Technology Trends: 1993

Rapidly changing technology constantly provides new materials for building the information future. Informing the institution's long-range plan are key trends--with a four- to seven-year timeframe--summarized here. The institution will continue to track these evolving trends and align its activities to the emerging potential, as it advances its vision of connection, access, and integration.

Ubiquitous networking. Advances in telecommunications will turn computing into an "anytime, anywhere" activity. The nation's backbone networks for research and education will operate at gigabit capacities, with the help of Federal commitments to upgrade existing networks and fund research aimed, for example, at better ways to transmit data such as CAT scans and engineering blueprints. Almost all office computers will be physically connected by very high-capacity local area networks. Wireless technologies will allow mobile access without a physical connection, although capacity and reliability are not likely to catch up to approaches for a number of years. The cable and telephone industries are racing to connect America's homes to the emerging web. Ubiquitous, high-capacity communications are essential, in fact, to most of the trends reported here.

Mobile computing. Mobile computing is the other half of the "anytime, anywhere" equation. Notebook computers will become very powerful and very common. Untethered scholars and professionals will carry only what they must and assume the infrastructure will provide the rest--network connections, common software, storage, printers, etc. Business systems will increasingly collect data at the source, as pen, rudimentary speech, and scanner input technologies mature.

Merging of computing and communications. Computing and communications have for years been converging as voice, video, and data all become digital. Telephone, cable, and software companies have recently announced major joint ventures, spurred by competition to create the off-ramps and secondary roads that will take us from the "national data superhighway" envisioned by the Clinton/Gore administration to the driveways of our homes. While it's too soon to tell how the race to wire America will end, it's possible that we'll all be watching our telephones and answering our televisions by the end of the decade as the boundaries between phones, TVs, and computers begin to disintegrate. "Narrowcasting" hundreds of specialized channels, interactive television, video phone calls, and customized news packages with "tell me more" capabilities are predicted.

Multimedia for the rest of us. Multimedia--the mixing of text, video, still images, and sound--will become central to personal computing. As authoring tools get simpler and libraries of audio/visual clips become available, multimedia will become something you can make yourself as a homework assignment or conference presentation. Practical addition of full-motion video to the mix awaits expected advances in data compression and faster processors for personal computers.

The new textbook. Traditional survey textbooks, with their three- to four- year development cycle, are likely to be edged out of the marketplace by customized books published on demand, course packs assembled from a variety of sources, and multimedia disks such as "Perseus," a CD-ROM from Yale University Press that contains 25 volumes of Greek text, a Greek dictionary, and 6,000 photos and drawings of artifacts and archeological sites.

Interoperation, integration. The ability to mix and match hardware and software from a variety of vendors will substantially improve as vendors come to the conclusion that their markets will be constrained otherwise. Paired with advances in data management tools and networking, this "open systems" approach will make it easier to integrate bodies of data. Administrators will reap the benefits of a larger business picture. Research communities can also begin treating bodies of data as integrated--tracking related studies and building multiple-study databases, for example.

Commodity hardware, software stability. Hardware at almost all levels will increasingly become a commodity, with fewer and fewer differences among vendors. As with televisions today, brand will come to matter less than features. Traditionally, organizations have sought stability by standardizing to a family of hardware platforms. As the ability to work across platforms improves, stability will mean standardizing to the user interface and a familiar set of personal productivity software.

"User-centric" computing. The individual is moving to the center of the computing universe, thinking and working in familiar ways instead of having to adapt to the technology. One development is the compound document, in which data, applications, etc. are "attached" to the document, rather than the other way around. The links can be "live," so that data updated elsewhere is automatically reflected in the document. The document is the organizing principle for the relevant text, sound, video, etc., along with their supporting applications. Personal productivity software--another aspect of "user-centric" computing--will flourish, with genres such as "personal assistants" becoming as common as word processing today.

Client/server model. The client/server approach to computing will mature and dominate, as open systems standards and the necessary base of development tools emerge. In this model, application software is divided among computers of different sizes in different locations so each function can be done where most effective. "Clients," usually personal computers, interact with a number of "servers" that provide data, computational power, or other services as needed. The servers--mainframes, powerful workstations, novel printing devices, etc.---can be located almost anywhere. The network ties the components together. This approach lets people interact with a vast range of sources through the familiar user interface of their personal computer. This flexible, modular strategy also breathes new life into the possibility of integrating data and systems by building many smaller applications that can communicate and cooperate.

More power in the user's hands. A range of powerful computing options will be available to individuals. More sophisticated notebook computers will be the only machines many faculty, students, and staff will need. Much of the research traditionally done on mainframes is already moving rapidly to workstations with advanced multimedia and numerical capabilities. Specialized servers on the network will provide additional capabilities such as high performance computing, printing, file storage, and electronic mail.

A switch in metaphors. Today's graphical user interfaces employ the metaphor of manipulating objects on a desktop. The desktop metaphor is likely to be replaced by the "agent" metaphor as the strategy of delegation replaces the strategy of making it easier and easier to find it yourself. Swamped by information, people will turn increasingly to interfaces that "know" enough about their habits and preferences to help locate and filter that information. Individually tailored filters, based on artificial intelligence techniques, will be able to comb the network, for example, inspecting and understanding information regardless of the form in which it is expressed, selecting what is relevant. The filter might be instructed to deliver a percentage of more broadly conceived information to preserve the serendipitous pleasure of "browsing the shelves."

Computer support for collaborative work. More software will be written for the way many people actually work--collaboratively and in groups. Editing, collaborative writing, group brainstorming, conferencing and other activities will be supported by real-time, multimedia technologies. Tools that let groups view and amend the same multimedia workspace will be common. As advances in telecommunications make computing an "anytime, anywhere" activity, groups can likewise exist anytime, anywhere.

Behind the scenes. As computing becomes a user-centered, highly networked activity, servers working behind the scenes are critical--and it's not yet clear where advanced server technology is headed. One likely direction is large mainframes that harness thousands of small processors working in parallel on the same task, for massive power in modular increments. Another approach sets clusters of workstations on the same task, using the network to move data and instructions around. As networking technology advances, the workstations are likely to rival the performance of the new mainframe.

The potential is extraordinary. So too are the challenges--rebuilding, migration, integration, flexibility, standards, reliability. And the technical concerns are less formidable than the organizational, cultural, and financial challenges. The institution has begun this planning effort in the hope of steering a wise course.