



## This year, the Air & Waste Management

Association celebrates its centennial. The past 100 years have yielded remarkable technological advances, especially in the area of information technology (IT). Within our professional lifetimes, we have shifted from using manually typed memos and reports, pink telephone message slips and pagers to computer-generated reports, Internet data exchange, e-mail, and cell phones—now necessary tools for environment, health, and safety (EH&S) professionals. In a relatively short period, we have gone from a few mainframe computer air dispersion modeling programs to hundreds of Web- or PC-based software applications for air dispersion and groundwater modeling, geospatial data display, incident and greenhouse gas tracking, environmental management systems, and a myriad of other purposes.

This article highlights six information technologies that have had a profound impact on the way we work today.

### A PC ON EVERY DESK

Three developments were crucial to invention of the personal computer (PC)—the transistor, the integrated circuit, and a way to input data. Bell Laboratories invented the transistor in 1947 and Texas Instruments developed the integrated circuit in 1958. Douglas Engelbart of Stanford Research Institute demonstrated a keyboard, keypad, and mouse at the Joint Computer Conference in San Francisco in 1968. Intel was founded in 1968, and within a decade, Microsoft Corp. and Apple Computer followed (1975 and 1976, respectively).

IBM, whose roots trace to the 1880s, introduced the PC/AT in 1984 with a 6-MHz processor, 256-KB RAM, and 1.2-MB floppy disk drive for US\$4000. Today, most everyone owns a desktop or notebook PC, or both. A 4-lb notebook computer with a 2-GHz processor, 2-GB RAM, 120-MB hard drive, and wireless networking capabilities now costs less

than \$1900. Less feature-packed desktop and notebook PCs cost as little as \$350.

### SPREADSHEETS TAKE ON THE WORLD

Electronic spreadsheets have been around for almost 30 years. In 1978, VisiCalc was the first spreadsheet program available for PCs. Developed for Apple by Dan Bricklin and Bob Frankston, it is generally considered the application that turned the microcomputer into a serious business tool. Its developers copyrighted, but did not patent, VisiCalc—patent laws had not yet been applied to software—allowing others to “clone” the idea of an electronic spreadsheet. Mitchell Kapor co-founded Lotus Development Corp. in 1982. He designed Lotus 1-2-3, the spreadsheet “killer application” that probably had the greatest long-lasting impact on business productivity. Microsoft Excel became available for Mac OS computers in 1985 and for Windows 2.0 in 1987. The rest is history, as they say.

### THE INTERNET AND THE WORLD WIDE WEB

The Internet is a “network of networks”—a collection of interconnected computer networks linked by copper wires, fiber-optic cables, and wireless connections. The World Wide Web is a collection of interconnected documents and other resources, linked by hyperlinks and uniform resource

**“The advance of technology is based on making it fit in so that you don't really even notice it, so it's part of everyday life!”**

**— Bill Gates, co-founder, Microsoft Corp.**

locators (URLs). Users access the Web and many other services, including e-mail, via the Internet (see sidebar opposite “A Brief History of the Internet”).

### E-MAIL IS WHERE IT'S @

Electronic mail, or e-mail, has had one of the greatest impacts on business in the past 20 years. Invented in 1971 as a program to read, file, forward, and respond to messages, e-mail took off with the widespread use of PCs in the 1980s, and ultimately, the development of the Internet. E-mail has, in many cases, replaced telephone voice mail and fax machines as the primary form of business communication.

### GIS MAPS THE WORLD

The Great Trigonometric Survey of India commenced in 1802. In 1908, Wilbur Wright's passenger took the first aerial photographs. In 1957, Russia launched Sputnik, enabling photographs of Earth from space. In the 1960s, the first meteorological satellite launch occurred, the Canadian Geographic Information Systems was established, and India continued its extensive mapping efforts. In 1969,

## A BRIEF HISTORY OF THE INTERNET

- 1957 Russians launch the Sputnik satellite.
- 1959 Advanced Research Projects Agency (ARPA) forms within the Pentagon to establish an American lead in military science and technology.
- 1960 ARPANET is born: an internet is conceived.
- 1969 Pentagon commissions ARPANET for research into networking.
- 1970 Vinton Cerf and others publish their first proposals for protocols to allow computers to “talk” to each other. ARPANET begins operating Network Control Protocol (NCP), the first host-to-host protocol.
- 1974 Vinton Cerf and Bob Kahn present their “Protocol for Packet Network Interconnection” with detailed design for “Transmission Control Program” (TCP)—the basis of the modern Internet.
- 1978 TCP splits into TCP (now Transmission Control Protocol) and IP (Internet Protocol).
- 1982 TCP/IP becomes the protocol for ARPANET. One of the first definitions of an internet is a connected set of networks using TCP/IP, but “the Internet” is defined as all connected TCP/IP internets.
- 1990 Tim Berners-Lee starts work on a hypertext graphical user interface (GUI) browser and editor.
- 1991 The first World Wide Web (WWW) files are made available on the Internet for download using File Transfer Protocol (FTP).
- 1993 In October, there were around 200 known HTTP servers. Within a year, there would be thousands.

Source: [www.connected-earth.com/Galleries/Frombuttonstobytes/ComputerNetworks/DevelopmentoftheInternet/index.htm](http://www.connected-earth.com/Galleries/Frombuttonstobytes/ComputerNetworks/DevelopmentoftheInternet/index.htm)

the privately held Environmental Science Research Institute (ESRI) formed, preceding the formation of the U.S. National Oceanic and Atmospheric Administration in 1970. In the 1980s, ESRI developed geographic information systems (GIS) technology. In 1985, the Global Positioning Satellite (GPS) was launched, allowing real-time “location technology.” In 1986, MapInfo was founded and, in the same year, ESRI sold the first PC-based GIS software. In the late 1990s, Web-based GIS software became available, integrating local data with Internet data.

### CELL PHONES AND SMARTPHONES

Cellular (mobile) phones have gone from being rare and expensive pieces of businesses equipment to common low-cost personal items. In many countries, mobile phones now outnumber land-line telephones (see [www.connected-earth.com](http://www.connected-earth.com)). Cell phones have taken the place

of pagers, providing instant connectivity, mobility, and GPS location information. Like cell phones, smartphones began as expensive devices limited to business users and “techie” where cost is no object. Manufacturers have recently rolled out a new breed of smartphones designed for consumers. Sleek, compact, and multifunctional, these phones are becoming more affordable for the estimated 200 million cell-phone users in the United States (see “Blackberry and Beyond,” *San Francisco Chronicle*, October 23, 2006).

### ARE WE THERE YET?

As a child, my family took many road trips in our station wagon. On these journeys, we knew the destination, and usually knew the route. I don’t really recall asking, “Are we there yet?,” but I certainly was glad to reach our destination, as pleasant times lay ahead. Often, with information technology, we know neither the destination nor the route. And often we are sidetracked by something interesting along the way. We have had an interesting journey so far, applying IT tools to EH&S management. It is hard to predict where future technologies will take us. In the near term, we can expect wider adoption of improved communications and collaboration tools; growing delivery of software via the Internet or company intranets; and robust decision-making and reporting tools. I know that we are not there yet. **em**



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