

The Strength of Weak Ties in Electronic Development of the Scholarly Communication System

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How would knowledgeable use of the Internet develop within academic institutions or various research fields and then diffuse across the loosely coupled scholarly communication system? Conversely, how might the scholarly system become balkanized into autonomous, even antagonistic, cultures or camps based on differing technological competencies and interests? Three overlapping models of innovation (new technology) diffusion are described in relation to the Internet: individual threshold, critical mass, and the strength of weak ties. Two contrasting scenarios of a balkanized system are drawn: separate tables and braking mechanisms. The analysis discusses the prospective role of academic librarians in electronic development of the scholarly system and concludes with a note on future research in this area.



Little is known, in any systematic way, about the impact of the Internet on patterns of scholarly communication. While the effects of computer networking in the workplace have received some attention over the past decade, empirical research on the role of the Internet in the scholarly communication system hardly has begun. The literature in this area generally is marred not only by a lack of analysis but also by certain problems which have deterred understanding. These include an ambiguity of Internet effects and incommensurable differences between the print and electronic forms of communication.

An ambiguity of Internet effects—functions (advantages) being inseparable from dysfunctions (disadvantages)—is readily apparent to anyone who has joined a few electronic groups:

To inhibit the flow of “useless junk” is to risk the loss of one of the most valuable impacts of computer-mediated communication systems—the flow of potentially useful information and ideas among persons with no previous or off-line communication links.¹ Bound up with that dilemma is a law of diminishing returns: the more information accessed, the less its overall meaning.

In the midst of such ambiguity, two sharply divided schools of thought have emerged. Enthusiasts extol the revolutionary potential of the Internet to transmit interactive communication around the world at a rate close to the speed of thought.² More conservative analysts, however, emphasize the limited experience of most scholars in using the Internet. In that behavioral perspective, the “key issue in technological

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innovation lies not within technology itself but among its potential users—whether they possess a clear vision of opportunities that permit wise choices about what to pursue and what to prevent."³

On a more fundamental plane, the two schools have come to reflect incommensurable paradigms whose bases include everything from computer experience and scholarly tradition to time, space, and reality. Communication across that great divide is inevitably partial, for sustained and knowledgeable use of the Internet is a matter of personal conversion rather than simple logic:

The computer's allure is more than utilitarian or aesthetic; it is erotic. Instead of a refreshing play with surfaces, as with toys or amusements, our affair with information machines announces a symbiotic relationship and ultimately a mental marriage to technology.⁴

Consider, for example, the two schools' split assumptions about human adjustment to technological innovation. Conservatives contend that "people are not easily sold on anything [like the Internet] that promises change in cognitive processes and organizational social structure."⁵ Enthusiasts take a different tack, that "as we've learned from the history of the telephone, radio, and television, people can adopt new communication media and redesign their way of life with surprising rapidity."⁶

Or, consider mental models of the place of virtual reality. Where pioneers behold a "post-Gutenberg galaxy," other scholars discern an "infinite cage" in which the computer's faceless language and protocols threaten to govern the very processes of thought.^{7,8} Overall, it is not surprising that several writers have come to the view that few other areas of modern social science have such a large number of unsubstantiated speculations and such a small number of serious studies.⁹

A new field can be advanced if researchers agree on a framework of significant and feasible issues. Toward that end, this article suggests two allied issues: (1) the impact of the Internet on the structure of the scholarly communica-

tion system, and (2) the prospective role of academic librarians in that process.

The scholarly system has a loosely coupled structure, one with remarkably little interaction, coordination, or even direct cause-and-effect relationships among the main constituencies: universities, academic libraries, computing centers, publishing houses, the scholars themselves, and their societies. An essential issue is whether the Internet tends to make the system generally more tightly coupled (interdependent) or loosely coupled (organized anarchy).

The allied issue is which group(s) will take a leading role in the dual process underlying new technology diffusion in the scholarly system: on a micro level, to mentor adoption and knowledgeable use of the technology; and on a macro level, to make the connections across groups—the strength of weak ties—on which system-wide diffusion of innovation depends.

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The thesis is that academic librarians are strategically situated to be the main agents of electronic development of the scholarly communication system. In that role, they can help prevent academic institutions and other parts of the system from becoming unnecessarily divided into separate cultures or camps based on differing technological competencies and interests.

The analysis focuses on informal patterns of online scholarly communication. It does not cover the tangle of rudimentary issues involving development of peer-reviewed electronic journals. That latter, more futuristic, topic is treated in the author's earlier work on scholarly communication as a loosely coupled system.¹⁰

The article is arranged in four parts. The first describes scenarios of a balkanized system. The second part outlines a

set of models of innovation (new technology) diffusion that would lead to a more tightly coupled system. The next part focuses on the prospective role of academic librarians as the strength of weak ties in the loosely coupled system. The last part is a note on future research in this area.

SCENARIOS OF A BALKANIZED SYSTEM

If history is any guide, there is a real prospect of academic institutions or research fields breaking into autonomous, even antagonistic, cultures or camps based on differing technological competencies and interests. The scenarios described below are not bound to become dominant but doubtless will be evident.

Separate Tables

In the 1960s computer statistical packages associated with the behavioral movement caused tremendous divisiveness in academic departments and scholarly societies. The result, described decades later by Gabriel Almond, is that "in some sense the various schools and sects now sit at separate tables, each with its own conception of proper science, but each protecting some secret island of vulnerability."¹¹ Almond took his metaphor from *Separate Tables*, a 1955 play in which solitary diners in a hotel convey the loneliness of the human condition. Tables are a popular metaphor; scholars in the humanities complain that they do not have a "place at the table," that they are "starving at the banquet."^{12,13}

In this scenario, some functions of Internet groups—their international scope, nearly instantaneous interactive dynamic, and social equality—could generate a resurgence of chauvinistic conflicts over competing research agendas, theories, and methods. Even Howard Rheingold, a dean of Internet pioneers, recognizes this prospect:

The willingness of the online population to tolerate wide diversity of opinion might be . . . an artifact of the early stages of the medium's growth. Fragmentation, hierarchization, rigidi-

fying social boundaries, and single-niche colonies of people who share intolerances could become prevalent in the future.¹⁴

Separatism could take the broader form of a counter ethos to the Internet as a symbol of intelligence and modernity if numbers of scholars become appalled by computer jargon, electronic junk, and the semblance of "systems people" to a new-age "priesthood." A counter ethos might also develop in reaction to a failure of some hypertext systems to meet scholarly needs.¹⁵

Braking Mechanisms

An analogy drawn from the transformation of the former Soviet system highlights the sheer difficulty of cultural and behavioral change in any large-scale social system. Stevan Harnad coined the term *intellectual perestroika* to signify a restructuring of the pursuit of knowledge in the electronic era.¹⁶ Other writers describe such fundamental change in a similar fashion:

Adoption [of the Internet] has entailed a rather difficult process of unscrambling old procedures and attitudes, moving to new ways of performing intellectual tasks and of thinking about communications, and then installing the new processes into the daily agenda of individuals and groups.¹⁷

Back in the U.S.S.R., when the Soviet form of perestroika began to deteriorate in the late 1980s, Mikhail Gorbachev complained that traditional institutions and ways of thinking were operating as "braking mechanisms" on the reform movement.¹⁸

In the West, certain properties of either the Internet or the traditional scholarly system thus far have operated as braking mechanisms on electronic progress. These include perceptions of cognitive overload and information overload, lack of identifiable productivity gains, and lack of academic rewards for scholars to use the Internet.

Cognitive Overload. The Internet is often likened to the ancient Library of Alexandria, which had a world of

information but little in the way of a card catalog. As conservatives point out, navigating the Internet involves fundamentally new skills. Though not "rocket science," such skills do require a commitment to learn and pose continuing frustrations over inconsistent protocols, redundant or incomplete search-engine retrievals, incompatible text formats, and so forth. While such frustrations continually are being alleviated by technical refinements, the problem of cognitive overload should be seen in a broad context. The architectural scheme of the Internet remains that of ARPANET, the first computer network designed in the 1960s as a "doomsday" device—a communications and command medium that could survive a nuclear war by virtue of having no central control on either a policy or a technical level.

Enthusiasts, for their part, are not really concerned about technical difficulties: "We are early adopters of a chaotic technology, and the momentum of our own enthusiasm generally carries us beyond the many annoyances and impediments that stand in the way of an easy, natural, information retrieval environment."¹⁹ Indeed, some librarians make a game out of difficult search and retrieval in the form of Internet "treasure hunts," a behavior that anthropologists would term "galumphing"—the voluntary placing of obstacles or complications in one's path because the center of interest is process rather than goal.²⁰

Information Overload. The Internet expedites a host of traditional scholarly needs: current awareness of professional developments, exchange of information on a timely basis, and collaboration among distant colleagues. A new function is the creation of online journals that are "laboratories rather than showcases," enabling a shift in scholarly communication from a finished product to the process of developing "knowledge in conversation."²¹ Enthusiasts make the claim that, "once we're all connected," the Internet will be a liberating, edifying experience of global proportions. Some collection development policies for the Internet even call for libraries to main-

tain archives of electronic groups (not just journals) as part of the "scholarly record."²²

Conservative analysts, however, have a darker vision of the Internet being filled with "unmitigated garbage: off-the-cuff ideas, rabid diatribes, ideological vendettas—topics and recreations that have little relevance to any commercial, scientific, or serious activity."²³ Science fiction writers of the cyberpunk genre address this problem in different moods. Some writers depict a new profession of knowledge mediators called hackers. In the next century, there are so many computer sites, networks, and databases that accessing the Internet, in one novelist's delightful hyperbole, has become equivalent (in paper format) to "arranging for a 747 cargo freighter filled with telephone books and encyclopedias to power-dive into one's unit every couple of minutes, forever."²⁴

Other writers discount the role of knowledge mediators (whether hackers or librarians) to manage information overload. In a novel set in the year 2038, the Internet has become a "rowdy babel, a torrent of confusion and comment, made worse because in order to be noticed each user sends out countless copies of his messages to any node that might conceivably listen." A courtesy monitor warns people not to "act like mental patients who shout out anything that comes to mind."²⁵

The contemporary impact of the Internet on scholarly communication probably varies with each of the 1,200 or so discussion groups, as well as with individual competencies and interests. Still, the thrust of the Internet is hardly scholarly. As Charles McClure and associates found in a series of surveys, scholars have a clear aversion to online journals because "electronic publication does not enhance one's status or image; in fact, it may very well harm them."²⁶ The few successful attempts at establishing scholarly (indexed) online journals have relied on a strategy of putting famous researchers on editorial boards and having them twist the arms of colleagues to submit papers.²⁷

The thrust of the Internet is the sociability of networking. Indeed, a unique feature of this fiercely egalitarian medium is its diminished social-status effects: "People who regard themselves as physically unattractive report feeling more lively and confident when they express themselves over the network. Others who have soft voices or small stature report that they no longer have to struggle to be taken seriously."²⁸ The *New Yorker* captured this feature in a cartoon of a dog sitting at a computer terminal explaining to a puppy, "On the Internet, nobody knows you're a dog."²⁹

We simply do not know whether the Internet will lead (at least in our lifetimes) to a grand, across-the-board renegotiation of historical print-age patterns of influence and interaction.

By and large, people grapple with information overload (or simplify choice situations) by reducing environmental scanning; narrowing attention spans; and devising other rule-of-thumb strategies. For e-mail in particular, information overload tends to have a curvilinear pattern. Individuals with an intermediate range of experience—about 20–50 online hours—are most susceptible to overload.³⁰ With greater experience, individuals tend to withdraw from some groups and develop better networking skills. The essential point is that, as functions slide into dysfunctions, optimal computer networking requires some exposure to information overload.

Productivity Gains versus Opportunity Costs. To consider the prospective impact of the Internet, a two-level perspective is helpful. Technology can have first-level *efficiency* effects and second-level *social* effects. First-level effects involve the use of new technology to do old things in better or faster ways. Second-level effects lead people to do new things, to pay attention to different things, to interact with one another differently, or to develop new needs or expectations. Second-level effects are ex-

traordinarily difficult to predict and emerge in society rather slowly, as people renegotiate outworn patterns of influence and interaction.³¹

The literature on the Internet contains a few reports of first-level effects. For example, an online version of the *Mendelian Inheritance in Man* database, to which geneticists can post electronically a research note to a particular entry, is one way that networking can make a previously established form of scholarly communication more efficient.³² What is absent from the literature, however, is evidence of second-level effects of networking on scholarly communication as a social system. We simply do not know whether the Internet will lead (at least in our lifetimes) to a grand, across-the-board renegotiation of historical print-age patterns of influence and interaction.

Productivity gains from Internet activity are especially hard to specify. Even people with a lot of online experience tend to have only an intuitive grasp of its effect on their work. As the McClure team found in surveys, "members of groups have difficulty articulating specific network impacts [even though] they cannot imagine working without networks."³³ Common responses to other surveys on the Internet's social effects are likewise abstract: "increasing the stock of ideas" and "exchanging opinions."³⁴

Enthusiasts rightly contend that arguments about our inability to specify second-level effects of the Internet are too abstract to be really persuasive. Networking's power to transform and multiply the relativity of human interaction is plain enough. Still, the computer-productivity paradox and the distinction between efficiency and social effects remain interesting areas for research.

MODELS OF INNOVATION DIFFUSION LEADING TO TIGHTER COUPLING

Up to now, this article has considered prospects for electronic development of the scholarly communication system at the level of an individual scholar or librarian who must balance,

by experience or intuition, the benefits of learning how to navigate the Internet against the opportunity costs to other, more established professional concerns. As the McClure team found in surveys, scholars seeking access to the Internet typically have only one piece of research in mind and do not want to take a computer course or even deal with "systems people" to learn how to get the information. Instead, they need a personal consultant who understands their project well enough to offer application-specific training and "one-on-one hand-holding."³⁵ Other observers have drawn a similar conclusion—that academic librarians may find a unique niche as knowledge mediators who combine technical and disciplinary skills to meet specialized research needs.³⁶

Another two-level perspective is helpful. The foregoing analysis is a microlevel, somewhat static view of the scholar's teachable moment, when a particular need for the Internet arises. On a macrolevel, what are the conditions under which scholars' knowledgeable use of the Internet would be dynamic, spreading within academic institutions or across various research groups, then becoming a self-sustaining process in the system as a whole? In other words, how do individual decisions to adopt the Internet (or any innovation) possibly interact and aggregate in a loosely coupled system?

Three overlapping models of collective behavior address these questions at a systems level: individual threshold, critical mass, and the strength of weak ties. Although these models are not predictive (they can be "proven" only after they occur), they have attracted wide attention as conceptual schemes that integrate microlevel individual preferences with macrolevel patterns of innovation diffusion.

Threshold Model

This model applies to a situation in which an individual has two alternatives: to do or not do a certain thing. The "thing" can be any binary decision in which one's choice depends, in part, on

the choices of some relevant group of individuals in the preceding period. Such decisions involve adopting—or rejecting—an innovation, engaging in a political activity (striking, voting, or rioting), migrating, or conforming in various ways. The concept of threshold refers to the number or proportion of others who must make a choice before a given individual comes under the influence of "bandwagon effects."³⁷

As an illustration, individual preferences regarding the Internet can be imagined on a 100-point scale. Pioneers have low thresholds (barriers to innovation); indeed, people like Charles Bailey Jr., Elaine Brennan, Diane Kovacs, or Stevan Harnad who start electronic journals when almost everyone else is doing nothing of the sort have a threshold around zero. Edward Jennings, reflecting on the founding of *EJournal*, said that "given the efficiencies of the medium we were celebrating so noisily, it seemed to have taken us a ridiculously long time just to find a few people willing to listen seriously to our ideas."³⁸

At the other end of the scale, conservatives—whether from fear, indifference, or lack of a mentor—have high thresholds. Actually, this model does not apply where most thresholds are very low or very high—that is, where an individual's behavior is not contingent on that of others. Thresholds in the middle range are the relevant ones in making the conceptual link between individual preferences and aggregate outcomes.

Critical Mass

This pertains to the turning point when an innovation is adopted—or rejected—by enough individuals to induce many others to do the same.³⁹ The critical ("take off") stage of Internet adoption started in 1987 when extremely rapid advances in superconducting research pointed up the inadequacy of preprints and telephones for scholarly communication; clusters of researchers adopting technology more or less simultaneously are a familiar phenomenon.⁴⁰ However, the literature on computer networking draws a

bleakly different scenario in which sustained use of the Internet spreads for a while, then recedes, leaving academic institutions and research fields divided into separate camps.⁴¹ In face of that prospect, discussions on upgrading the Internet to a national information infrastructure have included the need for equity policies which would serve to universalize access to networking information and services.⁴²

The Strength of Weak Ties

This model describes how an innovation can spread from group to group in a loosely coupled system.⁴³ As opposed to bandwagon effects at the group level, the strength of weak ties focuses on the role that outsiders play in the diffusion process at the systems level. An indirect but striking example—pertaining to information diffusion rather than technical knowledge diffusion—comes from experiments on the French national network that uncovered the role of “cross-pollinators of *télématique*”:

As the [French] system evolved, it became a very loosely coupled collection of different information services and communication forums. Many people stayed in only one or two different domains, but a small number of people seemed to move ideas very swiftly from one group to another. We found that we could feed a small piece of deliberately false information to one of these people, and it spread throughout all the different groups, to as many as four thousand people within two days.⁴⁴

In a nutshell, outsiders are those individuals who are most likely to deal with acquaintances in other groups (specialties, organizations, or other branches of the same organization).

Scholarly innovations tend to come from interdisciplinary patterns of interaction at the margins of established fields.⁴⁵ If the innovativeness of a research (or social) group is shackled by vested intellectual (or cultural) interests, then new ideas must emanate from outsiders in the network of individuals. Weak ties thus provide the basis for both

microlevel change (by broadening group horizons) and macrolevel integration (by expanding intergroup connections).

What types of individuals are potential agents of Internet use in the scholarly communication system? Generally, it would be those who have ties that overlap generational, occupational, or knowledge groups: “Gaps in network attitudes and skills exist along several dimensions: between older and younger researchers, between researchers and network administrators, between people in different sectors, between researchers from different disciplines, and between researchers working on different kinds or different stages of problems.”⁴⁶ Success for a scholar as an Internet pioneer can be problematic. On the one hand, “some junior researchers fear that their network expertise would relegate them to a ‘computer ghetto,’ in which they no longer participate in the conceptual aspects of research.”⁴⁷ On the other, as the protagonist in a cyberpunk novel reflects when exploring an outdoor music and technology fair: “Interesting things happen along borders—transitions—not in the middle where everything is the same. There may be something happening along the border of the crowd, back where the lights fade into the shade of the overpass.”⁴⁸

PROSPECTIVE ROLE OF ACADEMIC LIBRARIANS

In considering the prospect of the scholarly communication system becoming balkanized into separate cultures or camps, one must weigh the opportunity costs of learning to use the Internet against other professional concerns. A vast majority of scholars may simply go along with what tenure committees recognize—teaching and publishing as usual—and avoid what they perceive to be a technological hassle. Certainly, there is no shortage of warnings by conservatives against “mindless safaris into galaxies of informational garbage.”⁴⁹

The idea that the library should assume a leading role on campus in developing positive faculty attitudes about

the use of new technology is hardly a new one. My point concerns a broader, more systematic, even historic process. Academic librarians, by facilitating knowledgeable Internet activity—teaching short courses; publishing descriptive accounts in scholarly journals; and making alliances, under the auspices of the Association of College and Research Libraries, with scholarly societies—can provide the strength of weak ties on which systemwide adoption and integration of the new technology rests.

Field Variances in the "Strength of Weak Ties" Model

The importance of this prospective role will vary, as will patterns of Internet adoption, with the nature or structure of collegial interaction within a particular field. Such interaction differs markedly among fields. In science and technology fields, work tends to be highly collaborative within a department because colleagues have a common environment—they share the same technology and much professional knowledge. Thus, one would expect departmental ties to be the primary social influence for scientists to adopt the Internet. Such close influence can be called the "classical Athens interface."⁵⁰

The social sciences and humanities, by contrast, have much less opportunity for collaboration within a department, partly because faculty hiring is geared to maximizing intellectual diversity as a means of ensuring broad instructional coverage. In that kind of setting, given the lack of shared technology and expertise on campus, collegial support tends to be on a regional or national "invisible college" level.⁵¹

Survey Research on Field Variances

Internet surveys conducted by the writer in 1993, while not having a rigorous level of statistical reliability (in the 90 percent range of confidence that responses are not merely random), are nonetheless broadly supportive of these alternate theories. For respondents of CIVIL-L (Civil Engineering Research and Education), one-third were

prompted to adopt the Internet by departmental colleagues and another third by more distant contacts (librarians, computer specialists, or "invisible college" acquaintances); the last third were self-starters. In contrast, 80 percent of respondents of HUMANIST (Humanities Computing) were prompted by distant social influences to adopt the Internet and another 10 percent by departmental influences; the remaining 10 percent were self-starters.

The problem of high statistical reliability is that Internet surveys tend to have very low response rates, 5 percent or less.⁵² The two surveys described here had rates of about 20 percent ($n=30$), but that rate was accomplished by asking only one question and by sending it personally addressed to individuals instead of posting it, bulletin-board style, on a listserv.

Low response rates are indicative of *task-centered* groups, which are characterized by strong individualism, low social cohesion, mobility of membership, and relatively narrow goals. Such groups, especially online, are well suited to enhance the information-gathering functions of *relationship-centered* groups, which have broad mandates, stable memberships, and holistic personal relationships.⁵³ Yet, the relatively narrow purview of online scholarly groups—with their low response rates to Internet surveys—is an important qualifier to the idea of "virtual communities."

FUTURE RESEARCH

At a broad, systems-level analysis, the Internet will tend to balkanize the scholarly communication system into separate camps or cultures based on differing technological competencies and interests. Of great interest, however, will be all the exceptions to that generalization. The force of some braking mechanisms—cognitive overload and information overload—will depend in part on the structure of collegial interaction within a particular field. The force of other braking mechanisms—lack of clear productivity gains or academic rewards—might lessen, over time, if computer networking becomes a

very symbol of intelligence and modernity. Simply put, the Internet will affect the various fields in diverse ways and at different rates.

Comparative case studies will reveal a central paradox of our time, that the scholarly communication system is becoming simultaneously more unified (tightly coupled) and more fragmented (loosely coupled). A rudimentary hypothesis is that the growth of electronic journals and groups in centralized fields will have *decentralizing* effects, whereas such growth in decentralized fields will have *centralizing* effects.⁵⁴

Another area for comparative case study involves patterns of social influence in new technology adoption and diffusion. The strength of weak ties model proposed here is different from the conventional model of "integrated"

librarianship. In the latter model, which evolved in the 1970s, subject specialists staff the reference desk and serve all comers, including those with simple information needs. While that model had fallen into "conceptual disarray" (Jerry Campbell's phrase) by the late 1980s, the Internet should accelerate its demise.

Just as scholars face opportunity costs (e.g., to research productivity) in learning how to navigate the Internet, academic librarians must be relieved of labor-intensive tasks if they are to have a more sophisticated involvement with the new technology, particularly that on UNIX-based systems. This is an important shift, one that warrants analysis and understanding, for it has aroused a strong debate that reflects the emergence of antagonistic cultures or camps within our own profession.⁵⁵

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