

As We Progress: Network Innovation and Social Change

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Abstract

Technologically-enriched communication environments are already changing many aspects of the human social fabric, including the bonds of friendship, the definition of neighborhood, the give-and-take of education, and the transacting of business. As the virtual network grows in scope, expressiveness, and functionality, it will affect our sense of sociability, our understanding of world affairs, and our engagement in the global economy.

In the past, point-to-point connectivity of the mail system and the telephone allowed us to reach across a distributed social landscape to specifically selected people and sites. At the same time, the one-way nature of capital-intensive "mass media" communications -- newspapers, radio, and television -- created a power structure dominated by the opinions of a few. As we enter the brave new world of the World Wide Web, the old paradigms of media control are breaking down. No longer is the creation and distribution of information restricted to large firms, governments, academics, or wealthy entrepreneurs. Individuals are able to receive and to publish what they want, when they want, where they want, and for whom they want at a reasonable cost.

As the network becomes "smarter," the highly distributed community of audience will be formed and reformed based on the manipulation of meta-data which conveys the interests of the consumer and the economics of efficient entrepreneurial effort to the system. Now, the system becomes an active player and the very concept of information becomes nebulous. By "information" do we mean streams of coherently organized story content, or small chunks of decontextualized data collected in a repository, or meta-information culled by the system? Can the system decide whether story content should be presented in the background or the foreground plane of consciousness? Who owns the meta-data, and how can we be sure that it will be used on our behalf? Finally, as the base of power shifts from individuals to the collective systemic network activity, how will we value human individuality and artistic expression?

Introduction

Alan Greenspan, Chairman of the United States Federal Reserve, recently commented that the US economy has been growing lighter (and the US is certainly not alone in this); Mr. Greenspan's reflection concerns the actual weight of goods per \$ of US exports. Is he not commenting on the obvious?

When we look at what has become the information superhighway (on which telephony plays a minor role), we cannot help but observe the rapid rate of growth of new servers and host machines appear on the Internet. By the time of the ConTel conference, the total number of servers and hosts will have surpassed 57 million. Business and social intercourse are being transformed by the new machine-mediated efficiencies of time, geography, inventory, and -- perhaps the most powerful -- community. As digital bits become valued as a commodity, global barriers break down and society-at-large gains access to knowledge, resources, and economic opportunity -- at a price yet to be determined.

The problem might be that we do not know how to value rampant innovation as represented by this sector. In 1996, Jeff Bezos realized a new paradigm for an atom-based business when he founded Amazon.com, an Internet-based bookseller. Anyone with access to a computer and modem can connect to Amazon.com on the World Wide Web, browse for the selections of their choice, immediately order them on-line, and pay electronically. The physical books are then shipped to the buyer by "snail mail." It is worth noting that, although Amazon.com does less than a billion dollars a year in business and has yet to turn a profit, its stock valuation currently exceeds \$30 billion. This astonishingly optimistic level of capitalization reflects how even savvy stockbrokers and investors are struggling to evaluate Internet innovations, even if it means abandoning the tried-and-true heuristics of conventional investment.

Amazon.com does not publish books; instead they serve as a brokering "middleman," drawing inventory from the real publishers' warehouses only when needed. Rather than maintaining many real-estate-based storefronts staffed with live sales clerks, Amazon.com runs their world-wide operation from a single electronic "storefront" serviced by an automated sales mechanism. They also buy from publishers in enormous volume. As a result of these savings, their book prices are substantially lower than those at their brick-and-mortar counterparts. Many bookstores are now going out of business, and many of them directly blame Amazon.com for their demise. Ironically, these business failures are the sort of thing that do show up in Mr. Greenspan's figures.

The consumer's experience of Amazon.com is both simple and profound. Using the standard electronic library-catalog functions such as "Search By Author, Title, Subject, or Keyword," the book-hunter can browse or search the enormous database-catalog in the comfort of her home or office without enduring the many hassles of physical shopping. However, Amazon.com truly shines in its embrace of "people power" -- the network of customers and their associated meta-data. Customers are invited to attach their own comments, reviews, and ratings (from one to five "stars") to a book's advertising page, providing a minimal communications "backchannel" which introduces the community of buyers to one another. The customer-provided ratings are culled to yield a single average "score," which is prominently displayed next to the image of the book's cover. Sales records are culled to offer an interesting new insight: "Customers who bought titles by [this

author] also bought titles by these authors;" followed by a clickable list. This web of associations -- built from encounters with its community of users -- is an interesting alternative to the usual shelf-based browsing in physical bookstores, which are organized by genre, and libraries, which are typically organized according to complex strictures such as the Dewey Decimal System.

Recently, Amazon.com has integrated its book-selling mechanism with other relevant marketing automatons. For example, if the customer is looking for a book about baseball, advertisements for baseball collectibles and memorabilia available at their gift shop and electronic "auction site" appear on the same page.

However, Amazon.com is not without sin. It suffers from an all-too-common malady: its Web pages are ugly, cluttered minefields of buttons, clickable texts, and tiny unmoving images. It embraces a "one book, one Web page" philosophy which makes prolonged use a disjointed and highly fragmented experience -- every transition is a "jump cut."

The shape-shifters

The shape-shifter, an archetype well-known to storytellers in every culture, is a clever trickster who can appear to the protagonist in many guises; "its very nature is to be shifting and unstable. Its appearance and characteristics change as soon as you examine it closely" [1]. In Celtic, Welsh, and Native American culture, it is the Raven; in Amariadian, Japanese, and some Slavic cultures, it is the Fox; in others, it is the Cat or the Unicorn or the Dolphin. All of these incarnations are attributed with the powers of initiation, protection, and prophesy; by serving as intermediaries between contrary realms (such as Life and Death), they practice magical healing through the "resolution of opposites."

Modern industrialized society now casts the computer in that mythic role. The "universal machine" becomes whatever we program it to be; it spans and intermediates all the diverse and far-flung realms within its networked reach. What is the true nature of this mythic being? How can people relate to it and play with it? For me, that metaphysical exploration has been centered in a remarkable facility -- the MIT Media Laboratory -- where for over a decade some 30 faculty members, senior research staff, and several generations of graduate students have engaged in building an academic and research program that blazes new trails into the digital future. The program is well-known for its focus on media arts and sciences and for its "demo or die" approach to learning. Making the demo brings dreams into the research lab. As the student constructs her project, she draws on the spectrum of ideas that are circulating within the community and combines them with her own vision: new ideas enter our dialog. If these ideas are powerful, they merge with, bend, and reframe the older ideas; if they prove practical, they enter the marketplace.

Over the past two decades, my Media Lab colleagues have advocated several key ideas which serve as useful models for the modern shape-shifter. Prominent among them are Marvin Minsky's "Society of Mind," Pattie Maes' agency of the human community, and Seymour Papert's ideas about constructionism and human learning.

In his book "Society of Mind" (1988), [2] Marvin Minsky stepped away from the traditional concepts of Artificial Intelligence -- pioneering efforts he had formerly

spearheaded -- and described several new hypothetical mechanisms which together explain how human beings might think and do. Minsky's structural approach to representation is often termed the "total AI" problem -- the ultimate goal is to build a working cybernetic brain comparable to that of a human. One key idea is that in order to develop what we think of as "common-sense" knowledge, the human brain must be composed of many sub-units, each of which is highly efficient in processing the relevant inputs and directing the appropriate output. That efficiency, Minsky suggests, requires massive parallelism: large numbers of processors of several different types, all working simultaneously. Central to this activity are the ways in which conflicts among the many parts are mediated and how information is represented, shared, and stored. Minsky devotes a large portion of the book to ideas of how we might understand language. The idea of the frame and the frame array remain important paradigms for how a computer might build up knowledge about the world.

While several researchers are exploring how to build systems which learn incrementally, the most promising common-sense system so far produced is Doug Lenat's Cyc. After 10 years and many thousands of entries by human analysts, this enormous (and still incomplete) representational base remains far smaller than that of the human mind. Notwithstanding, the problem of common-sense understanding will continue to be central to machine reasoning in the next millennium.

Pattie Maes's Ph.D. work focused on selection algorithms which allow systems -- or in her case, robots -- to learn. More recently, Maes has questioned how many people might provide a system with distributed intelligence. In 1995, Maes and her students built HOMR, an on-line music recommendation system based on "collaborative filtering" technology. This system began with zero information and grew based on the stated likes and dislikes of the people who used it. The recommendation system works by gathering a profile of the consumer's likes and dislikes, then offering recommendations based on the similarity between these preferences and those of other visitors to the site. Of course, in the beginning the system's knowledge was concentrated on certain areas of music, but over time -- as increasing numbers of people used the system -- its knowledge grew and diversified.

Maes' "Skinnerian box" approach -- the algorithmic manipulation of collected audience responses -- is radically different from Minsky's "build a brain" efforts, and is much simpler to implement. The important concept here is "people power:" the agency of the human community.

Seymour Papert, author of the Logo programming language for children and co-founder of MIT's Artificial Intelligence Lab (with Marvin Minsky), has spent most of his life questioning how children learn. In several recent books, Papert describes his observations of children learning through making. His theory of constructionism has made increasing inroads in design methodologies of computer software. Rather than designing the software to do everything, Papert suggests that the software merely sets up a system or framework for making.

Mitchell Resnick's work at the Media Lab has added a particular focus on distributed systems to Papert's ideas about constructionism and learning. In a recent paper, *Thinking Like A Tree (and Other Forms of Ecological Thinking)*, [3] he makes an analogy between distributed learning and the "walking tree" that can be found in the Costa Rica rain forests. The tree sends out exploratory roots a few feet above ground-level; these roots act as an evaluation system which searches out good soil

for the tree. If there is good soil on the north side of the tree, the roots on that side dig in deeply and hold firm. If the soil on the south side isn't as good, the roots on that side remain shallow and weak. As the roots on the north side become stronger and deeper, the whole tree gradually shifts toward the north, pulled in that direction by the strong roots.

Resnick's "walking tree" suggests a model for learning that resonates with what might be best called social constructionism. Social constructionism recognizes the learning that occurs through interpersonal exchange as well as through the personal construction of objects -- be it a LegoLogo creature, a story, or a song. Like the walking tree, Resnick's work proposes the autonomy of small programs which can be passed through many things to form a strength, or ideas which, once expressed, will spread throughout a whole community.

Interactive and personal... as if in conversation

At the moment of their creation, technological inventions capture a cultural "snapshot" of contemporary desires, philosophies, and paradigms. I recently helped a former student thread film through a 16mm movie projector -- a dinosaur of another age, when the movie palace offered the combined value of a social meeting space and a common immersion in the fantastic.

In 1987, I established a research group in "Interactive Cinema." When asked what that meant, I would explain: "Interactive Cinema reflects the longing of Cinema to become something new, something more complex and personal, as if in conversation with the audience." As a documentary filmmaker, I appreciate the complexity of real-life (and fictional) stories, for it is in complexity that I discover myself and am able to engage, as a feeling/thinking being, in social dialog.

Broadcast networks glory in the large-scale audience; in order to keep this audience tuned in, they value simplicity and commonly-held beliefs. Simplicity is the hallmark of the linear narrative, where each piece must resonate perfectly with the pieces that proceed it. I wanted to find out if we could capture or script a story with multiple viewpoints and use the computer to navigate the sequences in a comprehensive (and comprehensible) order. Technically, this idea required that we build an "editor in software" which could coherently access story chunks in a media database and seamlessly play out the results to an audience of one or many.

Today, with the increased bandwidth provided by the cable modem, video-on-demand is close to becoming a universal reality. The drive for bandwidth is amply illustrated by the purchase by AT&T of MediaOne, the second-largest cable operator in the US. Researchers and the marketplace are searching for "killer applications." Meanwhile, young IPTV "bandits," reminiscent of guerrilla television and pirate radio operators of the past, are creating their own programming and putting it out over the Internet with no appreciable overhead costs. RealNetworks claims that 300,000 hours of video and audio are accessed on the WWW everyday. The broadcast paradigm is rapidly giving way to "personalcast."

The addition of a low-bandwidth conversational back-channel will enable enhanced auctioneering and bartering as well as such activities as betting at the soccer match, personalized shopping, fan authoring, ballot-casting, and gossip. While a few applications will require the uploading of large amounts of data (such as still and

moving pictures), realistic developers will seek alternative solutions through the messaging architecture for the next several years.

As new two-way applications develop and more bandwidth is dedicated for use by the audience, many current questions become even more critical. How do you find what you want? How can you personalize it? What else can you do with it? And: Who owns the content?

The task of building search engines and indexes which can respond appropriately to the consumer's query is a half-solved problem. While systems such as Yahoo and AltaVista can search full text to find certain keywords, they cannot distinguish the beautiful and relevant from the ugly and useless. They cannot organize retrieved materials into a story experience or arrange them into a continuum running from the general to the specific. They cannot search for still images, audio, or video with specified content. They do not track audience use and satisfaction with specific resources and use that data to offer quality trails through the available material. Many people believe that these problems will not be solved in the immediate future, and alternative approaches -- such as the Mining Company's building of search indexes by human labor and judgment rather than automation -- are springing up to fill the gap.

Recently, portals have come into vogue. Using hierarchical structures, sites like I-Village, GeoCities, and Boston.com present us with a simple information world composed of "selected" Web sites and a special "chat room" or other messaging back-channel. As we travel around these virtual worlds, we become familiar with them and learn to navigate their metaphors as we converse with other visitors.

Unfortunately, the business plan for many of these sites is based on the same model as newspapers and network television (in the U.S.). However, rather than having a section for ads, banner ads appear throughout and in such numbers that businesses are already springing up that use agent technology to trade and place banner ads.

"Happenstance," a next-generation prototype for portal design, uses the metaphors of landscape and weather to arrange large amounts of Web resources into a navigable terrain. Instead of using static indexes to get at these materials, Brian Bradley's design uses dynamic behavioral settings to create a world "with a sense of itself," an ecological stage where information flows naturally through the stage mechanism, following its own purposes -- which are occasionally to find you.

Postcard sites provided a early benchmark for the combination of visual images with text messages as an e-mailable commodity. Pengkai Pan's "I-Views" updates and expands this concept by giving community members access to a shared "kit" of audiovisual resources. Community members can build alternative stories on-line using these raw materials and publish their creations to the community in order to stimulate comparison and dialog.

In time, media will increasingly migrate to small, portable -- even wearable -- devices. Whether the new medium appears in the form of a beaded amulet (as in Barbara Barry's "StoryBeads" project) or as intelligent, musically expressive footwear (as in Paul Nemirovsky's "Guide Shoes"), the selection and temporal sequencing of evocative images into stories will become the critical glue.

Conclusion

The first networked communications system, the telegraph, followed the course set by the developing railroad lines. Its hallmarks were geographic connectivity, speed, and dense non-intuitive encoding. Later, the telephone humanized electronic communications by preserving the speakers' voices in two-way conversations that could be conducted in real time, point-to-point, across great distances. The computer was developed in an age where the network was efficient but still, from a bandwidth perspective, in its infancy. Co-axial cable, fiber optics, standard protocols, compression schemes, and a wide variety of standardized encoding formats have made a satisfying range of data -- including text, pictures, video, and audio -- more amenable to network transmission.

Today, we are poised for the convergence of broadcast media (motion picture data & sound) with telephony, e-mail, and other point-to-point transmissions. What will the network become, what are the new efficiencies, who will own what data, who will pay for what product, where are the relevant areas of research? Evidence-to-date overwhelming suggests that community -- the effective structuring and restructuring of people-power -- will drive network expansion. This projection assumes that the system contains some knowledge of both the story and of the consumer. It goes without saying that the next big battle will be over privacy and ownership: who owns the data that the system collects about us?

Over time, displays will become untethered. Distributed devices and wireless components will change how we use media in our daily lives. As new mobile devices and smart cards come into being, they -- rather than a human user -- will connect with and transact business across the network.

The notions of interaction, complexity, personalization, and conversation are stepping-stones to the creation of systems which allow the participant-audience the power and freedom to experience a story from several different perspectives, provide the opportunity to study these perspectives in depth, and ultimately allow us to have and share opinions about the morality and veracity of story.

[1] Christopher Vogler, "The Writer's Journey: Mythic Structure for Storytellers and Screenwriters," *Michael Wiese Productions*, 1992, p75.

[2] Marvin Minsky, *Society of Mind*, Simon & Schuster, NY, 1985.

[3] M. Resnick, "Thinking Like A Tree (and Other Forms of Ecological Thinking)," to be published in *International Journal of Computers for Mathematical Learning*, Kluwer Academic Publishers, Norwell, MA, 1999.