
How this work can benefit both cultural studies and K-12 education.

A Review and Applications of Information Ecologies

Dickie Selfe and Dawn Hayden
Department of Humanities
Michigan Technological University
Houghton, MI 49931
rsselfe@mtu.edu; dhayden@mtu.edu

Abstract

This review of Information Ecologies notes how well Nardi and O'Day's biological approach fits with articulation theory (in rhetoric), since both encourage spelling out alternatives and consequences so as to avoid oversimplified technology choices. A closer look at the relevance of their case studies to promoting suitable technological improvements in K-12 education, however, finds concerns (about adequate social rewards and sustainability) along with promising parallels

K.4.m Computers and Society

Keywords: *Articulation theory, technical communication, user-centered design, education, participatory design*

The Bottom Line

We very much appreciate the “heart” and thoughtfulness of Bonnie A. Nardi and Vicki L. O'Day's work and find *Information Ecologies* a valuable starting point for professionals and citizens struggling to balance the potential and difficulties associated with integrating new technologies into their educational, working, and family lives: something we seem to be asked to do on a daily basis. In this review, the reviewers of *Information Ecologies* imagine two very different ways to use the work. Dawn Hayden will describe the useful connections she sees between this volume and the cultural studies theories she finds useful in her work on culture and technology. Dickie Selfe, on the other hand, demonstrates the value of

Information Ecologies in a graduate technical communication course designed for experienced K-12 teachers. In the process, both point to extended discussions that complement those taken up in this book. They conclude by suggesting topics for further thinking and research that grows out of the theoretical and case-study sections of this book.

Why a collaborative review?

We co-authored this review because of our different interests and needs as teachers and researchers in a technical communication program. Those interests, in turn, led us to review different sections of *Information Ecology*. Dawn took on the earlier, more theoretical chapters of the book (Chapters 1-6), while Dickie responded to the case studies described in Chapters 7-13.

Part I: Chapters 1-6, Dawn's Perspective on “Information Ecologies: Concepts and Reflections”

As a Ph.D. student in Michigan Technological University's Rhetoric and Technical Communication program, I came to *Information Ecologies* looking for theory and practices applicable to my research and teaching interests in technology studies and found it a refreshing and rejuvenating blend of both. It is refreshing because it uses theory to situate its perspective (yet it is not overburdened with theory), and it is rejuvenating because of its call to us to be

actively and critically engaged in technology studies and use. Their respective backgrounds and use of ethnographic case studies—Nardi is a researcher at AT&T Labs-Research and O'Day is a former researcher at the Xerox Palo Alto Research Center and a current graduate student of anthropology—provide readers with a way to actively examine the many layers and facets of our relationships with technology. Through the use of the ecology metaphor, they suggest a productive concept for understanding and relating to and with technology. Readers are asked not only to map out and closely examine the complex articulations inherent in our interactions with technology. In addition, my reading of their case studies suggests that they are also providing readers with several concrete examples of articulation theory in practice. My application of articulation theory to the technical practices found in *Information Ecologies* helped deepen my understanding of the theory itself and helped formulate the questions for further research found in the conclusion of this review essay. First, I would like to frame my review with a sketch or outline of the theory of articulation based on the much more comprehensive work found in two publications: Lawrence Grossberg's interview with Stuart Hall in *The Journal of Communication Inquiry* (1986) and Jennifer Slack's (1984) *Communication Technologies and Society*.

These cultural studies theorists use the term articulation in the generative sense, that is, as metatheory to help generate richer theoretical perspectives on cultural issues not readily resolved by common binaries, such as those that employ pro and con rhetorical strategies. Articulation, then, looks at an ensemble of strategies, solutions, and conceptualizations that include alternative, oppositional, and aberrant readings of a particular issue. I understand moments of articulation to be those moments when meaning moves from a fixed and intractable point to a position where meaning and understanding are in constant flux. Meanings constructed through articulation are never fixed but are contextual and a site of

constant struggle. That struggle is obvious in this volume. Nardi and O'Day take a similar approach (inadvertently, I think) as they develop their examples and case studies and attempt to look at the many layers of complications surrounding information ecologies.

In the introduction, for example, Nardi and O'Day examine the interaction between humans and technology in the 1927 Fritz Lang film, *Metropolis*. For them, Lang's film serves to work as "a reminder that our current questions and concerns about technology have a long history" (p. 13). In particular, they show how Lang is examining the social and ethical implications of cloning (with the creation of the "bad" Maria) while also exploring the creation of technologies used to replace human workers (e.g., the mechanized assembly line). We need only look to the uproar created by several technology-related events to realize that those same kinds of fears still exist 73 years later (e.g., the cloning of Dolly the sheep, the harvesting and selling of professional fashion models eggs, the reduction of educational jobs through distance education programs, etc.).

Nardi and O'Day follow this example with an assessment of the current discourse surrounding technology by suggesting that most of those conversations fall into either/or extremes. Technophiles like Nicholas Negroponte see the future of technology as "positive, unproblematic and without social costs" (p. 20), while dystopes vehemently voice their concerns about our future by calling for us to "walk away from new technologies rather than use them selectively and thoughtfully" (p. 23). Nardi and O'Day suggest that both sides of this technophobic/technophile binary share a common sense that "technological change is inevitable" (p. 17). In doing so they illustrate how well hidden and deeply embedded this ideology lies within technology studies. To uncover an ideology of this sort, they suggest we develop a sensitivity to and an awareness of the "interrelationships among the social, economic, and political contexts in which technology is invented and used" (p. 24).

In Chapter 3, "A Matter of Metaphor: Technology as Tool, Text, System, Ecology," Nardi

and O'Day show how their term, information ecology, grows out of other metaphorical approaches (a process that I would call articulation) when they say, "We see technology as part of an ecology, surrounded by a dense network of relationships in local environments" (p. 27). First they discuss the tool metaphor as one "useful for questions and discussions about utility, usability, skill, and learning" (p. 30). They go on to describe the technology-as-text metaphor as "useful as a way of prompting discussions of intentionality and meaning" (p. 33) and finish with the technology-as-system metaphor as a way of grouping together such diverse theorists such as Jacques Ellul, Langdon Winner, and others in an effort "to bring together ideas about phenomena of immense [technological] scope" (p. 33). Nardi and O'Day introduce these metaphors to not only examine more closely the "local settings" where technology is employed but also as a means of justifying their information ecologies metaphor.

In Chapters 4 and 5, Nardi and O'Day's use of the information ecology metaphor is intended to accomplish three things: "to evoke an image of biological ecologies with their complex dynamics and diverse species and opportunistic niches for growth," "to advocate collective participation in socially shared and valued activities" (p. 50, 57), and to encourage users of technology to become engaged participants within their own information ecologies. My reading of Nardi and O'Day's explanation of information ecologies suggests a connection to Grossberg and Slack's work on articulation. Articulation for Grossberg involves "describing the process of forging connections between practices and effects, as well as of enabling practices to have different, often unpredicted effects" (1992, p. 54), which theoretically resonates with Nardi and O'Day's information ecology metaphor. The process of defining ecologies involves "forging connections between practices and effects" and also assumes a place within the ecology for "unpredictable effects." For Grossberg, articulation is also "a continuous struggle to reposition

practices within a shifting field of forces, to redefine the possibilities of life by redefining the field of relations—the context—within which a practice is located" (1992, p. 54). This process of continuous redefinition is important in technology studies because, as Slack (1989) suggests, "technical breakthroughs, technical possibilities and limitations are all contextual factors; they are even social" (p. 329). From this perspective, Nardi and O'Day's implicit call for looking at the contextual uses of technology makes a great deal of sense.

Additionally, Nardi and O'Day's call for active participation resembles a similar movement made popular by user-centered design theorists (e.g., Robert R. Johnson, 1998) because it encourages "people to get involved in the evolution of their information ecologies—jump into the primordial soup, stir it around, and make as many waves as possible" (p. 58). Specifically, Nardi and O'Day employ a user-centered approach in the important list of "strategic questions" on pages 72-74. Here they introduce strategic questioning by explaining that it is "crucially important" to ask and understand both the how and the why questions concerning technology. "'Why' questions explore motivations, objectives, and values, while 'how' questions focus on logistics and tactics" (p. 70). In *User-Centered Technology* Robert Johnson (1998) suggests that "users understand technology from a unique perspective constructed from knowledge of practice within certain contexts" (p. 10). My reading of Johnson and Nardi and O'Day suggests that any well-formed information ecology will appropriate interesting methods and approaches from user-centered design theory in the implementation of a new technology. The fact that these questions have been created to tackle "taboo topics, raising hidden agendas to the surface or revealing tensions in current power structures" (Nardi and O'Day, p. 71) implies that participation, engagement and design should all be openly (and equally) shared among involved interactants. This concept becomes even more important in the second half of the book when Nardi and O'Day

illustrate their theoretical perspective in real-world examples that encompass many types of interactants: librarians, at-risk sixth graders, engineers, and others.

In the next section, Dickie reviews these case studies and the interactants described there as useful for both academic and professional technical communicators.

Part II: Chapters 7-13, Dickie's Perspective on Nardi and O'Day's Case Studies

As novel as the ecological metaphor is theoretically, the strength of this book seems to lie in the case studies that Nardi and O'Day provide in the second section, which I will review in some detail. But before beginning that review, it's important for readers know a bit about some projects that are currently influencing me and Dawn to which I'll be referring as I analyze the second half of *Information Ecologies*.

This type of background also seems important because this volume was clearly not written for us: teachers of technical communication (TC) and people responsible for TC program curricula. More specifically, it was not intended for academics, like ourselves, who are trying to convince beleaguered and hard-working kindergarten through twelfth-grade (K-12) teachers to incorporate issues important to technical communication into their packed and over-assessed curriculum. As an experienced teacher and graduate student, this is one of several projects in which Dawn is engaged, while I am increasingly *consumed* by this K-12 technical communication project. This summer, for instance, I mean to encourage K-12 teachers and curriculum designers to take into consideration—as they design communication activities for their science, math, social studies, and language arts classes—a related set of issues like the following:

- incorporate user-centered design and audience analysis into their approaches to the communication events they construct,
- expand the number of genres for commu-

nicating with real audiences that technologies can facilitate,

- take advantage of service learning opportunities,
- consider how electronic environments might facilitate communication events for the teachers and students who engage in those events.

To this end, I am currently (Spring, 2000) committed to developing a graduate-level course for K-12 teachers in a remote, rural region of Upper Michigan. The class, "Electronic Communication Across the Curriculum in K-12," will be held during the summer of 2000. Throughout this review, I suggest ways of using specific chapters from Nardi and O'Day to generate productive discussions about technology ecologies between these K-12 teachers.

Before I begin a chapter-by-chapter analysis, I'd like to recall a phrase I used in the bulleted items above: "communication events." People occasionally ask me, "Why not use words like 'writing, designing, speaking, presenting, drawing, imaging?'" My assumption, of course, is that technical communicators do all of the above and more. They deal with a wide range of familiar and not-so familiar media in such a way that the communication events they construct are not just read, listened to, vocalized, seen, or navigated; communication events require combinations of all these human activities. The same will be true, I hope, of the communication events that K-12 teachers construct this summer.

I was attracted to Nardi and O'Day's book because the notion of information ecologies seemed like a particularly appropriate metaphor for the amazingly complex and difficult situation in which teachers find themselves as they integrate technology into their curricula, into the teaching of their disciplinary content, and into the communicative events that accompany that content. An ecological approach to "technolog[ies] with heart" seemed like a good vehicle for getting teachers to attend to the complexity of their situation

and a good vehicle for helping them construct strategies that address the potential as well as the difficulties they will face.

I thought it best to warn readers that the connections I make to this volume are driven by specific contexts, contexts I hope some will find interesting in and of themselves.

One aside seems appropriate before I walk through the case-study section of this book. Nardi and O'Day are not, of course, the first to coin the term *information ecology*. Thomas Davenport (1997), for instance, published a more corporate volume (*Information Ecology: Mastering the Information and Knowledge Environment*) that many technical communicators might be interested in perusing. Like Nardi and O'Day's volume, it offers some of the same analysis of information systems and applies a similar ecological metaphor to an impressive array of corporate sites. He continues to develop the metaphor and analysis in *Mission Critical: Realizing the Promise of Enterprise Systems* (2000). But it was not just the ecological metaphor that attracted us to Nardi and O'Day's book; it was their emphasis on "heart." We associate this word both with the importance of human understanding as we deal with technological ventures and with human action, as in "Do we have the heart to try to change technological systems that seem over-determined and overwhelming?" and "Will the systems we develop have a human 'heart' behind them, or will they reflect only the dominate design principle of our time: efficiency?"

Chapter 7, Librarians: A Keystone Species

The first information ecology that Nardi and O'Day explore in some depth seems well chosen: that of the librarian and, in this case, the corporate librarian. In an age of apparently limitless data the librarian often stands quietly behind academics and professionals as they wade through the torrent. (We use "data" to clearly distinguish between inert materials in the digital domain and what might be called knowledge, which seems in short supply these days.) For Nardi and O'Day, librarians are

a keystone species. By this they mean that librarians reside at the "pinnacle of an arch—the keystone—[which] stabilizes the arch and holds it together" (p. 79). The arch becomes a metaphor for a complex information ecosystem to which librarians add "vitality." These unsung heroines and heroes help information ecosystems hang together; without them, as the keystone arch metaphor suggests, these information ecologies would fall apart. The chaos of data will continue flowing into the corporate libraries of Apple and Hewlett-Packard that Nardi and O'Day discuss in this chapter, but the corporate knowledge base and productivity will not continue without a strong information ecology in which librarians play a central role.

No doubt K-12 teachers would say the same thing. Their librarians perform many of the same valuable services as those in corporate libraries. These people, by design, serve behind the scenes. They provide "information therapy." They help with strategic planning, and they build relationships between "information seekers, the librarian, and the technology" (p. 96). Nardi and O'Day do a good job of describing this important cyborg relationship: part human (mostly human) and part technology. This, in turn, leads me to one observation about the book. Its greatest strength may lie in the metaphors they use to help us imagine the importance of understanding an entire information ecosystem: keystone species, diversity (as in biodiversity), information therapy, ... All of these terms (as well as one that I would add to the mix, sustainability) will be useful as we rethink our relationship to technologies and how we integrate them into our classrooms and curricula.

They conclude this section with a discussion of the future library: "With the advent of the Internet, we believe librarians are more important than ever." It's a common enough conclusion though some may dispute it. For other well reasoned and impassioned calls for valuing librarians (and paying for their expertise as well), readers might want to

look through James J. O'Donnell's *Avatars of the Word: From Papyrus to Cyberspace* (1998) or Roger Chartier's *The Order of Books* (1992).

Chapter 8, Wolf, Bat-girl, and Starlight: Finding a Real Community in a Virtual World

This chapter examines the ecology surrounding a MOO (Multiple-user dimension Object Oriented) set up and maintained for a low-income ethnically diverse elementary school in Phoenix, AZ. It might seem like a stretch to ask technical communicators to extract useful generalizations from a chapter based on a textual, virtual environment that provides synchronous "chat" capabilities (among other things) and is inhabited by school children. But I'm convinced that any attempt to set up and maintain "an experimental learning environment" can be instructive.

For instance, the ecological findings of Nardi and O'Day have informed our NorthWoodsMOO project (see <http://moo.hu.mtu.edu:800>), a system that will provide professional development opportunities for teachers (not just students). We hope to connect K-12 teachers to technical experts in reading assessment at a distance because the harsh winters and long distances between towns and cities in the Upper Peninsula of Michigan limit the amount of face-to-face inservice training in which teachers can reasonably expect to participate. These teachers and technical communicators, though, have at least one thing in common: both groups must continue to find opportunities for professional development even as they perform their jobs. Through interactive technologies like the web-based NorthWoodsMOO, we hope to provide these opportunities.

In addition, as we described earlier, our object, at least in part, is to encourage K-12 teachers to

I am less sure, however, that these gardening initiatives can be sustained if the recognition given gardeners remains entirely informal

- value user-centered design and audience analysis,
- expand the number of genres for communicating with real audiences,
- become more aware of the influence of electronic environments on communication events.

In all these areas, the process of developing an online environment of this type will provide excellent practice because teachers and students will be both the users of and the audiences for the project. In addition, it seems clear that the genre of online professional development and synchronous interaction at a distance will continue to be of growing importance to teachers and students.

One of the most important concepts drawn by Nardi and O'Day in this chapter has to do with encouraging independent learners. MOO environments invite participants and technical experts to collaborate in the design and policy making essential to the maintenance of online communities. The most important aspect of the Pueblo MOO described in this chapter, however, should also be of interest to technical communicators as citizens living in a world of unequal distribution of technological wealth (see C. Selfe, 1999). This is an example of an information ecology that provides an underfunded, often under-represented, and very young population of students with autonomous access to interactive technologies that would not have otherwise been possible.

If you want to know more about educational MOO technologies, particularly if you are interested in how they are being integrated into webbed environments, we recommend looking at two books edited and written by Cynthia Haynes and Jon Homevik: *High Wired* (1998) and *MOOiversity* (2000). Both are aimed primarily at institutions of higher education but are adaptable to the K-12 environment and are directly applicable to the transactional needs of the technical communicator.

Chapter 9, Cultivating Gardeners: The Importance of Homegrown Expertise

Considering the team-based project groups in which technical communicators work, they should find this chapter of interest. Nardi and O'Day pulled the term gardeners from a team of mechanical engineers, one of many teams from small and large companies in which Nardi studied the use of complex computer-aided design (CAD) and robust spreadsheet software systems. In this chapter gardeners were evident in groups of professional accountants, engineers, drafters, architects, software programmers, managers, and small business owners. They "were seen as 'growing the productivity' of the company" (p. 140) and had some very distinct characteristics. These people

- were fully engaged as professionals, not hired specifically to do software support,
- enjoyed and excelled at tinkering with new technologies and incorporating them into the specific work process of their team projects,
- took on technology support responsibilities by customizing and optimizing the use of these systems and by teaching team members and co-workers how to use complex software and hardware systems,
- spoke more than one language (the technical language of the IT professionals and the language of their profession),
- had an intimate awareness of the company needs, the needs of their team, and the purpose and scope of current projects,
- knew where and when to go for help, when to hand off more complex support needs to those able to provide it easily, and
- knew they had the social skills to work easily with people at many skill levels.

The chapter spoke to me directly because it described in some detail the hundreds of volunteer and paid student consultants who, over the past decade, have worked so hard to help run (garden) the computer labs in MTU's (Michigan Technological University) Depart-

ment of Humanities for the 100 undergraduate technical communication majors and 70 graduate Rhetoric and Technical Communication students. Their "gardening" spirits have been essential to our continued success and were well represented in this chapter. This metaphor also reminds me of a certain class of academic professional, who is often referred to these days as an early adopter (of technology). These academic mavericks willingly put up with the frustrations and inevitable technical failures that accompany any new technological venture because they find the potential for these systems impressive and sustaining. They also help pave the way for other teachers who develop an appreciation for the potential of electronic communication systems. Early adopters in the educational and corporate worlds are often the unheralded teachers and mentors we need as we integrate technology into our curricula or work practices.

Nardi and O'Day's description of gardeners also reminds me of the student workers, also often unheralded, in elementary, middle school, and high schools who help teach technological practices to other students and teachers. This chapter adds credence to our efforts to train students along with teachers in the use of and application of new technologies. We are certain of the value of creating an atmosphere in K-12 institutions, for instance, that is supportive of and committed to training young students and teachers to become gardeners in the information ecologies around them. Ten years of experience have shown that it is just as valuable at the college level in technical communication programs.

There is no doubt in my mind that in the near future, businesses, project teams, schools, technical communication programs, and even families will grow more dependent on people with the "gardening" characteristics listed above. Often those people will be the youngest members in each venue. I am less sure, however, that these gardening initiatives can be sustained if the recognition given gardeners remains entirely informal. Nardi and O'Day finish their chapter with a short discussion of the informal

and formal recognition that gardeners received from their respective teams and companies. I would hope that in follow-up studies this discussion might be a bit longer and more reflective of the power relationships set up in these teams.

Further study seems quite important to the long-range professional implications for the gardeners in question. Here's why. I worry about an informal approach to compensating gardeners. In my experience the graduating consultants, who have often worked at gardening for several years in our computer facilities at MTU, naturally take on gardening roles when they graduate into technology-rich positions. However, several of them have come back and discussed the strategies they have had to develop because of the overwhelming demand for gardening support experienced in their workplaces. They found themselves unable to get their own work done and were constantly badgered by co-workers needing help at relatively simple tasks. It wasn't in the company's best interests, they'd say, to have a professional communicator showing someone how to connect to a printer or how to navigate a local area network. In addition, there is this question: "Is the gardening experience necessarily good for the workers themselves and their careers?" If, on performance evaluations, gardening activities are given some explicit attention, then perhaps the answer is "Yes." But if not, the answer isn't so unequivocal. A terrific longitudinal study would follow gardeners over time to see how they fared professionally. I am already convinced of the value, for the institution, of these people and their support activities, but I'm unsure that the new "post-bureaucratic organization" (see Hecksher and Donnellon, 1994) will provide the reward structure necessary for the long-term advancement of these folks.

We hope that information technology personnel, team managers in industry, and technology coordinators in K-12 settings read this chapter and become aware of the value added by gardeners. We also hope that they will consider the difficult professional dilemmas associated with gardening.

Chapter 10, Digital Photography at Lincoln High School

This chapter focuses on an information ecology at Lincoln High School in San Jose, California, with "over a million dollars' worth of high-tech equipment [to] outfit the school [over the last five years]" (p. 153). Lincoln is an arts magnet school with a track record of procuring state and federal grants for its diverse student population. As one of the arts programs, Ms. Lynch's photography class was not "intended to support any kind of 'realism'" (p. 154), rather it was meant to explore visual possibilities. These student explorations were generated by manipulating digital images in a professional-quality application, Adobe Photoshop. Nardi observed and interviewed the various stakeholders in the summer class and came to the conclusion that this information ecology succeeded for three reasons:

- The artwork was the primary focus of the instruction (not the technology).
- The teacher provided structured lessons that allowed everyone to keep up, even those without previous computer knowledge, and
- There was plenty of technical support so that the artwork could remain the focus of the class and the students' work.

Apparently, other digital art classes at Lincoln were not as successful in bringing about this mixing of genders, races, and socioeconomic variety. But it's clear from this chapter that the three characteristics listed above were not solely responsible for the success of this class: other factors also intervened at some level in the digital photography class. Over a million dollars of grant funding certainly helped secure the physical and human infrastructure necessary for the class. The fact that this class had no prerequisites that served to weed out those less experienced in technology also helped insure the (gender, racial, socioeconomic) diversity in the class. And certainly the self-selected (parent-selected?) nature of a magnet school's student body must have also contributed to this particular information ecology in interesting ways.

The nature of this endeavor, so much like the kind of work I hope to encourage K-12 teachers to take on in the summer of 2000, makes this chapter of particular importance to me, and not just because it illustrates a successful attempt to incorporate digital technologies into an established curriculum. More important will be the process of watching the teachers this summer pick apart the reasons for success in this information ecology and then apply those observations to their local, rural school districts. This leads me to another observation on this book: the value of most of these case studies will lie in the critical reflection that comes after their reading and in response to the hard-edged reality these K-12 teachers face in their districts, buildings, and classrooms. What is said in each chapter is important, but more important yet is the use to which a chapter is put.

Chapter 11, A Dysfunctional Ecology: Privacy Issues at a Teaching Hospital

“Up to now,” Nardi and O’Day say in this chapter, “we have concentrated on vibrant, healthy information ecologies” (p. 175). In Chapter 11, they change direction and describe a technological implementation that disrupted the integrated workings of neurosurgery teams in their respective operating rooms. The idea behind the introduction of the technology—real-time video, audio, and data systems—into the highly specialized and professional ecology of neurosurgery was to make a “scarce and expensive resource,” (p. 169)—the person trained in neurophysiology—available at more than one operation at a time. The idea was for these specialists to observe many operations at once, and intervene if they detected any difficulties as they watched the data coming through the system and as they watched and listened to operating room procedures. It was hoped that the neurophysiologist could then respond immediately and with a full understanding of the operation at hand. Nardi and O’Day make clear in their descriptions of the operating room procedure how these real-time multimedia technologies might improve the operation from the point of view of the

neurophysiologist, a scarce and expensive resource person. But Nardi and O’Day also make clear that these technologies “threaten[ed] the sanctity and balance of the social practices that made the difficult work of neurosurgery possible” (p. 178). The primary concerns had to do with who might be watching and listening and how the audio/video might be used out of context (in legal cases, for instance).

Nardi and O’Day focus their critique on the way new technologies were implemented: they conclude that the implementation was flawed because designers didn’t incorporate “simple privacy safeguards” (p. 183) and, most importantly, didn’t seek “the buy-in of the people who generated the information” (p. 182). The lessons learned from this example are significant. In hierarchical systems (like K-12 schools and teaching hospitals) technologies are often imposed on workers without opportunities to intervene in the design process. Clearly, the “new” will not be integrated into an institutional ecology without a great deal of resistance or at least resentment unless all players become part of the development of the new system. Unfortunately, the hospital technology team eventually made suggestions for improvement only in a “reactive” way, after many other specialists were put off by the new technologies.

We found this chapter refreshing because it gives us a scenario all of us have undoubtedly encountered at some level—some institutional representative’s idea of a new and valuable technology is passed down to us without warning. In the K-12 educational information ecology, these events often accompany huge grants, or money meteors, that strike unexpectedly without the input of all parties concerned. Teachers are often left to deal with the changed technological ecology entirely on their own. In some cases, the results are irrevocable; that is, technologies change the original environment in ways that cannot be reversed. We don’t know if any negative, irreversible change indeed occurred in the case of the neurosurgery unit, or for that matter, in most of the information ecologies the authors describe in this book.

That's why this chapter and the book as a whole begs for a follow up critique of the sustainability of these information ecologies.

Chapter 12, Diversity on the Internet

In the final chapter before their conclusion, Nardi and O'Day get away from what is the strength of the volume: the in-depth case studies of local, particular information ecologies. They chose instead, to respond to one of the more invasive, compelling technologies of our time: the Internet. (The book is published in 1999, so they must have been writing the final drafts in 1997 or 1998.) Their approach to the Internet is interesting: show the diversity of information available and how it is a valuable technology for connecting people with services, connection people with goods, connecting people with people, and for providing people with some sense of the social action that can take place on the Internet (for a book-length effort to explore cases of international uses of the Internet see Hawisher and Selfe (1999)). They finish with a critique of Bill Gate's (1996) conception of the Internet in his *The Road Ahead*, in which they find "egregious... the attempt to convince people that the Internet is primarily a means of bringing together consumers and producers" (p. 206).

While this is not the most compelling chapter of the book, it does, like all the others, provide a useful point of departure for further study and discussion. We would like to think that the K-12 teachers who read this chapter will also grow to appreciate the Internet as "an important source of diversity in an increasingly flat and packaged world" (p. 207).

Chapter 13, Conclusion (of Information Ecologies)

Nardi and O'Day suggest that "what is at stake [in developing healthy information ecologies] is the impact of our technologies on the quality of our lives" (p. 209). Drawing on their experiences with ecologies, they finish the book by making a case for this idea. The authors advocate for the need to "know-why" as well as "know-how," and for humans to move

beyond the apocalyptic versus the hard-sell economics surrounding discussions of technology. They suggest we do this by engaging in local "habitations" or information ecologies, and by "adopting a stance of participation and engagement with technology" (p. 215). The conclusion then reflects what Nardi and O'Day are trying to do with the whole volume:

- introduce a new ecologically based vocabulary that points to the complex integratedness of our techno-social worlds,
- encourage us to integrate our values into decisions we make about using new technologies, and
- call our attention to what passes before our eyes. That is, to describe the daily importance of technological systems and how they co-evolve with the social systems in which we work.

Our Conclusion

Information Ecologies not only tells the stories of technologies at work, it also challenges us to more closely examine the information ecologies that make up our own environments. Considering the modest length of the book, we think the authors accomplish their objectives and leave us with the responsibility to encourage and expand these types of discussions. For example, it's fairly clear that Nardi and O'Day chose to take a fairly positive, proactive approach to the information ecologies they examine. Most examples were successful, robust, and, to some extent, meant to be visionary. But we could also learn a great deal (as we did in the chapter that looked at the neurosurgery team) by attending to other less functional ecologies.

Jennifer Slack (1989) suggests we look more closely at the "lines of tendential force" (p. 333), which for us are those places where agents in a technology-rich system experience conflicting points of interest and power relations that are out of balance. Quite often in these cases, cyborg systems (part human and part technology) function in odd, surprising,

and counter-productive ways. We could, for example, point once again to Chapter 9, "Cultivating Gardeners." The final person interviewed, Steve, jokingly hinted that while he had the knowledge to be a "gardener," he did not have the time nor the inclination to help sustain others. It might be quite instructive to interview people like Steve to find out how they came to adopt this attitude. Where were the points of conflicting interests in their experience with work and technology? What power relations had they experienced that contributed to their attitudes? And how far back do we need to go to understand nongardening attitudes: to early technology experiences or simply the last promotion review? Steve may not have felt the rewards for being a gardener were enough of an impetus for him to invest his time or his skills in supporting his coworkers. It would be helpful to know if a particular information ecology contributed to his attitude so that we might minimize counter-productive attitudes in those we create and help maintain. We can learn a great deal from both the functional and dysfunctional ecologies around us. By examining malfunctioning ecologies—those places where the implementation and use of technologies went awry—we might better prepare/create/foster information ecologies where the systems of support that are required for success and growth are both present and encouraged.

In future studies, it might also be instructive to look at other components of the ecological metaphor on which Nardi and O'Day don't dwell. Sustainability, for instance, is an important component in ecological studies these days, and we can imagine a follow-up book or report that addresses the sustainability question in some depth. Specifically, we envision (it's always easy to envision a project for someone else!) Nardi and O'Day revisiting these and other ecological sites in order to generate a better understanding of the longevity of these ecologies. How do we sustain them? What and who keeps them working and productive? Under what circumstances are they liable to crumble or deteriorate?

We are certain that these authors are interested in a continuing a conversation along these lines because they have accepted an invitation to attend a virtual meeting with K-12 teachers participating in the workshop this summer (2000). We have a great deal of respect for authors who attempt projects of this scope, who engage in an ongoing dialogue about their work, and who are willing to put themselves in the public eye. Nardi and O'Day are two such authors. We hope they realize, then, that the few critical statements and suggestions we sprinkled throughout this review are meant more for the readership of this journal than for them. Technical communicators (academic and professional) should broaden the scope of their professional, academic, and civic concerns about technology. We need to define for ourselves what it means to work in and live with healthy, heart-felt technological systems. This volume could be used to instigate that kind of discussion.

References

- Chartier, Roger. (1992). *The order of books*. Stanford, CA: Stanford University Press.
- Davenport, Thomas H. (1997). *Information ecology: Mastering the information and knowledge environment*. New York: Oxford University Press.
- Davenport, Thomas H. (2000). *Mission critical: Realizing the promise of enterprise systems*. Cambridge, MA: Harvard School of Business Press.
- Gates, Bill, Myhrvold, Nathan, and Rinearson, Peter M. (1996). *The road ahead*. New York: Penguin.
- Grossberg, Lawrence. (1986). On Postmodernism and Articulation with Stuart Hall. *Journal of Communication Inquiry*, 10(2), 45-60.
- Grossberg, Lawrence. (1987). Critical theory and the politics of empirical research. In M. Gurevitch and M. R. Levy (Eds.), *Mass communication review yearbook*, vol. 6 (pp. 86-106). London: Sage Publications.
- Grossberg, Lawrence. (1992). *We gotta get out of this place: Popular conservatism and postmodern culture*. New York: Routledge.
- Hawisher, Gail E. and Selfe, Cynthia L. (2000). *Global literacies and the World-Wide Web*.

- New York: Routledge.
- Haynes, Cynthia, and Holmevik, Jan Rune (Eds.). (1998). *High wired: On the design, use, and theory of education MOOs*. Ann Arbor, MI: University of Michigan Press.
- Heckscher, Charles, and Donnellon, Anne (Eds.). (1994). *The post-bureaucratic organization: New perspectives on organizational change*. Thousand Oaks, NJ: Sage Publications.
- Holmevik, Jan Rune, and Haynes, Cynthia (Eds.). (2000). *MOOuniversity: A student's guide to online learning environments*. Boston: Allyn and Bacon.
- Johnson, Robert R. (1998). *User-centered technology: A rhetorical theory for computers and other mundane artifacts*. Albany, NY: State University of New York Press.
- O'Donnell, James J. (1998). *Avatars of the word: From papyrus to cyberspace*. Cambridge, MA: Harvard University Press.
- Selfe, Cynthia. (1999). *Technology and literacy in the 21st century: The importance of paying attention*. Studies in Writing and Rhetoric series. Carbondale, IL: Southern Illinois University Press.
- Slack, Jennifer. (1984). *Communication Technologies and Society*. Norwood, NJ: Ablex Publishing.
- Slack, Jennifer. (1989). Contextualizing technology. In Brenda Dervin, et al. (Eds.), *Rethinking communication* (pp. 329-345). Newbury Park, CA: Sage Publications.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage, and that all copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers, or to redistribute to lists, requires prior specific permission and/or a fee. © 2000 ACM 1527-6805/00/05—00 91 \$5.00