

Paper Spaces: Visualizing the Future

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Introduction

This article is about paper spaces: room-sized maps, timelines, and charts used to develop, record and share ideas. When used in collaborative work, paper spaces support both focused, creative activity—the creation of a strategy roadmap, the outlines of a software development project, etc.—and informal social goals, like the development of a sense of community or common vision. These are essentially very large pieces of paper, but the term "paper spaces" (the term is borrowed from computer-aided design¹) highlights several things. First, we're used to thinking of things made of paper as physical objects whose qualities help shape the experience of reading, but it's useful to pay attention to their spatial and architectural qualities as well. Large visuals aren't just things: they're spaces that possess some of the qualities of desks or offices. IFTF workshops exploit their scale and physicality to promote social activity between workshop participants. In this case, the spatiality of paper is fairly self-evident; but many of our

¹ In computer-aided design, the term "paper spaces" refers to a particular view of a 3D model. In appropriating the term, I note the similarity between the designers' efforts to capture a useful representation of a complex digital object, and futurists' efforts to represent a group's vision of the future.

interactions with paper, books, and writing have a spatial quality. Scholars could gain much by analyzing print media using conceptual tools from architecture, design, and human-computer interaction, as well as literary theory and book history.²

Second, studying paper spaces help us understand the role that visualizations play in contemporary organizations. Historians have used studies of visual media and visual thinking to expand our understanding of science, technology, and other fields.³ The business world is supersaturated with visualizations—everything from advertisements, to PowerPoint presentations, to org charts, to brands, to workflows and flow charts—and studying those images could bring similar benefits. At the same time, it warns us against taking too passive or formal a view of visual tools in

² The rich possibilities of working at the intersections of the history of architecture or workspaces, the history of reading, and the history of media are suggested by Jonathan Rose, "Alternative Futures for Library History," *Libraries & Culture* 38:1 (Winter 2003), 50-60.

³ On visual representation in science, see Pang, "Visual Representation and Post-constructivist History of Science," *Historical Studies in the Physical and Biological Sciences* 27 (1997), 139-171; Jennifer Tucker, *Nature Exposed: Photography as Eyewitness in Victorian Science* (Baltimore: Johns Hopkins University Press, 2005); Renzo Baldasso, "The Role of Visual Representation in the Scientific Revolution: A Historiographic Inquiry," *Centaurus* 48:2 (2006), 69–88. On visualization in technology, see Kathryn Harrison, *On Line and on Paper* (MIT Press, 1999).

business, of treating them like paintings on a wall. In the way users interact with them-- they're annotated, extended, argued over, and played with-- they're more like Legos than landscapes. The process of creating maps, and the maps themselves, both reflect a set of attitudes about how to understand and prepare for the future, one that emphasizes user involvement, and the need for actors to develop and possess shared visions of the future. Finally, the term "paper spaces" highlights their hybrid, ephemeral quality. They work because they're simultaneously interactive media and workspace, but their lives are brief and easy to overlook: they are designed to support idea- and image-making, but leave little trace of themselves.

To illustrate how paper spaces work, this article will focus on their use in a specific context: in expert workshops and roadmapping exercises conducted at the Institute for the Future (IFTF), a Silicon Valley-based think-tank. The article begins with an overview of information spaces, and a brief look at IFTF's local culture and research practices. Next, it looks in detail at our expert workshops and facilitated exchanges, and describes how they're organized, what they aim to accomplish, and how they work. It then discusses how paper spaces support the co-creation of knowledge about the

future, and a sense of group solidarity. Finally, it argues that paper spaces are ubiquitous: most of our interactions with texts and other media have a spatial dimension that affects the ways we read, think, and create.

About IFTF

The Institute for the Future (IFTF) is a non-profit thin-tank founded in 1968, and located in Palo Alto, California. It conducts research on the future of health care, emerging technologies, and global trends. Its local culture is very visually intensive—it spends a great deal of time on information design and high-quality graphics—but several additional aspects of its history and practice explain its use of paper spaces.

Like many futures groups, its work doesn't revolve around making predictions; rather, it seeks to identify trends that will play a leading role in shaping the future, and help clients understand the implications of those trends. There is no single future to predict; trends may work together in many ways to produce many possible futures.

Because of its small size, the Institute often works with outside experts, ranging from scientists to early adopters, who help it map the future. The Institute also long emphasized group processes in its research and thinking.⁴ Among the Institute's co-founders were pioneers in the Delphi technique, a method for aggregating expert opinion. Today, the Institute prefers to bring together diverse groups of experts to explore a wide range of trends, and map how those trends may intersect to create different futures. This emphasis on collective thinking extends into authorship: not only do all its publications have several authors, but most are written in collaborative authoring environments like Google Docs, or draw on material in the Institute's wikis (a kind of open authoring environment).

Finally, the Institute spends a substantial amount of time conducting workshops with organizations, ranging from corporations to government agencies to non-profits. The Institute's own researchers aren't industry or regional experts, so the purpose of these events is twofold: to communicate

⁴ Theodore Jay Gordon, "The Methods of Futures Research," *Annals of the American Academy of Political and Social Science* (special issue on The Future: Trends into the Twenty-First Century) 522 (1992), 25-35 is still a good overview of futures methods.

the Institute's key research findings, and work with those organizations to understand those findings mean for them—i.e., to understand how large-scale trends might play out on a local scale, what strategic choices organizations will confront, and how organizations can plan to deal with its possible futures.

The Institute's reliance on expert workshops, the collaborative character of its internal work, and its workshops with clients, all contribute to its use of paper spaces. The next two sections will look in greater detail at how paper spaces help shape expert workshops and client workshops.

Workshops as Paper Spaces

Expert workshops generally bring together between ten and fifteen non-IFTF staff, ranging from academic scientists and engineers, to venture capitalists and entrepreneurs, to extreme athletes and online gamers, to think together about the future. The fundamental challenge with all expert workshops is to create a social situation in which people are encouraged to share their

expertise, but also think beyond their normal horizons. To do this, one needs a space that focuses concentration, and serves as a mirror of the collective work and thinking.

The process

IFTF workshops can vary greatly in the details, but they share a common structure. After participants have introduced themselves, they usually start with a brainstorming session, in which participants are asked to name the factors that they see affecting their business (or scientific discipline, or organization, etc.) in the next five to ten years.⁵ Experts are given a few minutes to write down those factors on cards. The facilitator then asks one participant to "play a card"—i.e., share a trend—and briefly explain its importance; as they do so, the facilitator puts the card up on a large sheet of paper facing the participants. If other experts have written about similar factors, those are placed on the board with the first card. A second person

⁵ Of course, every session is different; what follows is an idealized meeting, but one that practitioners should recognize as a representation of their practice. For more general overviews of facilitation, see Jeff Conklin, *Dialogue Mapping: Building Shared Understanding of Wicked Problems* (Wiley, 2005).

then adds a new trend ("plays a new card"), and similar cards are gathered and added. The process is repeated until all the cards are played.

By the end of the session, the board may have 75-100 cards on it, and look fairly chaotic. Experts are thus asked to give the board (and, though the board, their own ideas) some order. There are several ways to do this. The group might organize the cards into thematic clusters, to see which factors or trends are associated, or place them along a timeline, to clarify when different forces might come into play. Once the cards are organized, experts vote on the factors, identifying which are most important, marginal, or wildcards—events with a low probability but high impact. This map then serves as a foundation for the rest of the day.

In the afternoon, the group is guided through exercises focusing on those areas it previously identified as most important. For example, they may divide into several small groups, and each group creates a scenario that examines different potential futures made by combinations (or cross-

impacts) of these forces.⁶ At the end of this exercise, the participants reassemble, and each group briefly describes their work to the collective. If time remains, the entire group might brainstorm ideas for a strategy that would allow them to respond to any of the scenarios.

How Paper Spaces Work

How do you design a space that supports this process? By combining media, room, facilitator, and process into what Bonnie Nardi and Vicky O'Day call an information ecology.⁷ The key components of this ecology are book-sized Post-It notes cards; large sheets of paper (often 4' x 8' or longer); and rooms arranged in to allow facilitators and participants to move and interact both with the media and each other. These information technologies share several features: they're easy to use, highly flexible, shareable with groups, and can be manipulated by several people simultaneously. To understand how this

⁶ The classic work on scenarios remains Peter Schwartz, *The Art of Scenarios*. On cross-impact analysis, see Theodore Jay Gordon, "Cross-Impact Method," in Jerome C. Glenn (ed.), *Futures Research Methodology* (Washington, D.C.: Millennium Project Of American Council for the United Nations University, 1999).

⁷ Bonnie A. Nardi and Vicki L. O'Day, *Information Ecologies: Using Technology with Heart* (Cambridge: MIT Press, 1999), esp. chapter 4.

ecology works, and what makes the different components so important, let's start with the smallest pieces of this ecology, and work our way up.

When participants are asked to brainstorm ideas, they're given large Post-Its (usually 5" x 7") to write their ideas down on. These cards are inexpensive, easy to use, and easy to edit. Participants can afford to be profligate with them—and, one hopes, generous with their ideas. It makes it easy to toss out their first couple tentative experiments once the really good ideas start to flow. Cards are also easy to handle. They can be put up on a board quickly, which keeps a meeting (and ideas) flowing. Facilitators also don't have to worry about choosing between similar cards: stacking them together provides a quick visual indicator that an idea is popular. Later, when making chronologies or idea maps, cards can be moved around easily. As they migrate from one point on a timeline to another, or from one cluster of ideas to another, they acquire new neighbors and context, which subtly changes their meanings and importance. In short, cards are cheap, flexible, and eternally tentative—but in some very useful ways.⁸

⁸ The material qualities of information devices can have a strong effect on the ways they're used, and the moral economies that develop around them. For example, the *Drosophila* fruit fly is cheap to feed, travels well, and breeds very quickly—qualities that

Cards also make ideas shareable, social things, both through the opportunities they create and the limits they impose. Processes that alternate between private and public modes of thinking, the Institute believes, encourage greater creativity among participants. Participants are encouraged to write in very large letters, to make them legible at a distance: this makes ideas shareable. This also prevents participants from writing more than a few words on a card. Cards cannot stand completely on their own: they're signs, not signifiers. Unless the few words on them are a familiar term of art or technical phrase that the group already understands, contributors have to explain to the group what their cards mean. Playing cards, in other words, starts a conversation—about that card, about what it means, and how it fits in a larger scheme of meaning.

A card isn't absolutely fixed: its meaning, importance, and connection to other ideas can evolve in the course of a day. That evolution takes place in the heart of the paper space, the large sheets of paper and templates that

made it an exceptionally valuable subject for early geneticists: see Robert Kohler, *Lords of the Fly: Drosophila Genetics and the Experimental Life* (Chicago: University of Chicago Press, 1994), esp. chaps. 4 and 5.

groups work with. These sheets of paper are generally four feet tall, and between eight and sixteen twelve feet long, depending on the space available. Large papers like these let individuals hold, examine, and process lots of ideas. They let members of a group work together to build a common vision of the future. And they support the development of complex, multilayered scenarios and threads.

Let's look first at how individuals relate to large sheets of paper. Most people are accustomed to thinking of paper as something we hold, read, then put down or discard. But a wall-sized document reverses the normal relationship between users and information: it makes you stop and think. My sense—which has a little bit of empirical backing from work in the psychology of perception—is that because these large sheets can take up more a participant's visual field, they can command more attention for longer periods.

Large sheets of paper provide room for everything from big ideas to small details. It lets users store and see a lot of information, and see it all at once. In this respect, large sheets of paper have some of the virtues of the zooming

browser.⁹ Personal notes only give note-takers enough room to record key points, and it's impossible to pack as much information in a handout as one can get on a wall. This reflects the fact that under normal circumstances, paying attention to the "big picture" and detail is difficult: a normal sheet of paper doesn't provide enough space for both. But in paper spaces, the big picture—the structures or abstractions that give context and meaning to the details—doesn't replace the details; it's built up from them. Abstract ideas emerge by literally moving the details from one place to another, embedding them in new contexts or creating new contexts around them.

Large sheets of paper let everyone in a group see and contribute to a conversation at once. Participants have space to build on each other's ideas. An entire group can work at once on large paper. Groups can reorganize or annotate the cards and clusters at the same time—something that would be impossible with regular pieces of paper. An eight-foot long sheet can comfortably accommodate several people at once, who may work together to arrange stickies in new clusters. This also gives people an excuse to get up

⁹ On zooming browsers, see Jef Raskin, *The Humane Interface: New Directions for Designing Interactive Systems* (Reading, MA: Addison-Wesley, 2000), esp. chap. 6.

and walk around, which keeps participants more energetic and engaged, and lets people see where others (literally) stand on an issue.

Paper spaces, by allowing people to move around, interact with maps, move ideas around, navigate around or negotiate with others, etc., turns thinking about the future into a kind of "embodied learning"-- or, as embodied as the future can be. Putting an idea on a map may look like a simple physical act, but it marks a person's contribution to a conversation; it locates that contribution in an emerging picture of the future; and it situates that contribution alongside (or against) others' contributions. It also allows practitioners to more finely develop their skills than they would through procedural learning alone.¹⁰ I would also draw a gentle parallel to multimodal forms of learning used in dysgraphia and dyslexia education: they often use a combination of "air writing" (forming the letters with large

¹⁰ My thinking about embodied learning is influenced by Diana L. Gustafson, "Embodied Learning: The Body as an Epistemological Site," in Maralee Mayberry and Ellen Cronan Rose (eds.), *Meeting the Challenge: Innovative Feminist Pedagogies in Action* (New York: Routledge, 1999), 249-274; Jim Horn & Denise Wilburn, "The Embodiment of Learning," *Educational Philosophy and Theory* 37:5 (2005), 745-760; Margaret Somerville and Anne Lloyd, "Codified knowledge and embodied learning: the problem of safety training," *Studies in Continuing Education* 28:3 (November 2006), 279 - 289.

motions of the arm) and speaking the letters to help fix the association between letter and phoneme in students' minds.¹¹

But just as systems like del.icio.us are innovative because they make private knowledge public and shareable, workshops, by making it a group activity, turn this activity into a shared experience in constructing a shared vision of the future. This is a type of embodied learning that goes beyond private contemplation of a text, and doesn't stop at creating knowledge by moving ideas around; it simultaneously embodies knowledge for an entire group.

What a group learns is a bit like what a sports team learns after practice: not just formal rules for doing things, but knowledge of how to things together.

By providing room for attendees to write, react, and interact with each other, large sheets of paper reach across the gap between media and workspace.

Facilitators can also design the physical space to blur this boundary.¹² The basic layout for a paper space is normally a U-shaped or curved seating,

¹¹ Alan S. Brown, "A Review of Recent Research on Spelling," *Educational Psychology Review* 2:4 (1990), 365-397.

facing a large sheet of paper. This has several virtues. Normal meeting rooms have fairly clear hierarchies: powerful people sit at the head of the table. A U-shaped or curved table, in contrast, helps decouple seating and social rank, and makes it harder for any individual to become the room's center of attention. In contrast to traditional lecture halls or classrooms, which direct students' attentions toward teachers and away from each other, a U-shaped arrangement gives all the participants clear views of each other, the facilitator, and the main board.

The ideal room also has several bare walls or picture windows, on which one can easily put up maps, papers, and other materials. Thus, after an exercise is concluded, a facilitator moves the final product to a side wall; this makes space for the next exercise, but keeps the previous work in view, available for reference. As the day progresses, the paper space fills with roadmaps, brainstorming, small group scenarios, and other materials: a prolific group will

¹² For those outside the business world, it may seem remarkable, but facilitation is a profession. Facilitators are generally valued for their neutrality (particularly when hired to run meetings dealing with especially complex or contentious subjects), their ability to organize and manage meetings to yield results, and their craft skills (e.g., their ability to read a room, to draw out reticent participants, rein in overbearing ones, etc.). See Michael Wilkinson, *The Secrets of Facilitation: The S.M.A.R.T. Guide to Getting Results With Groups* (Jossey-Bass, 2004); Suzanne Ghais, *Extreme Facilitation: Guiding Groups Through Controversy and Complexity* (Jossey-Bass, 2005).

eventually be surrounded by their own work. For a group dealing with a number of topics, in a workshop lasting a couple days, the paper space serves as a memory palace.¹³

A paper space thus demonstrates several of the features that Nancy Van Note Chism recently identified as essential to contemporary creative spaces: flexibility, comfort, sensory stimulation, decenteredness, and technology support.¹⁴ But paper spaces don't just keep groups focused or simulated: a paper space is a tangible expression of the work a group has done, and the progress they've made in describing their common future. It's something that every participant can refer to later, as well as feel some ownership over. This is especially valuable for groups that haven't worked together before, and don't already have a strong sense of common purpose.

This highlights another important function of paper spaces: they help create a shared sense of identity among the participants. As sociologists of science

¹³ On memory palaces, see Frances Yates, *The Art of Memory*; Jonathan Spence, *The Memory Palace of Matteo Ricci*.

¹⁴ Nancy Van Note Chism, "Challenging Traditional Assumptions and Rethinking Learning Spaces," in Diana G. Oblinger, ed., *Learning Spaces* (EDUCAUSE, 2006), 26-27

might put it, solutions to the problems of creativity are solutions to the problem of collective identity; the knowledge and its social context—the group that made, can interpret it, and put it into action—are all co-productions.

Paper as Space

IFTF workshops are unusual examples of paper spaces, in that it's easy to see how billboard-sized sheets of paper are spaces. But that's really the only way they're unusual. Many of our interactions with paper—or with printed objects more generally—have a spatial dimension that often goes overlooked, but which could be fruitfully explored.

First, the act of reading has an important, but easily-overlooked spatial dimension.¹⁵ First, in various ways readers behave as if books themselves

¹⁵ On the history of reading, see Alberto Manguel, *A History of Reading* (New York: Penguin, 1996); Steven Roger Fischer, *A History of Reading* (Reaktion: 2003); Guglielmo Cavallo, Roger Chartier, Lydia G. Cochrane, eds., *A History of Reading in the West* (Amherst: University of Massachusetts Press, 2003). On the place of the history of reading in the recent historiography of ideas see Anthony Grafton, "The History of Ideas:

are spaces. Readers' relationships with printed texts are generally defined by the simple fact that they're smaller than they are, and are brought within the reader's own personal space. Readers pick up magazines or curl up with good books. One of the first things many people do with newspapers or maps is fold them into something easier to hold. Even when spreading books out on a table or desk, reading materials are rarely further than arm's length: any further and they become illegible. Readers also treat books and manuscripts as spaces in which they can construct meaning: witness the practice of marginal annotation, which is virtually as old as the book itself.¹⁶ Though for others, reading is more a martial art: Charles Darwin, for example, "had 'no respect' for books but 'merely considered them as tools to be worked on,' reading them to pieces or tearing them in half as necessary."¹⁷

Precept and Practice, 1950–2000 and Beyond," *Journal of the History of Ideas* (January 2006), 1-32.

¹⁶ As David Livingstone puts it, "spaces of reading are always... sites of textual hybridity:" see Livingstone, "Science, Text and Space: Thoughts on the Geography of Reading," *Transactions of the Institute of British Geographers* 30 (2005), 391–401, quote on 393.

¹⁷ Jonathan R. Topham, "A View from the Industrial Age," *Isis* 95 (2004), 431–442, quote on 433.

All this reminds us of the simple fact that reading has a physical and physiological dimension, and thus a spatial one. This is easy to overlook today, when we think of reading mainly as a disembodied interaction with "content" rather than things, but this perspective is perhaps uniquely modern: as Ann Blair and others remind us, Renaissance readers "were distinctly aware of reading as a physical activity," and saw reading as a visceral, emotional activity that involved—and could even threaten—mind, body and soul.¹⁸

Not only does reading take place *in* space, reading *creates* space. N. Katherine Hayles argues that new media encourage readers to be cyborgs; I would argue, *pace* Andy Clark and Paul Saenger, that all engagements with media—and especially the compelling experience of losing one's self in a book—have the quality of encouraging readers to meld with media and content.¹⁹ As Rory Ewins puts it, "reading takes us into an imaginative state,

¹⁸ Ann Blair, "An Early Modernist's Perspective," *Isis* 95 (2004): 420-430, quote on 420; see also Michael Schoenfeldt, "Reading Bodies," in Kevin Sharpe and Steven Zwicker (eds.), *Reading, Society and Politics in Early Modern England* (Cambridge: Cambridge University Press, 2004), 215-243.

¹⁹ N. Katherine Hayles, "Print Is Flat, Code Is Deep: The Importance of Media-Specific Analysis," *Poetics Today* 25:1 (Spring 2004), 67-90, esp. 85-87.

a state shaped by the author of the words we read, and by ourselves as readers."²⁰ In fact, reading is one of the best examples of our ability to merge with technologies—to become cyborgs, as Andy Clark would argue. Experimental psychologists have shown that our sense of our body's dimensions is surprisingly plastic: we can easily be tricked into feeling like our nose is five feet long, for example.²¹

We think of reading as creating a private space in part, I would argue, because our engagement with texts has this cyborg-like quality. Recent neuroscientific research on reading has emphasized the degree to which it succeeds because of the plasticity of the brain, and the mutual influence brains and books have on each other. Stanislas Dehaene argued that "learning to read, and other forms of cultural learning, are only possible if... [the brain's] built-in flexibility can be used to divert brain circuits from their previous uses. The brain is predisposed to develop only in certain ways. In effect, we are able to learn to read because the primate visual system

²⁰ Rory Ewing, "You Are Where? Building a Research Presence in Cyberspace," paper presented at the Moray House School of Education, University of Edinburgh, 20 November 2003, online at <http://speedysnail.com/2003/youarewhere/>.

²¹ Andy Clark, *Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence* (Oxford: Oxford University Press, 2003).

evolved to do a different job that was sufficiently similar to allow it to be "recycled" into a reading machine."²² More recently, Maryanne Wolf's *Proust and the Squid* argues that brains and books have a symbiotic relationship: the "brain's design made reading possible, and reading's design changed the brain in multiple, critical, still evolving ways."²³

Of course, certain kinds of reading are important enough to require their own spaces. The growth of the home office in recent years has been notable only because it has spread from academics and professional writers to knowledge and service workers more generally.²⁴ Children who have desks in their rooms are more likely to get better grades than those who do not.

Scholars have recently begun to explore the implications of the spatiality of reading. Historians of science have in the last decades moved from

²² Stanislas Dehaene, "Natural Born Readers," *New Scientist* (July 5, 2003), 30-33.

²³ Maryanne Wolf, *Proust and the Squid: The Story and Science of the Reading Brain* (New York: Harper, 2007), quoted in Vikram Johri, "Proust and the Squid by Maryanne Wolf," *California Literary Review* (26 September 2007).

²⁴ On the history of efforts to bring knowledge spaces into the home, see Gadi Algazi, "Scholars in Households: Refiguring the Learned Habitus, 1480–1550," *Science in Context* 16:1 (2003), 9–42.

analyzing the internal content of scientific texts, to reconstructing scientific practices, to now making sense of reading practices.²⁵ David Livingstone advocates paying attention to the "geography of reading," the physical locations in which reading (and discussion and debate) happens, and the cultural and personal landscapes in which readers encounter texts. "Where scientific texts are read," he argues, "has an important bearing on how they are read."²⁶ As Lorraine Daston notes, scholars are just beginning to explore how "material form (octavo versus folio, luxurious vellum-bound volume versus cheap paper edition), physical setting (library, field, whizzing train), and bodily habitus (seated or standing, in concentrated silence or in the midst of laboratory hubbub) affect the assimilation of content" and "cognitive practices: economies of attention, arts of memory, the solidification and erosion of belief."²⁷ Consider two very different examples of how media affect cognitive practices: the impact of the introduction of

²⁵ Lorraine Daston, "Taking Note(s)," *Isis* 95:3 (2004), 443–448.

²⁶ David Livingstone, "Science, Text and Space: Thoughts on the Geography of Reading," *Transactions of the Institute of British Geographers* 30 (2005), 391–401, quote on 391. See also Jonathan R. Topham, "Beyond the 'Common Context': The Production and Reading of the Bridgewater Treatises," *Isis* 89 (1998), 233–262,

²⁷ Lorraine Daston, "Taking Note(s)," *Isis* 95 (2004): 4443–448, quote on 443.

paper on medieval scholarship, and the introduction of the Blackberry on modern reading practices.

Until the 1200s, many monastic authors dictated to secretaries who wrote in shorthand on wax tablets, summarizing rather than transcribing, and then recreated documents. As a consequence, Paul Saenger argues, "composition was... clearly a group activity... and a very prolific writer might well publish works which he had never seen or heard in final written or edited form." Composition involved less consultation of primary texts and fewer revisions, and the final works were "more repetitive and less tightly reasoned than those composed in later centuries in written form, when authors consulted reference works and exercised direct visual control over their work." Finally, wax tablets "limited the scope of written composition," so "glosses were phrase-by-phrase explications of the text without cross-references or discussions of problems pertaining to the work as a whole." Albertus Magnus and Thomas Aquinas, in contrast, were able to work directly on quires and parchment, and so "could revise and rearrange their texts while composing them." The greater availability of parchment and paper allowed "13th-century scholastic writers to prepare texts rich in cross-

references," creating the complex body of philosophical work remembered as Scholasticism.²⁸

In contrast, reading on small screens makes it harder to follow complex arguments. Business author John Hagel complains that essays are hard to interpret when read as "Berrybites," in Blackberry screen-sized increments.²⁹

Finally, efforts to create spaces to support learning, knowledge work, and collaboration—more permanent versions of paper spaces—are not new, though the media that help make those spaces work have not been much studied, however. Historians have documented how the spread of the blackboard in the early 19th century changed education, and was connected to the growth of more professional and systematic forms of pedagogy, and the evolution of now-archetypal school designs.³⁰ Cultural historians have

²⁸ Paul Saenger, "Silent Reading: Its Impact on Late Medieval Script and Society," *Viator: Medieval and Renaissance Studies* 13 (1982), 367-414, quotes on 382, 385, 386.

²⁹ John Hagel, "Beware 'Berrybite' Blowback," *Edge Perspectives with John Hagel* (25 July 2005), online at http://edgeperspectives.typepad.com/edge_perspectives/2005/07/beware_berrybit.html.

³⁰ On chalkboards and blackboards, see Steven D. Krause, "'Among the Greatest Benefactors of Mankind': What the Success of Chalkboards Tells Us about the Future of Computers in the Classroom," *Journal of the Midwest Modern Language Association*

also documented 19th-century visual spectacles like dioramas and lantern slides, but these were essentially one-way, broadcast media.³¹ Information spaces also evolved in the nineteenth-century stock exchange, exemplified by the large boards that broadcast information about stock trades and prices to traders on the floor. (The New York Stock Exchange is still called "the Big Board.")³² Blackboards and big boards are examples of information spaces that are permanent, but others are more ephemeral and project-oriented. Other well-known examples include the maps used in military headquarters or emergency field stations, which are used to plan actions, process information about goings-on in the field, and formulate responses.

33:2 (Spring, 2000), 6-16; Stephen J. Ressler, "Whither the Chalkboard? Case for a Low-Tech Tool in a High-Tech World," *Journal of Professional Issues in Engineering Education and Practice* 130:2 (April 2004), 71-73; Mary Ann Stankiewicz, "Between Technology and Literacy," *International Journal of Art & Design Education* 22: 3 (2003), 316-324. On the history of instructional technology since the blackboard, see Robert A. Reser, "A History of Instructional Design and Technology: Part 1: A History of Instructional Media," *Educational Technology Research and Development* 49:1 (2001), 53-64; John Swift, "Visual Memory Training: A Brief History and Postscript," *Art Education* 30:8 (Dec., 1977), 24-27.

³¹ Richard Altick and others who've looked at Victorian lectures, popular media, etc.

³² R Sobel, *The Big Board: A History of the New York Stock Market* (New York: Free Press, 1965).

All these spaces are characterized by substantial information flows; stock exchanges and military headquarters also try to coordinate activities that have a great deal of volatility, uncertainty, complexity, and ambiguity.

Thinking about the future likewise is an exercise in trying to understand the "VUCA world," as it's sometimes called; so it's no surprise that much of the Institute for the Future's work takes place in information spaces.³³

Finally, it's worth noting that IFTF workshops aren't unique in serving as venues for producing both knowledge and community; nor are they the only ones that use paper spaces to achieve these two ends. The analog circuit group design review is another example of a text-centered social knowledge exchange that illustrates how large-scale documents encourage communication and sharing of craft knowledge. The field "is highly collaborative -- passed down from generation to generation, like artisans learning from master tradesmen." The group design review is one ritual for sharing that information. As one journalist described it,

³³ On the "VUCA world" as an organizing metaphor for both modern business and futures, see Bob Johanson, *Get There Early: Sensing the Future to Compete in the Present* (Berrett-Koehler, 2007).

more than a dozen semiconductor engineers stood around a large conference table, scrutinizing a massive sheet of paper with the layout of a chip being developed for LCD TVs -- a bit like artists looking at a canvas.

The brightly colored design showing circuitry grids and their connections took up the entire table. As they walked around it, some made notations on the paper with black markers. The discussion was animated, with ideas, suggestions and debates going back and forth.... The interaction between the more experienced and the less experienced is key in developing analog design skills. "That room is where the real magic happens," [design manager Bryan] Legates said.³⁴

The large format of the design meant that several participants could study and interact with the design simultaneously, but also easily converse with each other: the design drawing serves both as a medium for capturing ideas, and a medium for stimulating discussion.

Conclusion

³⁴ Therese Poletti, "Immune from offshoring: Digital circuits are on or off; 'analog deals with the gray'," *San Jose Mercury News* (27 December 2005), <http://www.siliconvalley.com/mld/siliconvalley/13493561.htm>. On design processes and the role media play in them, see Mark Perry and Duncan Sanderson, "Coordinating joint design work: the role of communication and artefacts," *Design Studies* 19:3 (July 1998), 273-288.

My purpose in this paper has been to examine the role that facilitation and meeting technologies play in organizing meetings and producing group knowledge. Large sheets of paper and sticky notes, the core of IFTF facilitation practices, may seem hopelessly low-tech, but they have several advantages. They're easy to use. Paper doesn't fail unexpectedly. Everyone knows how to write. They're also excellent social technologies. They serve as a group memory, make it easier for people to collaborate on tasks, and develop a common vision of the future. Finally, they allow us to turn meeting rooms into collaborative microcosms, surrounding participants with their own ideas.

There are several larger lessons here. Information technologies have a physical and ergonomic dimension defined by the scale of their relationship to the body and group: a large board is a collaborative space, just as a small screen is a private one. Meetings and meeting spaces are themselves information technologies. Further, the success of paper spaces highlights how essential social interactions are to creative work. We are accustomed to thinking of communications and information technologies as unrivaled enablers of new forms of collaboration and group work. The Internet, we are

told, allows groups around the world to work together in real time, access common materials and documents, and even improves the flow of ideas by removing the normal distractions of status and hierarchy. In reality, however, too many information technologies have succeeded only by sacrificing social bonds, weakening real opportunities for collaboration and negotiation. It's an irony that technologies that let people communicate very effectively across thousands of miles disrupt communication within a room.³⁵

Finally, this article suggests how scholars and practitioners working in several apparently disparate fields can learn from each other. For example, the remarkably rich studies produced by historians of the book offer many lessons for professional facilitators and managers struggling to develop creative, collaborative spaces. Conversely, historians can broaden their understandings of media and knowledge work by looking at the struggles to

³⁵ Attempts to develop computer-mediated group facilitation have been at best partly successful. On the challenges, see S. Pak Yoong and R. Brent Gallupe, "Coherence in face-to-face electronic meetings: A hidden factor in facilitation success," *Group Facilitation* 4 (Spring 2002), 11-20.

create knowledge and order in today's rapidly-changing workplace.³⁶ Ideas from STS have been taken up and used by scientists and engineers working in ergonomics and human-computer interaction. Likewise, I believe, HCI scholarship could enrich STS, by teaching us how to think more deeply about the ways people and technologies interact, how bodies and devices merge, and how design and interface choices can affect the experience of using technologies. Paper spaces show how terms like "sites of production" or "spaces for negotiation," which are regularly used when talking about media, are more than just metaphors: in some cases, media really are sites and spaces.

My colleagues and I at the Institute for the Future are regularly asked, "If you're futurists, why do you still use paper in your meetings?" After all, for decades futurists have been talking about the death of the book, the obsolescence of print media, and the paperless office. The concept of paper spaces helps us answer the question, by alerting us to the ergonomics and affordances of paper spaces, their flexibility, their ability to generate formal

³⁶ This follows arguments regarding the utility of applying historical knowledge to analysis of new media and publishing practices: see Pang, "Work of the Encyclopedia" and "Hypertext, the Next Generation".

group knowledge about the future, and their utility in generating an informal sense of group solidarity around that knowledge and the process of making it. Paper isn't just a medium for recording content. Paper is where the action is.