groups, the digital divide has widened as the information 'haves' outpace the 'have nots' in gaining access to electronic resources. The following gaps with regard to home Internet access are representative:

> The gaps between White and Hispanic households, and between White and Black

households, are now more than six percentage points larger than they were in 1994.

The digital divides based on education and income level have also increased in the last year alone. Between 1997 and 1998, the divide between those at the highest and lowest education levels increased 25 percent, and the divide between those at the highest and lowest income levels grew 29 percent.

These are amazing findings, since the cost of purchasing an 'entry-level PC' has declined considerably in the last few years. In addition, Internet Service Providers have become commonplace in urban and post-suburban regions, and connection costs have declined. The costs of equipment, alone, cannot effectively explain these growing disparities.[35]

Infrastructure for Computing Support is Social as well as Technological

PCs are much more complicated to install and use for a diverse array of tasks than are appliances such as televisions and VCRs. While it is a standing joke that most people don't know how to program their VCRs (and thus a watch with an LCD blinking 00:00), most people can play a videotape and enjoy the resulting entertainment. In contrast, PCs that use networked services require much more complex configurations (including data rates and IP numbers) that changes with network configurations and service providers.

Effective computer systems that use Internet services will require reliable complementary technological resources—such as printers, electricity (reliable in urban settings, sometimes problematic after disasters and in remote regions). What is less well appreciated is how the infrastructure for making computer systems workable also includes a variety of resources that are social in character. Skilled technical installers, trainers and consultants are the most obvious social resources. In addition, people who use advanced networking applications need know-how—to be able to learn to effectively integrate them into their working practices—based on learning from others.

There is some debate about how computer use has simplified in the last decade. It is probably easier to use a stand-alone PC 'out of the box'. However, the dominant operating systems, such as Windows 95/98/NT, Unix (and Linux) can still stump experts when applications or components interact badly.

System infrastructure is a socio-technical system since technical capabilities depend upon skilled people, administrative procedures, etc.; and social capabilities are enabled by simpler supporting technologies, such as word processors for creating technical documents, and cellular telephones and pagers for contacting rapid-response consultants.[36] Malfunctioning computer systems are not only an opportunity loss, they are a time loss that can be more than frustrating, it can be critical and even life threatening depending upon what the system is designed to accomplish. When people organize their days about the expectations that key technologies will work well—and they don't—they often spend considerable time tinkering to get systems to work, waiting for help to come, and so on.

Workable computer applications are usually supported by a strong socio-technical infrastructure. The 'surface features' of computer systems are the most visible and the primary subject of debates and systems analysis. They are only one part of computerization projects. Many key parts of information systems are neither immediately visible nor interesting in their novelty. These include technical infrastructure, such as reliable electricity (which may be a given in urban America, but problematic in wilderness areas, or in urban areas after a major devastation.) They also involve a range of skilled

support—from people to document systems features and who train people to use systems, and rapid-response consultants who can diagnose and repair system failures.

Much of the research about appropriate infrastructure comes from studies of systems that under-performed or failed.[37] The social infrastructure for a given computer system is not homogeneous across social sites. For example, the Worm Community System was a collaboratory for molecular biologists who worked in hundreds of university laboratories. Key social infrastructure for network connectivity and (UNIX) skills depended upon the laboratory's work organization (and local university resources).[38] Researchers found that the Worm Community System was technically well designed; but it was rather weak as an effective collaboratory because of the uneven and often limited support for its technical requirements in various university laboratories. In short, a weak local socio-technical infrastructure can undermine the effective workability of computer systems, including those in people's homes, as we have discussed above.[39]

How Social Informatics Matters

Social informatics research pertains to information technology developments and uses in any social setting, not just organizations. Social informatics researchers are especially interested in developing reliable knowledge about information technology and social change based on systematic empirical research, in order to inform both public policy issues and professional practice. Our concepts and analyses provide increased understanding of the design, use, configuration and/or consequences of ICTs so that they are actually workable for people and can fulfill their intended functions.

This careful contextual and empirically grounded analysis contrasts with high-spirited but largely a priori promotions of technologies that may occasionally work well for some people and may occasionally be valuable, but are sometimes abandoned or unusable, and thus incur needless waste and inspire misplaced hopes. In this article I have discussed a variety of ICTs, including local government information systems, computer networks, electronic journals, and the Internet. I described two exemplary cases in which ICT professionals and managers relying on the standard Tool Model (as outlined in Table 1) devised systems that were underused relative to their expectations or potentials. These are not just isolated examples, but rather, represent a widespread phenomenon. Various studies[40] have shown that utilization of the conventional Tool Model can result in considerable losses of various kinds (e.g. money, time, productivity, efficiency). However, because many of these losses occur 'behind closed doors' they may be unseen by the general public. Indeed, even those who observe them may not be fully appreciative of their scope and depth, being unaware of the extent to which other groups suffer similarly, or the degree to which things could have been different.

The standard Tool Model tends to both underestimate the costs and complexities of computerization, and overestimate the generalizability of applications from one setting or group of individuals to another. The resulting problems from the use of this model may be likened to an 'invisible' health problem, such as migraine headaches. Those who suffer from migraine headaches experience severe pain and the resultant missed opportunities, decreased productivity, and generally reduced efficiency.[41] Others who live or work with them can also be distressed or discommoded by migraine sufferers' increased emotional volatility or unreliability caused by their ailment. However, many of us are almost completely oblivious to the chronic, but publicly invisible, suffering and loss being experienced by millions of people due to migraines.

In similar fashion, we may be ignorant of the needless waste and human distress that improperly conceived ICTs may cause. However, even if we do not work in an

organization that suffers from poorly realized ICTs, these wastes and stressors may affect us more directly and more frequently than we realize. Financial losses to private organizations will result in our paying more for their products and services (although we may be unaware of the reasons for the price increases). Similar losses in public organizations may raise our taxes, or result in a diminution of services. New services that we might want to try may prove to be considerably more frustrating than we anticipate. For example, there is growing evidence[42] that many students in Internet-based distance education courses have been extremely frustrated when key participants (instructors, administrators, students) approached it as simply a new way to present courses, and thus overlooked important (mis)communication behaviors. To be most effective, computerized distance education will require the recognition that new conventions will be needed, such as the development of new communication practices under conditions of asymmetrical power.

Social informatics researchers study specific ICTs in specific settings to develop concepts and theories that apply to many kinds of ICTs in many kinds of settings. In each of the cases discussed in this article, I have shown how a social informatics analysis would have helped the participants to design or configure the ICTs differently, or to alter some social practices in order to improve their usage. This is one important way that 'social informatics matters' and one that I have emphasized in this article. This view of social informatics has important repercussions for public policy, professional practice, and the education of ICT professionals.[43] It is all too common today for ICT professionals, managers, and policy analysts to ignore or be unaware of that which has already been learned. Thus, each ICT community, such as electronic publishing, digital libraries, distance education, and electronic commerce, has to learn expensive 'lessons' anew. A major concern of social informatics researchers is to develop a cumulative body of research that will help many people effectively shape ICTs so that they can improve people's work and lives. Such research is trans-technology and trans-institutional—i.e. it develops concepts and theories that are applicable to understanding numerous kinds of ICTs and highly varied social settings.

Social informatics research also investigates intriguing new social phenomena that emerge when people use information technology, such as the ways that people develop trust in virtual teams,[44] or the ways that disciplinary norms influence scholars' use of electronic communication media.[45] But these phenomena would be the focus of a future article. In this article I have identified a few key ideas that come from 25 years of systematic analytical and critical research about information technology and social life. These ideas include the following central concepts about social informatics analyses:[46]

- These analyses differ considerably from the traditional deterministic impact analyses.
- Such analyses consider an array of relevant factors, including social, cultural, organizational, and other contextual components.
- Work processes and practices need to be studied *for how they are actually carried out.*
- ICTs are more usefully conceived as socio-technical networks than simply as 'tools'.

As we develop more elaborate ICTs and try to use them in almost every sphere of social life, we face fresh theoretical challenges for social informatics. Its possibilities and value are illustrated by some of the key ideas developed in this article—the social shaping of ICTs, the conceptions of highly intertwined socio-technical networks, the roles of social incentives in energizing new electronic media, and the conceptualization of ICT infrastructure as socio-technical practices and resources. The significance of social informatics research is continually expanding in this age of ever-increasing development of, and reliance on, ICT applications. Although ICTs are becoming more and more

enmeshed in the lives of rapidly growing numbers of people, much still remains unknown about the ultimate social consequences of the ensuing changes. At this time, when significant opportunities still exist to shape the forms and uses of these new ICT applications, social informatics offers an indispensable analytical foundation, which this article briefly introduces.

Notes and References

1. An earlier version of this article was published as R. Kling, 'What is social informatics and why does it matter?', *D-Lib Magazine*, 5, 1999, p. 1 <http://www.dlib.org:80/dlib/january99/kling/01kling.html>.
2. This work has benefited from continuing conversations about social informatics with many colleagues and students. Phil Agre, Bill Arms, Hank Brawley, Todd Cherkowsky, Holly Crawford, Blaise Cronin, Elisabeth Davenport, Elke Duncker, Paul Edwards, Joanna Fortuna, Amy Friedlander, Roberta Lamb, Suzanne Iacono, Geoff McKim, Javed Mostafa, Howard Rosenbaum, Steve Sawyer, Deborah Shaw, Bob Travica, and Suzanne Weisband commented on interim drafts of this article. Sharon Ross commented extensively on later versions of this article. The discussion of scholarly communication on the Internet is based upon joint research with Geoff McKim. This work was supported, in part, by NSF Grants No. IRI-9714211 and No. SBR-9872961.
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9. We use the term network rather than system because these configurations are open ended and not 'designed'. 'A network, by contrast, is loosely organized; often imperfectly integrated; has nodes that may be part of one to many other networks as well; and can be reconfigured' (P. N. Edwards, 'Y2K: Millennial reflections on computers as infrastructure', *History and Technology*, 15, 1998, pp. 7–29).
10. R. Kling and W. Dutton, 'The computer package, dynamic complexity', in J. N. Danzinger, W. H. Dutton, R. Kling and K. L. Kraemer (eds), *Computers and Politics: High Technology in American Local Governments*, Columbia University Press, New York, 1982, Chapter 2. This concept was later generalized to the 'web of computing'. See R. Kling and W. Scacchi, 'The web of computing: Computing technology as social organization', *Advances in Computers*, Academic Press, New York, Vol. 21, 1982; R. Kling, 'Behind the terminal: The critical role of computing infrastructure in effective information systems' development and use', in W. Cotterman and J. Senn (eds), *Challenges and Strategies for Research in Systems Development*, Wiley, New York, 1992, Chapter 10, pp. 153–201. Available from <http://www-slis.lib.indiana.edu/kling/pubs/webinfra.html>.
11. These ideas derive from a much larger body of research. See P. Edwards, 'From "Impact" to social process: Computers in society and culture', in S. Jasanoffet *et al.* (eds), *Handbook of Science and Technology Studies*, Sage Publications, Beverly Hills, CA, 1994, Chapter 12; R. Kling and T. Jewett, 'The social design of worklife with computers and networks: An open natural systems perspective', in M. Yovits

(ed.), *Advances in Computers*, Academic Press, Orlando, FL, Vol. 39, 1994, pp. 239–93. For recent reviews see R. Kling and R. Lamb, 'IT and organizational change in digital economies: A socio-technical approach', in B. Kahin and E. Brynjolfsson (eds), *Understanding the Digital Economy. Data, Tools and Research*, MIT Press, Cambridge, MA (in press).

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16. We will focus on those electronic journals whose primary distribution medium is electronic, unless we note otherwise.
17. There are substantial criticisms of peer reviewing as well as defenses. See, for example, B. Hibbitts, 'Last writes: The Law Review in the age of cyberspace, 1996, *First Monday*, 1, 3, 1996 <http://www.firstmonday.dk/issues/issue3/hibbits/index.html>; B. Hibbitts, 'E-journals, archives and knowledge networks: A commentary on Archie Zariski's defense of electronic law journals', *First Monday*, 2, 7, 1997 <http://www.firstmonday.dk/issues/issue2_7/hibbitts/index.html>; A. Zariski, 'Never ending, still beginning: A defense of electronic law journals from the perspective of the E-law experience', *First Monday*, 2, 6, 1997; A. Zariski, 'Knowledge networks of discourse communities?: Response to Hibbitts' Commentary on electronic journals', *First Monday*, 2, 8, 1997 <http://www.firstmonday.dk/issues/issue2_8/zariski/index.html>.
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22. T. Davenport, *Knowledge Management Case Study: Knowledge Management at Ernst & Young*, 1997 at

< http://www.bus.utexas.edu/kman/E&Y.html >; T. Gierkink and R. N. D. Ruggles, *Leveraging Knowledge for Business Value: Creating Living Knowledge Representations Through the Power of Communities* < http://www.businessinnovation.ey.com/mko/html/levera.html >.

23. See R. Lamb, 'Informational imperatives and socially mediated relationships, *The Information Society*, 12, 1, 1996, pp. 17–37, available at < http://lamb.cba.hawaii.edu/pubs/infoim19.html >; D. Robey, 'The paradox of transformation: Using contradictory logic to manage the organizational consequences of information technology', in C. Sauer and P. Yetton (eds), *Steps to the Future: Fresh Thinking on the Dynamics of Organizational Transformation*, Jossey-Bass, San Francisco, 1997.
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30. J. McConnaughey and W. Lader, *Falling Through the Net II: New Data on the Digital Divide*, National Telecommunications and Information Administration, Washington, DC, 1998.
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32. See National Research Council, *More Than Screen Deep: Toward Every-Citizen Interfaces to the Nation's Information Infrastructure*, National Academy Press, Washington, DC, 1997. See < http://www.nap.edu/readingroom/books/screen/ > for an integrated review.
33. S. Kiesler, R. Kraut, T. Mukhopadhyay and W. Scherlis, *Homenet Overview: Recent Results from a Field Trial of Residential Internet Use*, Carnegie Mellon University, Pittsburgh, PA, 1997 at < http://homenet.andrew.cmu.edu/progress/ovrview8697.html >.
34. National Telecommunications and Information Administration, Washington, DC, 1999.
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36. R. Kling, 1992, *op. cit.*
37. S. L. Star and K. Ruhleder, 'Steps towards an ecology of infrastructure: Design and access for large-scale collaborative systems', *Information Systems Research*, 7, 1996, pp. 111–38; Kling and Scacchi, 1982, *op. cit.*
38. See Star and Ruhleder, 1996, *op. cit.*
39. Also see L. Haddon and R. Silverstone, 'The domestication of ICTs: Households, families, and technical change', in Mansell and Silverstone, *op. cit.*
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