

Online Editing, Mark-Up Models, and the Workplace Lives of Editors and Writers

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Abstract—Although editors make extensive use of the computer in their work, most editors still mark changes on paper using traditional editing symbols. There are, however, compelling reasons for editors to begin marking copy on the computer. In this article we consider online editing from the perspective both of editors and their employers. We then focus on one aspect of online editing: the mark-up models embodied in various editing tools. We demonstrate that the different mark-up models and their particular implementations have major implications for the editing process, including the quality of edited material and the worklife satisfaction of editors and writers. We conclude by recommending that the technical communication community exert its influence on software developers and corporate technology planners to encourage the development and adoption of online editing tools that will be congenial to editors.

for this article. We review the role of the editor in workplace writing and the status of both general computer use and online editing. Then we consider how organizations and editors view online editing, concluding that online editing will gradually take hold in the workplace. If this is so, the nature of the online editing tools that will be used becomes important both for editors and the writers who work with them. Therefore, we show some of the ways that the fundamental operation and features of these tools can affect both the quality of edited material and the workplace lives of editors and writers, and we suggest that the technical communication community should take an active role in determining the character of the tools that will be developed and adopted.

SIGNIFICANT writing projects in the workplace are generally carried out by a group of people working together [1]. Typically, a team of writers will contribute components of the eventual whole. In the process, they are likely to informally edit each other's contributions. The draft may also undergo review by higher-level subject-matter experts, whose focus will be technical accuracy and appropriateness for the intended audience [2], [3]. Very often, a professional editor will apply his or her communication expertise to the document.

Today's computer technology can provide impressive support for many group-writing activities. Writers can easily share fully formatted drafts over computer networks, either within their building or across continents. The computer can also serve as a project librarian, keeping track of who has (and has had) each section of the document and controlling who can change certain components. The review process is also reasonably well supported: features such as hidden text, pop-up notes, and special annotation footnotes allow reviewers to comment on the author's draft. Soon it will be commonplace for reviewers to embed audio and even video clips anywhere in the author's document where they want to comment.

There is, however, one part of the review process in which computer support is considerably less effective: editing. Consequently, although almost every stage in the preparation of typical workplace documents is digital, most editors, as we shall see, continue to work with paper and pencil. This situation and the prospects for change are the starting point

THE EDITOR'S ROLE IN CREATING DOCUMENTS

Editors serve a variety of roles in preparing documents, including helping to plan the document, coordinating the work of writers, and supervising production; however, their fundamental and defining role is to improve the document by marking changes in the draft they receive from the author [4], [5]. These changes include making large-scale organizational changes and rewriting whole passages, but editors—unlike reviewers—are responsible for style, grammar, usage, and mechanics, and so they mark a large number of small-grained changes. For this reason, a key characteristic of any online editing tool is how the mark-up process is handled. As we shall see, there are major challenges in creating software that can effectively deal with large numbers of small-grained changes.

In addition to marking changes, editors—much like reviewers—must write messages to the author. These may be queries for more information, justifications of what they have done, or proposals setting forth how the editor would like to deal with some difficulty in the document. In most cases, the author has ultimate responsibility for and intellectual "ownership" of the document. Authors therefore reject some changes and make new changes. Also, they will send their own messages back to the editor, messages that the editor may reply to. Editing, then, entails a dialog between editor and author, a dialog that may continue through several cycles. After the editor-author dialog, the editor (or the editor's assistant) will incorporate the agreed-upon changes into the document in preparation for final formatting and printing. Or, the author or the person doing the production work will incorporate the changes.

Authorial review can be a difficult and troublesome part of the editor's job. Many editors establish excellent relationships with authors; on the other hand, there are inherent tensions

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stemming from one person's making corrections in the work of another. Indeed, this relationship is often characterized by suspicion, disrespect, and antagonism. From the author's point of view, the sins of editors include making unnecessary and arbitrary changes, introducing errors and unintended meanings, and not adequately explaining why changes were made [4, pp. 338-345], [6, pp. 47-64]. Editors, of course, do not defend introducing errors or changing the meaning of the document without querying, but they expect to be recognized as the project's communication experts [7]. Tarutz's book on technical editing provides numerous glimpses of writers' frequent suspicion of and antagonism toward editors. She notes, for example, that most writers "approach editors cautiously and skeptically," and "have a lingering bad taste from previous edits" [6, p. 54]. She portrays an editor who asks, "Why do writers hate me?" [6, p. 47].

In Duffy's survey of 28 expert editors, the ability to establish a collaborative relationship with the author ranks as number 6 in a list of the 39 most important editorial skills—more important than the ability to find and correct errors of grammar, syntax, and punctuation [8]. Speck's bibliography of the literature on professional editing [9] shows that relations with authors is a constant theme. Because relations with authors is an important and problematic aspect of the editor's work, an important consideration in the design or selection of an online editing tool is how the tool is apt to affect editor/author relationships.

HOW EDITORS USE COMPUTERS

Most editors make some use of the computer in their work. A survey of "writer-editors" by Rude and Smith [10] showed 63% of the respondents using the computer as part of their editing work. Duffy's survey showed 78% of his expert editors using the computer. The computer tasks performed are varied, including formatting, checking spelling and grammar, performing search and replace operations, generating an index, and sending and receiving drafts. Most likely the amount of computer use by editors will continue to increase.

Editors work differently in different settings and have individual habits and preferences; therefore, there are innumerable specific scenarios for how editing is carried out. Following is one scenario that entails significant use of the computer. It is not, however, complete online editing because the editor is still marking changes on paper. In this scenario, the editor

- 1) Receives a draft from the author over a computer network or on disk.
- 2) Prints a copy and skims or reads to become familiar with the material. The editor may take some notes at this stage.
- 3) Performs a computerized spelling check (and perhaps a grammar check) and makes changes in the online version. (Here we assume that the editor has been authorized to make minor changes "silently"—without marking them for the author to review.)
- 4) Makes any necessary major organizational changes online and writes a message to the author explaining these changes. It is easier to re-arrange large sections of an

online document than to mark these changes on a print copy. Also, the author is better able to visualize the re-structuring when he or she sees the changes executed.

- 5) Prints a copy of the document and makes one or more major editing passes, marking the changes with a pencil on the print copy. This is the heart of the editing process.
- 6) Returns the paper copy to the author and negotiates the final changes.
- 7) Keyboards the changes into the computer in preparation for final formatting and bookbuilding or gives the paper copy to a formatting/production person, who will keyboard the changes while doing the production work.

This scenario shows that an editor can use computer technology while marking changes on paper. This fact, no doubt, helps explain the loyalty of many editors to the red pencil. On the other hand, the use of the pencil, the only non-digital part of the entire publications process, is a return to an earlier era and, as we shall see, is inefficient in some important respects.

Neither Duffy's survey nor Rude and Smith's provides a precise view of the prevalence of online editing; clearly, however, online editing is atypical among these respondents. Of Rude and Smith's respondents, about 15% edit online. When Duffy's 28 expert editors were asked to list the computer tools they employ, only two listed an online editing tool (DocuComp from Advanced Software, Sunnyvale, CA), and one of these editors commented that DocuComp was only usable for documents that contained few editorial changes.

Alred, Oliu, and Brusaw offer a negative assessment of online editing, an assessment that we believe is widely shared: "The potential advantages that online editing offers cannot compensate at this time for its liabilities" [11, p. 293]. In this comment, they are referring primarily to difficulties in marking copy on the computer and in visualizing and navigating an online document, issues we address later. Princeton University Press is seeking to widely implement online editing, but nonetheless "red pencils still rule in the editorial department" [12, p. 235]. Boeing and Microsoft are two large, technologically sophisticated organizations that have been looking at online editing for quite a few years, but hardcopy editing remains the rule at both companies.

While online editing has achieved only limited acceptance, there clearly is interest in it and pressure for its adoption. In the following sections, we look more closely at this situation by examining both the perspective of organizations and the perspective of editors on the use of online editing. We believe that from both perspectives the advantages of online editing are considerable, although the benefits accrue more assuredly and directly to organizations.

THE ORGANIZATION'S PERSPECTIVE REGARDING ONLINE EDITING

Online editing potentially offers organizations greater speed in preparing documents, better version control, better archiving, increased productivity, improved systems integration, and other benefits. Online editing, however, must not degrade quality and must fit within the organization's overall operation.

Speed

The speed with which a proposal, product catalog, or manual update can be prepared is often crucial. Formerly, when deadlines were tight and collaborators were physically separated, paper drafts were often sent back and forth among authors, reviewers, and editors by Federal Express or even courier. In the era of fax, the physical distance separating collaborators is a less important issue, but even now valuable time is lost and errors may be introduced when agreed-upon changes marked on the paper copy are keyboarded into the digital version. Online editing in its most current implementations makes it possible to incorporate agreed-upon changes in the manuscript instantly and without introducing errors. In fact, with currently available tools, such as Aspects (Group Logic, Arlington, VA), authors, reviewers, and editors can simultaneously change a document and view a continuously updated version of the document.

Version Control to Prevent Mistakes

One major difficulty in creating complex documents is simply keeping track of where the various parts are in the writing, review, and editing cycles and controlling who is working on what. At times, organizations mistakenly assign writers and editors to work on sections of a document that managers have already decided to delete from the final version. Worse yet, draft chapters containing serious factual errors are inadvertently included in a printed document; and occasionally writers or editors, following a personal agenda, make surreptitious changes that appear in the published version. In paper environments, project librarians check drafts out, check them back in, and in general attempt to maintain version control. As noted earlier, in an all-digital environment, the computer can be used to provide effective version control: the computer can keep track of who has (and has had) each section of the document, limit the distribution of certain sections, withhold all but "read-only" access to parts of the document an individual is not authorized to change, and display the changes made by each individual.

Efficient Archiving

Organizations must often archive the complete life histories of documents. They must archive not only all published versions, but all drafts, review comments, and even personal notes. Such archiving may be necessary to support an old version of a product, trace responsibility for a mistake, or determine the date on which a patentable idea was conceived. Archiving paper material is time-consuming, requires expensive storage space, and still leads to serious problems of information retrieval. Archiving and retrieving digital material is much easier and cheaper.

Increasing Productivity While Maintaining Quality

Naturally, organizations are concerned with the productivity of individual editors and the efficiency of the editing process. An online editing tool that significantly slows down the editors or the authors who review edited copy is not acceptable.

Similarly, while organizations might not have the same sensitivity to document quality that editors do, serious quality-control problems caused by a clumsy editing tool will likely be unacceptable. Some online editing tools have failed in the marketplace for these reasons; newer tools may prove superior to current tools and to paper editing as well in regard to both productivity and document quality.

The Requirement of Overall Systems Integration

Necessarily broad, *systems integration* refers to all the ways an online editing tool fits the organization's existing technologies and operations, including the kinds of documents they prepare and their writing and publishing processes. It includes such issues as staffing, training, and budgets. The need for systems integration within an organization can easily lead to the rejection of a particular online editing tool and possibly all available online editing tools. For example, an organization may reject tools that cannot be tightly integrated into its electronic publishing system or electronic mail system, that cannot gracefully handle elaborately formatted documents, or that cost too much. For all these reasons, editors cannot simply assume that tools they like and that authors like will automatically be adopted by their organizations. Editors may have to make a strong case for preferred tools within their organizations and encourage the commercial development of tools that both satisfy themselves and fit the needs of their organizations.

Other Values

Organizations should inherently value the quality of workplace life and want their employees to work comfortably, feel pride in their work, and enjoy positive human relations. In any case, deficient workplace quality ultimately hurts productivity. Another priority valued in organizations is respect for the environment; online editing reduces the amount of paper and toner consumed in large organizations, thereby both protecting the environment and reducing costs.

THE EDITOR'S PERSPECTIVE REGARDING ONLINE EDITING

Because editors have a stake in their employers' success, they share an interest in efficiency, accuracy, and cost reduction. Presumably, they support technologies that protect the environment. Editors, however, also have their own concerns. They are naturally concerned with the comfort and healthfulness of their work environment. Also, they care about the operation of their tools—whether these tools make possible high-quality editing, and whether they make the job more complex and difficult.

Comfort and Health

Online editing increases the number of hours each week that the editor spends at the computer, raising questions about health and comfort. Back pain, carpal tunnel syndrome, eye fatigue, and (in the opinion of many) monitor emissions are major societal problems. These questions should be and are being addressed through such means as ergonomic office furniture and keyboards and low-emission monitors with more legible displays. Ergonomic problems associated

with computer use persist, of course, and this makes editors understandably wary.

The computer is nevertheless the center of the professional workplace, and many kinds of workers spend long hours staring at the screen. If online editing tools become highly efficient, editors (like newsroom journalists a decade or more ago) will probably have little success citing increased time at the computer as a reason for rejecting these tools. Fortunately, editors are apt to engage in professional activities such as interviewing and project management that limit time at the computer. Also, editors can significantly reduce time at the screen by reading from a print copy when they first familiarize themselves with a document and switching to the computer screen when they begin marking up the document. Paper thus becomes a useful temporary interface but is not really part of the main flow of the process of preparing a document.

Typos and Reading Errors

It is also possible that the screen's inferiority to paper in regard to resolution and other viewing factors can cause editors to miss typos and make other character-level errors. Evidence regarding reduced performance is mixed. Horton reviews a variety of conflicting studies and concludes that "with careful design of screen displays, reading speed and accuracy can approach those of paper" [13, p. 246]. No doubt the quality of displays will continue to improve. Furthermore, an important but often unnoticed point is that the editor is not restricted to a particular set of font and display variables when reading from the screen. Contemporary word-processing software allows the editor to zoom in on the document (effectively increasing font size), view text in ultra-readable screen fonts, change the text color, and in general create a customized reading and editing environment. Most editors, we assert, would miss fewer typos working in their preferred on-screen reading environment than they would reading a document in 9-point Times Roman type produced by an ink-jet printer on both sides of low-quality, show-through paper. The ability to create a custom on-screen reading environment also alleviates part of the comfort and health problem discussed earlier.

Visualization and Navigation

Visualization refers to how well an editor can visualize the structure of a document; navigation refers to how easily an editor can find a portion of the document (e.g., the editor needs to look quickly at the fourth section of Chapter 11). Without adequate visualization and navigation, online editing becomes impractical.

Like many other editors and non-editors, the editors surveyed by Rude and Smith cite superior visualization and navigation as major reasons for working on paper. This belief is certainly not surprising: we are all comfortable with such print elements as tables of contents, running heads, and page numbers; furthermore, the heft and physicality of paper help people gauge the size of the whole document, sense their current location within it, thumb through it readily, and keep several pages open at once.

On the other hand, perhaps because the visualization and navigation issue pertains not just to professional editors but to all those who use computers to prepare documents, the visualization and navigation capabilities of word processors and electronic publishing systems have improved greatly in the last decade. For example, contemporary word-processing software provides means for visually gauging the approximate size of the document and one's location in it, can display different portions of the document in separate windows, and offers such special views of the document as the outline view and thumbnail images of multiple pages. Editors, moreover, can instantly jump to any word, phrase, or page and can easily find every element in a manuscript that shares a certain formatting characteristic (boldface, a certain heading level, etc.). Finally, monitors on desktop machines are becoming larger, and monitors that can display a full 8-1/2 by 11 page (or larger) are not rare. It may well be that some of Rude and Smith's respondents were not considering the capabilities of the best software and hardware when they judged in favor of paper, and significant improvements have occurred since the survey was conducted.

Those who laud the heft and physicality of paper almost always assume a document that is very manageable in size, not a physically cumbersome document requiring multiple volumes. We assert that, objectively considered, visualization and navigation in the best word processors clearly exceed visualization and navigation in paper when documents are even moderately long. Furthermore, there is at least one study in the research literature that lends strong support to this view [14].

Marking Copy

The way the editor marks copy is crucial. It bears upon productivity, document quality, and job satisfaction. It has major implications for editors' relationships with authors. Consequently, in assessing any online editing tool, editors will doubtless give much weight to this aspect of the tool. We examine mark-up in the next section. For now we can say that editors will make rigorous demands regarding mark-up, both because of its importance and because the mark-up model embodied in traditional paper editing is efficient in four important respects.

- The traditional symbols are fairly easy for editors and authors to learn, and a workable subset (e.g., the symbols for deletion, insertion, transposition, and some other basic operations) is both familiar and highly intuitive.
- The traditional symbols represent a rich repertoire of editing operations, enabling editors to mark changes rapidly.
- There is no difficulty distinguishing the editor's hand-entered work from the author's printed draft. The author easily sees what has been changed.
- Because of the rich, well-designed symbology, the careful editor can make fairly extensive changes without making the marking so complex that the author will have difficulty reviewing the changes. At some point, however, it is best for the editor to simply re-write a passage and ask the author to compare the new one with the original.

PROSPECTS FOR THE FUTURE

Editing is almost always an organizational activity, performed within or for companies. Consequently, the organization's perspective is apt to be influential. We expect that the organizational agenda will result in a gradual but steady increase in the amount of online editing. Furthermore, although many editors are wary (or even hostile) regarding online editing, the benefits, we believe, of editing online and working entirely in a digital environment should continue to win over more editors. There is certainly anecdotal evidence of editors who have become enthusiastic proponents of online editing. For example, Lynnette Porter, who works actively as a freelance editor, reports positive experiences using a range of online editing techniques; and Joann Een, an editor for the Seattle-based training company Catapult, endorses the online editing tools in Microsoft Word and declares online editing to be "more efficient than manual editing."

If online editing is apt to become prevalent (and perhaps dominant), an important question is, What will the tools be? Will there be many tools or just a few? Will they be standalone tools or will they exist as part of word processing and electronic publishing applications? Will some tools become optional add-ons, possibly created by third-party developers? Most important, what will be the features of these tools, and how well will the features fit the work of editors and writers, as well as the agendas of their organizations?

Editors and writers certainly have a stake in the nature of these tools, and if they are to influence the tools they use, they will first need to understand the key differences among these tools and the implications of these differences. Clearly, the nature of a tool significantly affects the user of the tool, but the nature of this relationship is not easy to determine. In the next section we look at what is perhaps the most fundamental characteristic of any online editing tool: the mark-up model it embodies.

IMPLICATIONS OF MARK-UP MODELS

It is hard to overestimate the importance and centrality of mark-up in any online editing tool. It is how the editor works and how the document is changed. Mark-up is also a key means of collaborating with the author. Michael Shrage observes that "all collaboration relies on a shared space" [15, p. 153] and writes about the computer's potential to create better shared spaces among collaborators in many domains. The mark-up model embodied in any online editing tool, the particular implementation of the model, and the features associated with it collectively make up much of the shared space between editors and writers.

To provide a full survey of mark-up models or online editing tools is beyond our scope. Rather, our goals here are simply to delineate the concept of a mark-up model, illustrate the most important models, and argue that the choice of a mark-up model and, more generally, the choice of an online editing tool have many important, subtle, and hard-to-predict implications. Also please note that the names of particular products are used only as examples of the models these products embody; we have made no attempt to discuss all product features or to

Mary had a savage <del little lamb.

Fig. 1. A typical implementation of the comment model.

evaluate these products. Finally, we assume that any useful online editing tool will enable two-way messaging between editor and author, although this facility may lie outside the mark-up model. In most instances, whatever means reviewers use to send comments to writers (e.g., hidden text or an annotation feature) will serve for messaging between writers and editors.

The Silent Editing Model

Silent editing means simply that the editor works on the author's draft using the normal features of a word processor. This is the simplest model—almost the lack of a model. It requires no special tool or technique. This model is effective when the author fully trusts the editor (or has limited concern for the manuscript). This model, however, causes frustration and likely antagonism if the author wishes to check the editor's work against the original carefully, for doing so requires the author to read both versions sentence by sentence, an excruciating task.

Editors may enjoy working in this untrammelled manner, but the practice is dangerous, even when authors will permit it. First, this model causes the editor to work in the manner of an author and likely results in less regard for the author's original text and, hence, over-editing. Second, because this model is "destructive," the editor cannot readily recover the author's wording once it has been changed.

Silent editing is routinely and effectively used in a very limited form and in conjunction with some other model. The editor is authorized to make minor, utterly unarguable changes silently, thus simplifying the workspace shared by editor and author and reserving this workspace for weightier issues. Even here, however, the author must trust the editor's judgment regarding which changes to make silently.

The Comment Model

The comment model is embodied in pop-up notes, temporary footnotes, hidden text, and special symbols placed within the text. It was also the basis for the unsuccessful product MarkUp (Mainstay Software, Agoura Hills, CA), in which the editor marked changes on a virtual "acetate" layer created by the editing tool.

In its most rudimentary form, such as pop-ups and hidden text, the editor is simply writing brief notations indicating desired changes, as in Fig. 1.

The notation indicates the editor's intention to delete "savage." This model can work reasonably well, especially for editing manuscripts that are short or in need of few changes, but it is too labor intensive for many settings.

In its more sophisticated form, software can execute the marked changes. Online editing is performed in this manner at the Princeton University Press [12] using the XyWrite word processor and custom programming. Even in this more sophisticated form, however, a significant amount of extra keyboarding is required to mark the proposed changes.

A little lamb Mary had a little lamb whose
 fleece was white like as snow. And
 everywhere that Mary went The lamb,
 moreover, was sure to go everywhere that
 Mary went.

Fig. 2. The edit trace model.

The Edit Trace Model

The edit trace (or "compare") model is the dominant model in current online editing software. It has been implemented in DocuComp and in various word processors.

In the edit trace model, the editor works like an author, deleting, adding, and moving text using all the usual features of the word-processing software. The computer, however, can compare the editor's new version to the author's original version, and so permits the author to view the draft with the editor's changes juxtaposed on it by means of such typographic attributes as strikethrough to show deletion and underlining (or boldface) to show insertion. The edit trace model is shown in Fig. 2. Microsoft Word includes a useful feature that enables the author to jump from one of the editor's mark-ups to the next.

In a less sophisticated variation of this model, only a change bar appears in the margin where the editor has changed the text. The author must look at the original version to see the unedited passage.

The edit trace model could easily win favor among editors because of the ease of making changes. On the other hand, this mark-up model is apt to encourage heavier editing and less regard for the author's original text. If this is indeed the case, there may be significant implications for the quality of edited documents, the editor's standing within the organization, and the editor's relationships with authors. In this way, the edit trace model is like the silent model but far more feasible because the editing is not destructive.

There are three different ways that editors can view the "trace" made by the computer. In the first, the editor stops and begins a distinct compare operation. In the second, the trace appears in real time as the editor works. In the third, a second scrolling window continuously shows the trace. The second and third options are apt to limit heavy editing and are therefore more desirable than the first.

Because this mark-up model uses typographical attributes rather than a complete, highly refined symbology, changes are not economical or easy to interpret. For example, in Fig. 2 there is significant visual complexity just to show the change from an uppercase "T" to a lowercase "t." With traditional paper editing, only a single slash mark would be drawn over the upper-case "T."¹ This difficulty may hinder editors, and it can be quite difficult for authors. Conceivably, it can make authors careless about reviewing their edited drafts and/or less

¹Complex changes in formatting may, in fact, surpass the capabilities of an edit trace tool or result in typographic markings that are too complex for anyone to deal with. Therefore, when an editor wishes to show complex formatting changes in a text element—for example, a list or table—the best procedure is often to duplicate the element, reformat the new instance, and let the author simply compare the two.

willing to work with editors. An implementation that used traditional editing symbols rather than typographical attributes would be better.

Most implementations of the edit trace model have another deficiency: they show that a block of text has been deleted and they show that a block of text has been inserted, but they do not communicate the concept of moved text. Hence, when text is moved beyond the confines of a paragraph or page, the editor must provide messages to indicate the move. Otherwise, the author is apt to see the deletion and ask, "Why did the editor take that out?" Seeing an insertion, the author might say, "Why is the editor putting this in twice."

Traditional Model Adapted for the Computer

The traditional paper mark-up model can be adapted for the computer screen. One approach is that of Red Pencil, a clever DOS product that allows the editor to apply a nearly complete set of traditional editing symbols directly to a document. Using the mouse or keyboard, the editor highlights a word, phrase, or passage and issues a command to add a particular editing symbol to the highlighted text. Once marked in this way, the document can be transmitted to the author for review. The author can then remove and add new editing marks to the document. When the process is complete and the final changes have been made, all the marked changes are executed with a single command; and so, as with the edit trace model, there is no manual keyboarding of editing changes.

Red Pencil has not been successful in the marketplace. This is partly because Red Pencil was never designed to deal with elaborately formatted text and partly because Capsule Codeworks (Redmond, WA), the very small software company that developed Red Pencil, has had trouble keeping up with changes in computer hardware and software environments, leading to limitations in systems integration.

Another implementation of the traditional model is becoming feasible due to the advent of a technology that lets the computer recognize both human handwriting and basic editing symbols: the editor uses "digital ink" to mark a simple subset of the traditional editing symbols, along with the words the editor means to insert in the draft. The digital ink looks like a simple bitmap but is much more powerful [16]. For, when the author has reviewed the editor's changes, the editing symbols (known to computer scientists as "gestural commands") can be executed. The editor can also enter messages to the author, such as "Please improve this passage." These comments remain as digital ink and are ultimately deleted.

MATE is a research prototype that uses digital ink, although the editor writes with a stylus on a pressure-sensitive tablet rather than directly on the screen [17]. One excellent feature of MATE is a second window, which scrolls in conjunction with the main window and shows what the document looks like with the changes executed. This second window is a major benefit to both editors and authors, especially when text has been heavily edited. The two windows are shown in Fig. 3. One capability that is not present in MATE but that can be implemented with digital ink is the automatic "neatening" of editing symbols.

Annotation View	Edit View
<p>This is a sample document with several annotations marked on it.</p> <p>Note <u>some</u> that annotations correspond to specific editing commands.</p> <p>Whereas others are more general comments.</p> <p><i>Reword</i></p>	<p>This is a sample document with several annotations marked on it.</p> <p>Note that some annotations correspond to editing commands.</p> <p>Other annotations are simply comments to the author.</p>

Fig. 3. A passage edited in MATE. One window shows the changes marked in digital ink; the other shows the passage with the editing commands executed.

PenEdit (Advanced Pen Technologies, Upper Saddle River, NJ) is a promising new online editing tool that emulates many aspects of traditional paper editing. In PenEdit, the editor uses an electronic pen to place the traditional deletion symbol and certain other editing symbols directly on the computer screen. Text can be inserted both with the pen or with a keyboard; text appears on the same line as the author's text, but in a distinctive "handwriting" font. Text marked by PenEdit is shown in Fig. 4. This process encourages restrained editing, and in one published account a pencil-and-paper editor describes the new process favorably [18]. If authors have computers that run PenEdit, they can view the editor's changes and respond to them on the computer; the less expensive procedure is for editors to ask authors to review printouts of the marked copy. Editors and authors can also view a "clean" version of the manuscript, in which all the changes have been executed.

Because PenEdit currently runs in a special pen-based operating system and because manuscripts need to be imported into PenEdit, organizations using PenEdit must address some systems-integration issues. This product, however, is under active development by people who are attuned to the needs of professional editors.

A special section of *Byte Magazine* [19] that discusses digital ink is notable for emphasizing that digital ink and voice recognition are complementary technologies. In the scenario that emerges from this section, editors use both digital ink and voice commands. Crane and Rtsichev offer this example: "While editing on the screen, you might say the following: Move this sentence [indicating what 'this sentence' refers to by simultaneously circling the sentence] to the beginning of this paragraph [simultaneously circling the paragraph] . . ." [20, p. 100]. Assuming that the oral "move" command would also create some traceable record of the move, the combination of pen and voice input might be a very efficient implementation of the traditional mark-up model.

Whether implemented on paper, in Red Pencil, or with digital ink (possibly augmented by voice commands), the traditional mark-up model encourages restrained editing. Editing

Much of the background knowledge & and guidelines for structure ~~look~~ plan design comes from the field of exhibit plan design (e.g., Klein, 1988; Konikow, [Au: Spell 1] 1984; Miles & Alt, 1988). [Au: Date 1] Indeed, a major principle of exhibit plan design is to create displays that attract attention & and invite participation. However, the many technology components & and the nature of the interaction possible with interactive systems poses many new challenges even for experienced exhibit designers [FN: 2].

End Page 1

Fig. 4. Copy marked with PenEdit. The rounded rectangle indicates a footnote. The squared-off rectangles indicate queries to the author.

changes take more time to mark than they do with the edit trace model, and the editor is always reminded that he or she is altering another person's document. Restrained editing is favored by most experienced editors and reduces conflicts with authors. Furthermore, to the degree that the rich vocabulary of traditional editing symbols is retained, authors and editors can interpret the editor's markings more readily than they can in the edit trace model.

THE ROLE OF THE TECHNICAL COMMUNICATION COMMUNITY

No one can know just how editing will be performed in the future. We believe, however, that online editing will be prevalent if not dominant, and we have tried to show that in regard to just one design issue (albeit a central one), the number of design options is great and the differences among them significant.

A key question is whether online editing will improve the quality of edited documents and the worklives of both editors and the writers who work with them. There is at least the potential for a "win-win" situation in which these tools will please editors, writers, and their employers. To ensure that good tools will be developed and to ensure that the best of these are adopted, editors and the technical communication community in general should try to exert some influence. We can, for instance, help software developers understand the work of editors (as well as informal editing) and make clear which features are necessary and useful and which will create problems. We can also influence the technology planners in our own organizations.

The basis of this influence is our own understanding of the still-uncertain issues surrounding online editing. Therefore, we have great need for research such as the survey of Rude and Smith [10] and that of Duffy [8], which had the explicit goal of contributing to the development of better tools for editors. Also important are detailed and sensitive case studies, such as that of Kincade and Oppenheim [12]. We hope as well that this analysis focuses attention in a useful manner.

Finally, we note that editing is just one of an enormous number of collaborative activities that are moving online [21]. Online editing, however, is a relatively early and fairly

challenging test case for computer-supported collaboration. If effective tools for online editing emerge and are accepted, the prospects for computer support of collaborative work in many other domains brighten and there may be lessons to share with others whose work is moving online.

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