Those opinions seem to miss the fact that communication is no longer restricted by geography or time – and that it no longer depends on messengers. Today we hit a button and we're in touch with anyone in any part of our organization. In seconds, we complete transactions with customers, bankers, and alliance partners no matter where they are located. Internet and intranet capabilities not only move information faster, they also move it without requiring intermediaries. The operations specialist has access to the CEO, the strategist has access to those who work directly with customers, people with questions can find answers, and employees with ideas and opinions have a means to express them.

Wishful thinking? Not at all. In a typical day's E-mail, I receive scores of messages from employees. They might be sent from Cleveland or Brussels; written during the workday or late at night; and composed by a secretary, an executive, a repair crew supervisor, or a public relations manager. E-mail messages from me are equally likely to pop up on their computer screens.

Today's communications technology is a fantastic equalizer. Those of us who take advantage of it don't need to spend time wondering if our organization has a top and a bottom or where we fit within a circle. We don't need layers of people translating what one of us thinks and passing it along to others. We can take our managers' talent and put it to work on operational excellence instead of on information shuffling. True, advanced technology is but one element of an environment that prizes and rewards open communications. But the capabilities are a godsend to those of us for whom empowerment is far more than just a buzzword.

Henry Mintzberg replies: Here we have two letters from American CEOs. The first presents one number after another, and the second makes the case for electronic media to communicate with flesh-and-blood human beings. I rest my case with my original article.

THE VIRTUAL FACTORY

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The emergence of virtual factories has been painfully slow, and, to date, their promise has been largely unfulfilled. However, we are clearly at the threshold of a revolution that will change the manner in which not only manufacturing but also business in general is conducted.

As David M. Upton and Andrew McAfee point out in "The Real Virtual Factory" (July-August 1996), many of the tools of the old network paradigm are ineffective for implementing any true form of virtual enterprise. And a successful, smooth transition from the old network model to a virtual factory is unlikely. Although some modest benefits may be realized by organizations that modify existing systems, the real payoffs will go to those that, after careful planning, implement new systems comprehensively.

The Internet provided the initial communications standards and infrastructure that allowed virtual enterprises to be formed. However, in its current form, the Internet is not suited to providing the communications capabilities necessary for virtual enterprises to realize their potential. Although speeds on the Internet may seem sufficient to the casual user, they cannot support the real-time multimedia communications necessary for true "telepresence" – which is essential for remote concurrent engineering and simultaneous prototyping of a product and its production process. The solution to the problem lies in high-bandwidth "superintranets." Unlike proprietary intranets, these superintranets likely will be managed by telecommunications companies with seamless global communications. Proprietary subnetworks will be created as they are needed – to improve security, for example.

The benefits of virtual factories have been widely acknowledged. The technologies necessary for implementation are available at prices that are dropping rapidly, and standards are being established. In other words, the stage has been set. Upton and McAfee have provided a valuable overview of one model for a virtual factory that will elevate awareness and give others confidence to move forward.

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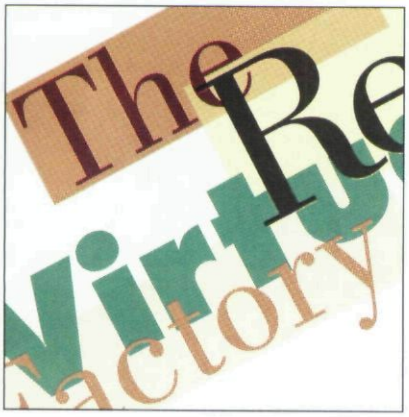
Although Upton and McAfee have made some illuminating points in their article, they have also made assumptions that current technological developments do not bear out. The authors are right on the mark in their discussion of how open standards are having an impact on information technology and expanding the electronic trading of critical documents between businesses and between departments. The open standards of the Internet have made possible, for the first time, the establishment of industry standards for the transmission of E-commerce documents and the presentation of data within those documents. As those standards are established over the coming months, E-commerce over the Internet will take off, and the number of companies participating in it will explode.

However, I do not see electronic data interchange dying the slow death that Upton and McAfee portray in their article. They are correct in stating that "conventional forms of EDI cannot satisfy all the demands of a virtual factory"; but EDI is quickly assimilating the open standards of the Internet as well as the pleasing user interfaces of World Wide Web technologies. As a result, EDI – "the oldest form of electronic collaboration among manufacturers" – is also becoming one of the newest forms of collaboration between trading partners. For in-

stance, forms-based EDI is an entry-level solution for smaller manufacturers who haven't been able to trade with larger partners. A small company using a forms-based EDI service doesn't need to purchase proprietary software or subscribe to a private network service. With a Web browser



and Internet access, the small company can access EDI forms that are located on the Web. The forms are filled out and then sent from the Web into the full-blown EDI service used by the large trading partner. At the same time, large manufacturing companies now can greatly expand the scope of their electronic-trading community by including their third- and fourth-tier trading partners, who typically haven't participated in electronic commerce.

The example of forms-based EDI over the Internet also shows how EDI can have an impact on a trading relationship before the "marriage" stage described in the article. Indeed, forms-based EDI over the Internet can facilitate an "engagement" and help develop it into a marriage partnership. And there are Internet-based services that can facilitate the "dating" stage between two companies that haven't done business together before.

Although Upton and McAfee have painted an intriguing picture of a virtual factory that uses what they call *internetworked telepresence*, they have dismissed too quickly the E-commerce tools that are available to manufacturers today. Those new tools incorporate much of the open technology – which they praise so highly – that makes the virtual factory possible. With newer forms of EDI, companies can reach more of their trading partners, exchange business data quickly, and rely on an information broker to manage their trading community for them.

David M. Upton and Andrew McAfee reply: These thoughtful responses bring up two important issues about virtual factories. The first is whether the model we propose for virtual factories will eliminate the models that came before it – including approaches using EDI, groupware, and wide-area networks – or instead subsume them. We believe that the latter will happen.

We do not predict a slow death for EDI. The transfer of documents is the most basic task for a virtual factory. The forms-based Internet EDI and other E-commerce applications that Chovnick describes are viable ways to accomplish that task. As he correctly points out, EDI's movement onto the Web will bring its benefits to inexperienced users of information technology and to partners who are only dating. However, those technologies still will serve primarily as vehicles for the electronic trading of documents. They will not bring to users the benefits of interactivity: telepresence and real-time access to data. Those capabilities are critical for virtual factories, which is why we stressed EDI's limits. We made similar arguments regarding groupware and wide-area networks. Those approaches will not disappear, but their valuable capabilities will be incorporated into more complete solutions.

A second issue is whether the Internet will continue to play a major role in those solutions. We are confident that it will. The Internet is a great boon both to users and to information brokers because it is cheap and easy to join and to leave. A virtual factory that uses it as a starting point is therefore immediately open to small companies and to those that are only exploring partnerships. If some of those partnerships last and need lots of dedicated bandwidth, an information broker can add it; it does not need to be hardwired from the outset.

That progression is very different from the planning and construction of high-bandwidth intranets proposed by Efteland and Martina for building virtual enterprises. They appear skeptical of the Internet's potential to accommodate partners' needs for growth. We are much more hopeful. As our case study points out, Aerotech and McDonnell Douglas Aerospace built a highly functional environment starting with only a few Internet connections. Their example shows that it is quite possible to have a smooth transition from a single network to a real virtual factory without having to make large up-front investments in dedicated bandwidth or prepare a detailed project plan.

REACHING AND CHANGING FRONTLINE EMPLOYEES

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The strong case for targeting frontline supervisors in change efforts put forth by T.J. and Sandar Larkin in "Reaching and Changing Frontline Employees" (May-June 1996) is based on incomplete research that was conducted in a business environment that no longer exists. It is designed more for shock value than for stock value.

Research conducted by Towers Perrin with the International Association of Business Communicators in the 1980s revealed that, overall, employees viewed their supervisors as preferred sources of information. But other data showed that top management was the preferred source of strategic information related to company plans and directions.

More to the point, however, is that the workplace has changed dramatically since the 1980s. With increasing emphasis on self-direction, virtual offices, spiderweb organizational structures, and telecommuting, we need to adopt more efficient and effective ways of moving information internally in order to achieve business strategies.