

The Role of Paper in a Wired World

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Abstract

A Paperless World?

For years, the idea of the "paperless office" put forth by "futurists" a decade or so ago has been laughed at in the computer printer industry, which has watched gleefully as office and consumer paper consumption soared year after year. But the advent of the Internet means that the paperless, or at least less-paper office, and perhaps less-paper home, is no longer a joke. The Internet has changed the role of paper: it once *was* the document, but has become only a transient display medium for the document, which is now a computer file, email, or Web site. Even though paper consumption continues to rise, research shows that many, even most documents that cross a person's desk are no longer printed. And, as computer design and display technology improve, that percentage can only rise. At the same time, a horde of "dot-coms" are spending billions to automate processes in every industry that have long depended on inefficient paper-shuffling. In short, a paper-based culture that has lasted hundreds of years is under assault, an assault that will certainly affect the market for computer printers and printing.

Paper has been a mainstay of civilization for hundreds of years. But, in the few brief years since the advent of the Internet as a mass-market communications medium, the role of paper, or more specifically, paper documents, has changed dramatically. On the one hand, many traditional paper documents such as the personal letter and the inter-office memo have all but disappeared thanks to the emergence of e-mail as the personal communications tool of choice. Virtually every other type of document has been affected as well, if not as dramatically: the content of most newspapers and magazines is available on the Web, many book publishers now release titles in electronic format as "ebooks," and even such revered reference books such as the Encyclopedia Britannica and the Oxford English Dictionary have been published on the Internet.

The big question for the computer printer industry, and indeed for many other related industries such as the paper industry, the lithographic printing industry, the overnight express industry, and national postal services, is: what will happen to paper in the long run? By our estimate, about 3 percent of the U.S. labor force is involved in the production, delivery, and disposal of paper documents, and most likely similar or even higher percentages in other industrialized countries. So, the fate of the paper document will have a big impact on the economy.

For the most part, arguments about paper's future role follow a certain pattern. First, someone from outside the industry argues that a paperless world is imminent. They note the superiority of the electronic document: it costs nothing to send and consumes virtually no natural resources; it is searchable and sharable; it arrives instantaneously anywhere in the world; and a library-full of them can fit on a laptop computer's hard drive. Why use paper?

Immediately, those of us in the hard copy world respond: yet people *do* use paper, more of it every year, in spite of the Internet. Indeed, what little data is available suggests that the Internet, far from eroding paper consumption, has driven it to even greater heights, simply because it has put a universe of documents on people's desktops, a great many of which get printed. So, even if it is granted that people are printing a lower percentage of the documents they use than in the past, the absolute number of documents printed has nonetheless risen.

No hard numbers exist on exactly how many documents are printed, let alone how many documents exist, but a few firms have made estimates. For example, in a presentation at a Lyra conference earlier this year, Xerox ex-CEO Richard Thoman said that Xerox estimates that the percentage of documents printed in 2005 will be only 40 percent, down from 60 percent in 2000 and 90 percent in 1995. But this decline will be more than offset by a ten-fold explosion in the total number of electronic and printed documents, from 2.2 trillion in 1995 to 9 trillion this year to 20 trillion in 2005. As a result, the absolute number of prints made will quadruple between 1995 and 2005, from 2 trillion in 1995 to 8 trillion in 2005.

Research done in 1999 by Lyra also suggests that the Internet has driven tremendous growth in the number of documents printed. In our survey, we found that people receive on average 23 e-mails per day, and print 20 to 25 percent of these, which, projected to the entire U.S. market amounts to 45 billion pages per year. About a third of those 23 e-mails have attachments, of which 40 percent are printed, which amounts to around two per day. Assuming each attachment is two pages long on average, this amounts to 1,500 pages per year per user, or another 50 billion pages per year. Finally, survey respondents told us that they print about six pages per day from the Web, which amounts to another 50 billion pages, or a total of around 150 billion pages per year. All told, we estimate

that around 250 to 270 billion pages were printed in the U.S. in medium to large businesses in 1999, which means that the Internet *today* generates about 60 percent of all prints in these establishments. As a point of reference, we believe 400 to 420 billion pages were printed in the U.S. overall.

So, as things stand today, both sides of the "paperless" argument are right: although the percentage of documents being printed is dropping dramatically, the number of pages printed continues to rise. But the question remains: will this state of affairs continue indefinitely, or can we look forward to further dramatic changes in document usage and paper consumption? The rest of this paper will examine the factors that I believe will drive further changes in these areas.

What is Paper For?

Why do people print documents at all? Fifteen years ago, the answer was self-evident: there was no other easy way to read the document. Or send it. Or, reliably, store it. Computers were born in a world that lived by paper, and so computer documents naturally were printed so that they could seamlessly slip into the world's century-old paper-based workflow: its in- and out-boxes, its filing cabinets, its postal delivery systems. The paper document *was* the document. The computer, like the typewriter before it, was merely a tool to create the document.

All that has changed in the past fifteen years, thanks to a cascade of improvements in computer and networking technology that culminated in the arrival of the Internet and the World Wide Web. Bit by bit, technology has eroded paper-based habits: improved networks first made it possible to send internal documents electronically, then the Internet and e-mail made it possible to send external documents electronically. Vast improvements in computer storage technology are gradually making file cabinets obsolete, while improved displays that are larger, brighter, and driven by WYSIWYG software provide an alternative to a print-out.

In the same survey of workers in medium and large offices mentioned earlier, two-thirds said that more than half of the information they need for their job is now delivered electronically rather than in hard copy. Increasingly, it is the computer file that is perceived to be "the document," while the printed document is merely a transient display medium. People print today either because they need to read a document when they are away from their screen, or because the document is long or complex and would be hard to digest on-screen. Otherwise, they *don't* print the document, because printing is inconvenient and costly.

So, at least conceptually, evaluating the future of paper and printing is fairly simple: the key is to identify the factors that will make reading a document on-screen as easy as printing it. I have lumped these into three categories:

Technology issues: today, it simply is not that easy to read on-screen, so people avoid it for all but the shortest documents. However, the inexorable forward march of computer technology promises to address the limitations of current PCs, and this will eventually have an impact on demand for computer printing.

Publishing issues: already, publishers have moved tremendous amounts of content to the Web. For now, that's been a boon to the computer printer industry because much of this content winds up getting printed. However, what's good for printers is bad for publishers, because the screen limitations that drive people to print also limit the impact of both Web content and advertising. Thus, the publishing industry has an inventive to drive forward new display and computing platforms that make printing unnecessary.

Cultural Issues: even if all the technological, economic, and legal obstacles to purely electronic document publishing, distribution, and consumption are overcome, there is inevitably going to be resistance to this new technology for the same reason that people resist anything new: they don't want to change.

Technology Issues

Perhaps the biggest problems that lead people to use paper rather than view a document on-screen are technological: today, it simply is not easy to *avoid* using paper. The obstacles range from poor displays to awkward computer hardware designs to the absence of satisfactory document management standards and applications.

Display Technology

Now that paper's function is reduced to display, its key electronic competition is, of course, electronic displays. And, it's safe to say, much of paper's continuing appeal reflects dissatisfaction with current display technology. The corollary, of course, is obvious: as electronic display technology improves, it increasingly will make the printed document unnecessary.

Resolution: The most obvious failing of the typical computer display relative to paper as a display medium is its resolution. A document printed on any but the most antiquated machine is far sharper than the same document viewed on-screen. However, advances on two fronts are gradually negating this advantage.

First, the resolution of display hardware has improved steadily over the years. Display technology, particularly flat-panel display technology, remains an area of vibrant innovation, so there is every reason to assume that resolution will continue to improve.

Second, the design of flat-panel displays has made possible a software technique for improved resolution. Microsoft among others is exploiting this with a technology called ClearType that exploits the arrangement of the RGB cells in the display to boost resolution. Microsoft

asserts that the result is a display with a resolution that approaches that of paper.

In short, very soon, poor display resolution will likely no longer be a factor in a user's decision whether or not to print. Indeed, it may not be much of a factor today; in all likelihood, there are more important although perhaps less obvious factors that make reading on-screen unpleasant.

Size and form factor: The size and form factor of most displays is at least as important a limitation as resolution, perhaps more important. Historically, computer displays have been designed with a landscape rather than a portrait orientation, even though most of the documents they display have a portrait orientation. This anomaly was necessitated by the small size of early displays, which could not display a full 80-character line of text in any other than landscape orientation.

Even though standard modern displays are now more than big enough to display a full page in portrait orientation, virtually all continue to be designed for use in landscape mode only. As in the past, the display is seen as a window into the section of a document that is being worked on, rather than a tool to view the entire document. This of course is good for the printer industry: when the time comes to view the finished document, the file is sent to the printer.

Unfortunately, document size and orientation are key factors in legibility: it is not a coincidence that most printed documents are published in a portrait orientation, and documents that require the reader to search (for example, newspapers and magazines with a maze of multiple stories on a page) are published on sheets at least letter-size and as large as broadsheet-size. These in combination with other time-honored publishing tools such as headlines, captions, breakers, and "pull-quotes," make it possible for a reader to quickly scan and identify material that they wish to look at more closely.

In short, the printer industry has benefited from the computer industry's inertia. As long as PC manufacturers continue to rather mindlessly insist on offering customers landscape-oriented displays, it will be harder than it has to be to read documents on-screen, and more printing will result.

Computer Design

Indeed, computers in general have not been designed for the reading of documents. Not only are their displays a poor substitute for paper, every other aspect of most PCs is designed not for the relaxed absorption of a document, but rather for intense interactivity of various kinds: writing, spreadsheet-building, data entry, database searching. Most computers today are desktop units with large stationary CRT monitors and keyboards that require a user to sit bolt-upright before them as they work.

This is the primary reason why many people print all but the shortest documents: it's uncomfortable and inconvenient to read the documents on the screen, no matter how sharp the screen might be. Reading, especially of long documents, requires a kind of concentration that is difficult to achieve sitting at a desk. Rather, people prefer to choose when and where they read. More often than not, people read when they are commuting, or traveling, or at home, or at lunch. They can't do this with their desktop PC, so they print.

However, ongoing technology advances are making it ever easier to squeeze more and more powerful electronics into smaller and smaller spaces, and the result are new devices that bring computer power to the customer rather than the other way around. This of course has driven the emergence of the notebook computer, the sales of which are growing much more quickly than those of desktop units. More recently, new classes of handheld computers such as personal digital assistants (PDAs) and the ebook have emerged.

All of these devices force customers to trade some degree of functionality for mobility: the more mobile the device, the less functionality it offers. And one of the functions that is generally sacrificed is display resolution and size. For example, the screen on the typical PDA is so small that reading anything more than a sentence or two is a real chore.

However, market dynamics are driving the industry to offer the maximum possible functionality *and* mobility. The screens on notebook computers have steadily grown, and the same trend is visible in the PDA market, to a point (the devices by definition must fit in a pocket). Meanwhile, the ebook represents a new product category that offers customers a different functionality/mobility trade-off: ebooks have a much bigger screen than PDAs, big enough to match the page size of a paperback book page, but sacrifice all other computer functions, in particular data entry capability.

From the perspective of the printer industry, the question is whether future computing devices will evolve to the point that they will offer both the mobility *and* functionality to post a real challenge to paper as a portable medium. So far, no such product exists, but many in the industry speculate that such devices are coming. Microsoft, for one, predicts the development of a product the firm calls a "PC tablet" within a few years. This device will be very light but also offer full PC functionality, including a page-size very sharp screen. If in fact such devices materialize, they undoubtedly will pose a real threat to paper.

Software

While the discussion thus far has focused on hardware, there are many unresolved software issues that make a paper-free existence difficult. Adobe and Microsoft, among others, offer reading software that makes it relatively easy to scroll through and read an electronic document. But reading is only the tip of the iceberg: documents not only must be read, but also must be annotated, stored, and shared, not to mention copyright-protected.

In all of these areas, current software is woefully inadequate. Consider the following scenario: you visit a

Web page that has material on it that you would like to archive. What do you do? If you simply save the URL in your "Favorites" list, in a few months, the page may be gone. Or you can select and copy the page and paste it into a Word document. But then you lose most of the formatting and accompanying images. Or you can use the browser's "save as" function to create a saved version. But this file consists of a bulky HTML file plus a separate folder with all of the non-text objects on the page. Not a pretty solution.

Another software limitation that encourages printing is boot-up time: personal computers typically have a boot-up time of two or three minutes, while paper's boot-up time is zero.

In short, today, it's not easy to manage documents purely electronically. And, of course, there is always a reliability concern: if my computer hard drive dies, what then? As a result, relatively few computer users depend entirely on the electronic version of a document. Instead, they print out key documents "just in case."

Publishing Issues

One industry that has been hit particularly hard by the emergence of the World Wide Web is the publishing industry. The Web has made it possible for just about anyone to become a publisher, and of course the flood of investment capital backing new publishing enterprises hasn't hurt. Meanwhile, virtually every "old-world" publisher of paper documents such as newspapers, magazines, books, technical journals, and even reference works has move to put some, if not *all* of their content on the Web, often for free.

In theory, Web publishing should be a boon to the industry: it eliminates the tremendous costs of printing and shipping publications, and it enables a publisher to provide customers with timelier, more extensive, personalized information that includes not only text and photos but also video and audio content.

But in reality, all kinds of problems surround Web publishing, including copyright issues, cannibalization of print publications by Web content, and more. The entire publishing industry is in the midst of a radical reformation as it struggles to find business models that work on the Web.

Two key problems present themselves. First, it has proven difficult to generate subscription revenue from Web publications. Almost all Web publications remain free, despite the hopes of publishers that after an initial period of free access to build traffic, subscribers would realize the value of the information and would willingly pay. So far, this has not happened.

Meanwhile, the other primary source of publishing revenue, advertising, has also proven problematic. While Web advertising revenues are rising rapidly, they remain a tiny fraction of total advertising revenue, and considerable doubt exists that tiny banner ads on the Web are an effective advertising tool that can replace print advertising.

Ironically, both of these publishing problems are directly related to the technological limitations of current PCs. The relatively small, landscape-oriented screen of the typical PC is adequate for reading a short document—or advertisement—but is a bust when it comes to the longer articles and larger ads that are the mainstay of most publications. As a result, publishers on the Web are seriously handicapped: neither they nor their advertisers can present content to readers in a form that can be easily absorbed. As a result, the readers aren't willing to pay for Web publications, and advertisers aren't willing to pay for Web advertising.

All of this means that the publishing industry is in a very unstable situation. Publishers, all of whom realize that the Web has the potential to be a vastly superior distribution medium, are eager to exploit that opportunity. They know that the Web will cut their distribution costs dramatically while simultaneously providing readers with content that is more current, more sophisticated (multimedia), and more accessible and searchable. But until the PC evolves into a tool that can effectively display a full-size publication, their efforts are stymied.

In short, it is in publishers' interest to drive forward the evolution of the "PC tablet," and once they realize this is the case, they presumably will bring considerable force to bear to ensure that such products appear. For example, it is not inconceivable that the publishing industry and its advertisers will actually subsidize these products. With total U.S. advertising spending predicted to be around $200 billion in 2000, more than half of which is print advertising of one kind or another (newspapers, magazines, yellow pages, direct mail, etc.), advertisers are spending close to $1,000 per capita on ads. Diverting some of that revenue to help put PC tablets in consumers' hands might not be a bad investment.

Even if publishers do not go so far as to subsidize new publication-friendly computing platforms, they will most likely make efforts to accelerate their development. This is bad news for the computer printer industry. The same PC tablet that makes the on-screen reading of *Time* or *The Wall Street Journal* easier will make it easier to read *any* document, published or private, magazine or memo, which means that that document will be less likely to be printed.

Cultural Issues

The final variable in the paper vs. electronic equation is the intangible of "culture," meaning people's predisposition to ignore new inventions that would seem to be superior in every way because they are quite content with their current approach. Certainly, much ink has been spilled discussing the bond between man and paper, especially by defenders of the hard copy industry.

Of course, no quantifiable data exists on this subject. Nobody really knows how long it will take for people's longstanding habits to change. In lieu of hard evidence, many analysts have sought historical analogies. For example, some observers point out that the advent of a new media, say radio, did not put newspapers out of business,

and the advent of television did not destroy the market for radio broadcasting. Therefore, they conclude, the emergence of the Web does not mean that paper will go away. Rather, they argue, paper and electronic documents will coexist, each fulfilling functions for which it is best-suited.

This almost certainly will be true: no one argues that paper as a document medium will disappear altogether. But it does not really resolve the question of degree and timing: how *much* will paper consumption drop, if at all, and over *what* timeframe?

A few observations are in order. First, for that segment of the population that already uses computers and the Internet, switching from paper to electronic documents is not a traumatic change. After all, in the workplace, people already receive most of the documents that they use electronically. And they already read most of these documents on-screen, according to Lyra's research. The only decision these people must make is whether or not to print documents that they find difficult to read. If technological improvements make every document easy to read on-screen, they have one less decision to make. This hardly consists of a traumatic change.

Second, document usage will be bipolar in distribution, that is, people will either tend to be paper-document-centric or electronic-document-centric, with few people in the middle. The benefits of a purely electronic workflow are enormous in terms of convenience, and once people realize that they no longer need to print, they will stop doing so and will quickly learn to rely on electronic documents whenever possible.

Third, there will be very different patterns of document usage in the office and in the home. In the office, the shift to a pure electronic document workflow that excludes printing will happen more quickly, for a variety of reasons. First, companies have the financial wherewithal to buy the "PC tablets," the document-management software, the high-speed Web access, and other tools that make it easier to do without paper. Second, the pressures of the workplace will drive people to give up inefficient paper-based habits that they will continue to indulge in when they are at home. Or, to put it another way, it's one thing to read *Business Week* on a PC tablet, but quite another to read *Vogue* or *The New Yorker* that way, let alone a novel.

Conclusions

It is clear that paper's role as the primary medium of information exchange is coming to a close. The advantages of a purely electronic document workflow enabled by the Internet are enormous: electronic documents are cheaper, faster, and better in virtually every way. Already, paper has been displaced as the primary medium for document transmission and storage, a transition that happened quite quickly. Only a small jump is required for its replacement as the primary medium for document display.

The fact that the Internet has driven paper consumption *up* in recent years should not be misunderstood: this is a transitional phenomena, a brief uptick before a long decline. Today, people print the flood of new documents delivered by the Internet, but it won't be long before they stop.

To the extent a debate remains, it is on the timing of this transition away from paper, not that it will happen. Here, the crystal ball is cloudier. I would venture to say that the technology changes needed to support a fully electronic document workflow are only a few years away from realization. Indeed, if they had the imagination, PC makers could probably build a reasonably adequate "PC tablet" today. Certainly, in two or three years, they will be able to do so, and probably at an affordable cost. The software work may take longer, say five to ten years, since it will involve the creation of new standards and new applications.

Once the technology is in place, it is anybody's guess how long it will take to be sucked up into the mainstream. My feeling, for the reasons noted in the previous section, is that this transition will happen quite quickly. While it is and will always be true that it is hard to teach an old dog new tricks, it is not that hard to persuade someone to *not* do something, namely printing, that they never particularly liked doing, anyway.

All of this means that we are on the brink of a new age. From a hard copy industry perspective, perhaps this is a gloomy prospect: just when the industry has developed print technology with unprecedented and remarkable capabilities, the market's demand for this technology has started to evaporate. However, for computer users as a whole, the emergence of technology that provides instant access to every document, everywhere, is a tremendous advance that will have huge repercussions for how people live, work, and play.

Biography

Charles LeCompte, President of Lyra Research, is Lyra's chief spokesman and a frequent consultant to leading industry firms. Mr. LeCompte is responsible for all of the firm's advisory services and manages all printer and printer-related research activities. He also serves as Publisher and Managing Editor of The Hard Copy Observer and directs The Hard Copy Industry Advisory Service. Mr. LeCompte has served as an analyst of printer products and markets since 1985, for Lyra, which he founded in 1991, and previously for BIS Strategic Decisions, where he worked for six years as editor of the industry-leading newsletter, Printout, and as the author of numerous industry reports.