RECORD OF SOCIETY OF ACTUARIES
1993 VOL. 19 NO. 4A

COMPUTER BUZZWORDS

Moderator: ALLEN J. ROTHMAN
Panelists: JOSEPH T. BROPHY
JOHN F. KALNBERG
Recorder: ALLEN J. ROTHMAN

- *Expert systems, object orientation, artificial intelligence, software engineering,* open systems, fuzzy logic, image, EDI, GUI, CASE, database management system (DBMS). . . . First, we'll define the jargon and any other alphabet-soup phrases. Then we'll find out what other actuaries think about some of the latest technologies. Are the vendors overstating the real value? Under what conditions are they practical today?

MR. ALLEN J. ROTHMAN: John will lead off by discussing computer buzzwords in general and a bit about operating systems. John is an associate consulting actuary at Buck Consultants and graduated from Fordham University. He currently has responsibility for training support at Buck. I'm director of technical resources at Actuarial Sciences Associates and will follow John with a discussion of a few of the currently-in-vogue buzzwords and their perils. Joe Brophy, who will be our last speaker, probably doesn't need an introduction; most of you already know who he is. He currently serves as cochairman of the Workgroup on Electronic Data Interchange (WEDI). He has worked with Hillary Rodham Clinton on health care reform, served as president of Travelers Insurance Company and has been chief executive officer (CEO) of Travelers' health businesses.

MR. JOHN F. KALNBERG: I have the easy things to talk about. I'll be going over some general principles and mentioning some odds and ends. Joe and Allen will get more specific and more detailed as we go on.

One of the things that I've been doing over the last two years is training our actuarial users, and I've been manning the help desk for actuarial software. I spent ten years on the other side of the fence as a user before that. So now I'm in the unenviable position of having to tell the actuarial users why we can't do what they want and telling the systems people why the users want to do certain things. So it puts me in a good position to speak about buzzwords.

First, I'd like to answer the question, why do we care about computer buzzwords? I think a lot of us care because we're all part "hackers," which is our first buzzword of the day. I'm sure you've all heard about those 18-year-old kids who are sitting home working on their computer, trying to break into the Defense Department secrets and learn how to make hydrogen bombs. Well, there's a little bit of that larceny in a lot of actuaries. We all come from the same kind of training that many computer programmers come from. Computers aren't foreign to us, we don't freak out about computers the way many people do. We're used to not knowing exactly what the answer is going to be, and we get into playing. For many of us this is part of our regular job. We use the computer a lot, especially with the advent of personal computers. Everybody's working on Lotus, a database, or maybe working on some company system. We're all familiar with them; we aren't intimidated by them, and that gives us just enough knowledge to be dangerous sometimes.

One of the things that's happened on the other side of the fence (on the systems side) is that many systems departments have changed. Twenty years ago when you dealt with the systems department you heard, "Yes, we can do that for you. It's no problem." But now we've gotten to the point where users expect that systems people can do anything, and the systems departments are more often put into the position of saying no, or saying, "We can do that, but it's going to cost you a lot of money and you're not going to see it for three years." So the attitudes are changing. The products that are being put out by the systems departments are becoming more open. In the past, you would deal with the systems department for something specific, such as a report that you needed or a system for inputting data on the mainframe. But it was limited. You didn't have a lot of options on what to do with it. Now, these things are becoming much more open. You set up database systems where different people can effect different parts of it. Security becomes more important because you're going to have several people putting data into this database, and you want to make sure that only certain people can put in only the things that they're supposed to. You don't want somebody from one section updating some kind of corporate database and wiping out all your sales data or something.

As a result, the solutions that you're getting are much more open, which means that the people who are actually using the tools have to know a lot more than they ever did. In the past, when you received a hard copy report, you could read it and say that yes, this is what you told them and that was all the computer stuff you needed to know. Now you're going to have to know how to interact with these more open systems if you really want to get the best advantage out of them. All these trends are only going to get worse. What's happening more and more is that the need for hard core computer programmers is going away. There are more computer languages in which mere mortals can program. There will still be technical people working for companies like Microsoft and Lotus, but we're moving to the point where the individual users in a company are doing their own programming. It's going to become more important and at the same time a little scary when I look at this trend. I have a five-year-old daughter who has been taking computer classes for two years. When we unpacked our new computer at our home last year, she said "That's the mouse and that's the mouse's tail, and this is the computer's brain." I know how to work our personal computer (PC) and our video cassette recorder (VCR), yet when I compare that to what my parents know and to what my five-year-old knows, just imagine where we're going to be 20 years from now! Computer literacy is going to be increasingly important, and you're going to see people coming out of college having more exposure to computers and programming. I think you'll see that the entry-level people are going to have a greater impact. They're going to have more knowledge. People who are already established in the workplace are going to be required to learn more to keep abreast of what's going on in the computer world.

Now what should we know about all these buzzwords? One of the things I get to do now is go to meetings with computer programmers. It's another thing I learned; it's kind of different. When we go to a meeting or you get into a discussion with a lot of systems people, they start talking this funny language that nobody's ever heard, and it's very easy to lapse into it. But the first thing to do is not be intimidated by any of the stuff you hear spoken. Don't be afraid to ask. I've met a fair share of computer professionals who drop phrases like "client/server database object-oriented programming" and when push comes to shove and you ask them what that means

or what they are talking about, they really don't know. So I think it's important not to be afraid to ask and not to let these people try to intimidate you by dropping all these buzzwords.

The best way to learn anything about computers is to play. One of the greatest things I've seen, now that the PCs have come around, is that it's the best way to get people to do junk work. If you want some senior consultant or some senior vice president to do junk work, give them a PC. They'll do these notebook sheets; they'll do these beginner's all-purpose symbolic instruction code (BASIC) calculations; they'll type letters, they'll type memos. You can get people to do anything if you just give them something to play with. I think the best way you learn about lots of this is by playing with it. I was fortunate to have a client that needed lots of work done in Lotus when it first came out, so I spent a whole summer hacking away, and that's the way to pick it up. Don't be afraid; there's nothing you can seriously break on a PC as long as it's backed up and you don't spill your coffee on it or anything like that. Most of the systems people wouldn't let you, so don't worry. You're probably safe.

Another thing to be aware of is what's going on in the computer world. You can learn a lot of this from reading *The New York Times,* which has a science section on Tuesdays. There are usually a couple of articles on the computer industry. There are some general trade magazines that many of you probably are reading already – magazines such as *PC World* and *PC Magazine*. You don't necessarily have to read these from cover to cover, but scanning them every once in a while, even just scanning the ads, can be helpful to keep up with what's going on in the world. You learn a lot just from scanning through the ads, seeing what's out there, and getting familiar with it. It will really help you when you're dealing with your systems people because it will help you have realistic expectations of what the software can give you. You hear a lot of great things, and many of these machines can do a large extent of what you want, but there are trade-offs involved with anything. There's the expense of development. There's the expense of maintenance. So you need to make decisions about which of these technologies are worth pursuing, and I think you can help yourself a long way by just keeping abreast.

Now that we've gone over some of the preliminaries, I'd like to talk about some buzzwords. First, I'll talk about a few emerging trends that we've been exposed to. Later, Allen and Joe are going to talk about more. One thing that you hear everyone talking about now is operating systems, the software that makes the computer run. Without an operating system, you've just got a hunk of metal sitting there. What most computers have used in the business world has been either MS DOS or the DOS used on Apple computers. The operating systems world is in the middle of a big change. Using DOS requires that you know a lot of stuff. You have to look up syntax in the manuals. You need to know when to put in a colon. Does this need a blank? What does an asterisk-dot-asterisk mean? You need to know a lot, and you spend lots of time going back to the manuals.

But now we're moving to graphical user interfaces (GUIs). What this means is that instead of having to remember names, you have to remember pictures. What researchers found is that it's easier to remember things that are visual. For example, if you see a picture of a file cabinet, that's your file manager. A lot of these have built-in help associated with them so that if you don't know how to do something,

you just hit F1 and a screen drops down that will take you through what you need to know. So it's not like going through your piles of manuals. Now everything's built right into the machine. The two most popular choices of these new operating systems are Windows and OS/2. Debating them is like debating religion or politics. The people who like one can't see why anybody in their right mind would want the other. What we're doing at my company is going to Microsoft Windows because there's a large installed base of software for it. OS/2 is also a fantastic product. OS/2 does a lot of what Windows does, only better. OS/2 is IBM's version of a GUI and there are a lot of people who absolutely swear by it.

The one thing to remember when you're dealing with PCs is that you're dealing with mainframes of 20 years ago. A lot of what we're spending our time developing right now are things like security measures, file back-up, and file management. There are very good solutions available for these on the mainframe, but nothing yet built into the PC. So a lot of PC development is reinventing what worked on the mainframe. But the big difference is the ease of use. These products are really going to open up computers to the masses.

Using the graphical user interface, you click on icons, enabling you to do more than one thing at a time. You can set something up to run and leave it running, then flip over to something else, such as working on a worksheet or a document, and then you can bring up each one on half of the screen and you can drag the information over to the other application, which makes it a lot easier. If any of you are used to working with big reports where you have your actuarial staff do everything on a PC and then you give it to a secretary who will type the report, this makes moving the information back and forth a lot easier. The one difference that it makes, though, is that it means a lot more of your actuaries are doing a lot more secretarial work, and it really requires that the actuaries be familiar with the word processing tools that your company is using. One of things that we've seen is that the actuaries know Lotus, and the secretaries know WordPerfect. When an actuary tries to talk to his or her secretary about what he or she wants to put in the report, it does not compute. They're talking totally different languages; they have no idea what's going on with each other. So now actuaries are having to learn more word processing. The benefit is that it's a lot easier to use once you get over that first month or so of the learning curve.

When you first start, mice seem to be something that really get people's Irish up. I have had so many people say to me, "I'm not using that mouse. You can put me on Windows, but I'm not using that mouse. I hate that mouse." It takes a little while, but as with any new operating system, you wind up sitting there cursing at your machine for a month. But once you're past that, it makes work a lot easier. The problem with it is that these things often have big learning curves. A lot of people think that Windows or OS/2 is going to make the world safe for democracy, be the best thing since sliced bread, automatically overnight make your company 50% more efficient. It isn't going to happen. What is going to happen is that over the long term, people will be working more efficiently. But the first day that you put this up, it's going to take a lot longer for people to get their work done. These things aren't penicillin; they're not the cure for the common cold. They're just an evolutionary thing to make people's life a little easier.

Another thing is that GUIs require a lot more hardware. They require a lot more computing power. I don't know if any of you worked on the old Lotus 1.0 that worked on the IBM 8086 machines. Those machines did a lot, but they weren't like the current machines. The machines that we're working with, the 486s, are similar to the mainframes that we were working on in the early 1970s, but these machines are a lot more powerful. All the stuff that goes on the screen, the WYSIWYG, "what you see is what you get," eats up lots of memory and takes up a lot of computer resources. If you want to be able to really use Windows, you probably need a 386 or better machine. For many organizations, that means investing a lot of money in upgrading. So what you're seeing not only in the consulting and insurance industries, but in industry in general, is an evolutionary process. The whole company isn't going on to Windows or OS/2. Users are being brought on a few at a time. It's probably going to be another couple of years before you see the majority of companies upgraded.

When you first get these applications installed, there is a lot more extensive training and support than what you're used to dealing with. Much of what I support now is mainframe applications. If somebody in our Honolulu office has a bug and they can't figure out what to do about it, they call me up, I fetch the program that they're in, I view their output results on my machine, and then we work through it and I may try some stuff to see if I can get it to work. It's not like that on the PCs. With PCs, there are a million different settings that you can set on them, and tracking and supporting them are going to be a lot harder. So I think there's going to be a greater need for support from the management information systems (MIS) area once you get these things out and available.

Another thing that you often hear about these days are local area networks (LANs), and they're very important for a lot of the things that we do. They're very helpful. They allow you to share information, they let you use electronic mail (E-mail). They let you send spreadsheets and other things back and forth between different people. They let a group of people work on the same spreadsheet or the same database. You can get into some of the applications that are client/server, but they have their costs and their dangers. One of their problems is that there's more hardware cost involved with them. Each machine needs a card to be able to hook in to these networks, and you need file servers. A file server is not just another mainframe. It's another PC, so you need to develop a procedure for backing up the files. On mainframes, that's nice and easy and automatic; but with file servers, there are lots of kinks still being worked out. There are no great ways of doing it. Standards need to be set up. A lot of the software still needs to be developed. It's still in its infancy. Ultimately, it's going to promise great improvements to people, but right now there are still many glitches. All you read in the ads are the things that work. You don't see in the ads any of the horror stories of things that haven't worked, but there's plenty of them out there.

Another advantage of getting on LANs is they let you share software, which is useful for maintaining in-house programs, especially the legacy programs. A LAN is a great way to store it because you can keep it in one place, and if you have to make any fixes to it, you put your fix out and it fixes it for everybody. Many times what I hear in our place is, "If the systems department isn't going to cooperate with us, we're just going to throw it out on the C drive." Well, that gets you past the systems

department initially, but if you're dealing with programs where there are periodic changes or you have tables that have to be updated, having it on everybody's C drive is going to be difficult to control. There's no way that you're going to be able to ensure that everybody's running a current version of the program. But having a LAN and having all your cooperative software on there protects you by allowing you to make fixes when you need to and making sure that everybody gets them. It also protects you because it keeps the software where you know it is. If you have any really big programs, it also keeps people from making copies of them. LANs do require some training. They involve a lot of support. They require human LAN managers, which isn't bad if you have a big, centralized location. If you have isolated locations, the person who ends up as LAN manager out there is the person who likes computers the most. I think you're going to see more and more LANs in industry and ultimately, the LANs are going to do a lot of what we're used to seeing the mainframes do.

The last thing I have to discuss is migrating software to the PC. Another great myth is "if you put it on the PC, it runs cheaper." It just isn't true. If you put an application on a PC, there are a lot of hidden charges that people aren't paying attention to, things like updates and maintenance. Just having something on the PC doesn't make it run cheaper. There's security involved in using a mainframe, things like nightly backups. If you blow out a file server, you may have to go back a few days before you get the copy of what you're looking for, depending on what your company's backup schedule is. Most mainframes are backed up nightly. A lot of the mainframes are much safer and it's something that many people don't appreciate. There are always going to be mainframes around, or at least I think so, for the indefinite future, because mainframes can do things that PCs can't. First, they have a huge repository of disk storage that is really fast and easy to control. I think the disk packs alone will keep the mainframes around. You also have a central area for communications, which you're going to need one way or the other, and you also have the processing hardware that the PC still can't keep up with. We're in the process of bringing all our valuation software down to the PC, and everybody at our company is excited because now they think that they're going to get their valuations for free. One of the things that I've done is run a pension valuation for 1,000 people on my machine at home, which is a 486, in 5 to 10 minutes, but I've also run a postretirement medical valuation, using 50 trials of stochastic processing for 50,000 lives. I started my machine on Friday night at about 10:00 and finally unplugged it on a Tuesday night, and it hadn't finished running. Mainframes aren't going to go away. They're going to be here for a long time to come just because there are things they can do that PCs can't.

When does it make sense to migrate to a PC? When you have applications that you can run in isolation, or versions of what you're running on the mainframe, PCs are probably a good choice. You're not going to see a lot of people migrating programs that they've been running for 20 years on the mainframe just because there are PCs. What's going to happen with migration is evolutionary. You're going to see some of the software migrate as they bring down what is currently running on the mainframe and put a nice front end on it. You're not going to see people throwing out programs that took three or four years to develop. There are no companies out there that can afford to do that. There also are other changes that become necessary when you bring programs down to the PC. When you're working on the mainframe, you need

more computer knowledge. You have to know what goes in column 37 of a particular control card, or you need to know how to format something to do things. When you get the programs down to a PC, the first thing you see added is some kind of front end to allow you to code it easier. There are some nice screen programs for mainframe programming, but there are more things you can do on a PC. You can drag information across applications, you have position-sensitive help and drag-and-drop menus of things you can select.

The other thing that you wind up changing is the print trail. Let's assume you have a program that gives you a report that's one or two inches thick. Well, that may be great coming off the mainframe, but when you're on the PC you'd use a ream of laser paper. That's a lot of paper and that means that the secretary, or whoever else is attached to that printer, can't print out any letters while you're printing your report. So one thing that winds up happening is that the output gets redone. I think you're going to see more applications migrating to the PC, but I think it's going to take a while before they get there.

MR. ROTHMAN: John has just given us an overview of buzzwords. I'd like to expand on that by addressing two of the current crop of buzz phrases along with some introductory remarks about their inherent perils.

When Alice Liddel passed through the looking glass, she encountered one creature in particular who would have been the perfect panelist for today's discussion -- Humpty Dumpty. Humpty Dumpty understood the sensitivity of words to context, and that words have no intrinsic meaning, only that meaning assigned by their user or by the listener.

"There's glory for you!"

"I don't know what you mean by glory," Alice said.

Humpty Dumpty smiled contemptuously. "Of course you don't -- till I tell you. I meant 'there's a nice knock-down argument for you!'"

"But 'glory' doesn't mean 'a nice knock-down argument'," Alice objected.

"When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean -- neither more nor less."

"The question is," said Alice, "whether you *can* make words mean so many different things."

"The question is," said Humpty Dumpty, "which is to be master -- that's all."

So it is with the computer buzzwords. What the user means them to be is not what is perceived by the listener. Let's examine briefly what happened to artificial intelligence (AI).

When Joseph Weizenbaum wrote ELIZA in 1965, he intended it to address several technical problems with natural language processing by machines. That is,

programming computers to communicate with humans in other than formal, programming languages: the identification of key words in a sentence, the discovery of "minimal context" or meaning, the choice of appropriate transformations of the input sentence, and the generation of responses in the absence of key words.

As a demonstration of the capabilities of ELIZA to simulate human response, Weizenbaum created DOCTOR, an ELIZA "script" that played psychiatrist.

Men are all alike
IN WHAT WAY
They're always bugging us about something or other
CAN YOU THINK OF A SPECIFIC EXAMPLE
Well, my boyfriend made me come here
YOUR BOYFRIEND MADE YOU COME HERE
He says I'm depressed much of the time
I AM SORRY TO HEAR YOU ARE DEPRESSED
It's true. I am unhappy
DO YOU THINK COMING HERE WILL HELP NOT TO BE UNHAPPY
I need some help, that much seems certain
WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP
Perhaps I could learn to get along with my mother
TELL MORE ABOUT YOUR FAMILY

And so it goes. This now classic example of a dialogue between a human and ELIZA playing doctor was taken by many to be proof-positive that computers could be taught to think, that artificial intelligence research would eventually lead to a complete understanding of thinking, learning, even soul. Ten years later, by the time that Weizenbaum published *Computer Power and Human Reason*, the damage had been done: the buzzwords "artificial intelligence" meant whatever you wanted them to mean and the potential power of such systems as ELIZA obscured their potential evils.

And AI begot "expert systems." The premise here seemed to be: if all human thought is logical, and experts represent the epitome of logical thought in a given domain, then we can build systems that capture the essence of the expert, allowing for widespread distribution of the expert's knowledge. Companies wouldn't suffer anymore when their avowed experts retired. You wouldn't need to travel thousands of miles to receive "expert" medical care. The researchers would build a program that would allow your auto mechanic to perform open heart surgery or at least diagnose problems and fix them in any car ever made. At least that's what we thought the researchers were saying. So we built or bought "expert system shells," which were the engines that would operate on the codified knowledge of the experts. We identified the expert underwriters and sales representatives, and we interviewed them ad nauseam, only to find the fatal flaw in the logic: experts don't always know how they reach decisions; they somehow sense solutions rather than follow the logical, mechanistic steps we needed.

The promise of artificial intelligence somewhat diminished; we built "decision-support systems" and found other uses for the techniques that had been created. Object-oriented programming, which has become of its own right one of the most touted,

yet least understood buzzwords, began as "frames" in artificial intelligence languages. Natural language processing became voice recognition and has been moderately successful. Eventually, we will have Stanley Kubrick's HAL, but the fact that we allowed expectations to go unchecked has left many with a bad taste in their mouths about artificial intelligence.

More recently, we have been confronted with a new buzz phrase, virtual reality (VR). Like its predecessor, artificial intelligence, VR seems, at first, to be whatever you want it to be.

As we all learned in Psych 101, "perception is reality." Your dreams are real, at least at the time. Who hasn't awaken from a nightmare in a sweat? And by substituting stimuli, researchers have found ways to fool the brain -- commercial flight simulators tilt and turn to simulate G-forces while feeding appropriate visual and auditory inputs. NASA trains astronauts, in case they ever launch them, by simulating weightlessness through enclosed freefall; and some in the 1960s did it with hallucinogenic drugs.

In the second edition of *Digital Doings*, the Computer Science Section's newsletter, there was an article entitled *The Actuary in Cyberspace* after the buzzword from the novel *Neuromancer*. In this article, Faye Albert and Irwin Vanderhoof discuss virtual reality, that is, techniques that completely substitute some or all sensory inputs. I recommend it as a good overview of what the buzzword encompasses. Immersive VR uses helmets that sense movement and modify visual and auditory stimuli appropriately, and special gloves that detect motion and give tactile feedback, while also modifying the visual display, allowing the user to be completely immersed in and interacting with the virtual world. Nonimmersive techniques allow interaction without the use of special head-mounted displays. One system that has applicability in actuarial work uses a metaphor called "worlds within worlds." The n-Vision system, developed by Feiner at Columbia University, exploits 3-D to visualize n-dimensional business data. Multivariate functions can be displayed using nested coordinate systems and manipulated using special gloves that allow interaction with the data directly.

Virtual reality has itself spawned a new buzzword -- "augmented reality." Here, instead of substituting visual stimulus in its entirety, it is augmented. Most of you have seen films of the "heads-up displays" in modern fighter aircraft or experienced the projected instrumentation available on some cars. Imagine instead that you are wearing a virtual reality helmet, one that detects your head position, possibly even where your eyes are gazing. (Eye-gaze detection is already in use on some 35-mm cameras; rather than focusing on the object in the center of the viewfinder, they detect where you are looking and choose that as the object to focus on.) The main difference between this unit and the one used in immersive virtual reality is that it is both see-through and hear-through. By merging projected virtual objects with real objects, a system known as knowledge-based augmented reality maintenance assistance (KARMA), also by Feiner of Columbia, superimposes graphical and textual information on real-world objects and can, for example, guide its user through the operation and repair of a laser printer.

But, of course, this buzzword also comes with its problems, caused in part by uncontrolled expectations. Despite what the Moody Blues sang, Timothy Leary is not

dead. He's alive and well and an advocate of recreational virtual reality, having designed the programs for Light, Wisdom, and Sound, a night club in New York City. In true form, and much to the chagrin of valid researchers, Leary's ravings about virtual sex and electronic LSD get more press time than real applications, creating the same dilemma faced by the original AI researchers – how do you limit expectations while still garnering grants? And even without Leary, the popular misconceptions that VR is somehow drug-like, aided by Steven King's film *Lawnmower Man*, or that direct neural connections, as described in William Gibson's *Neuromancer*, are on the near horizon, have caused some to shun the term "virtual reality" in favor of more restrictive labels such as "virtual environments."

This brings us to what I consider the most overused and poorly understood buzzword around – the data superhighway. Indeed, recent news of the merger of Bell Atlantic with Tele-Communications, Inc., brought out every semi-informed "expert" in the country to tell us what the superhighway is and how it's going to help us interact. Let's see how the government defines the superhighway, or National Information Infrastructure (NII):

> All Americans have a stake in the construction of an advanced national information infrastructure, a seamless web of communications networks, computers, databases, and consumer electronics that will put vast amounts of information at users' fingertips. Development of the NII can help unleash an information revolution that will change forever the way people live, work, and interact with each other.

But, as we've seen with artificial intelligence and virtual reality, there is just enough left to the imagination here to cause unrealistic expectations. The *National Information Infrastructure: Agenda for Action*, from which the definition comes, goes on to define the principles and objectives guiding government involvement in the NII:

- To promote private sector investment
- To ensure affordable and available access
- To promote technological innovation
- To "promote seamless, interactive, user-driven operation"
- To ensure security and reliability
- To improve frequency management
- To protect intellectual property rights
- To coordinate with other levels of government and with other nations
- To provide access to government information and to improve government procurement.

Let's examine each of these in turn.

1. Promote Private Sector Investment. The private sector has in recent years invested $50 billion annually in the existing telecommunications infrastructure, the voice, data, and cable television connections across the country. The President's 1994 fiscal year budget included less than $2 billion for the NII. How, then, do you induce investment? The NII includes two proposals – to provide investment tax credits, including a three-year extension of the research and development tax credit, along with a targeted capital-gains reduction for investment in small

businesses, and to pass legislation that increases telecommunications industry competition. President Clinton has signed the investment tax credit revisions. The Telecommunications Infrastructure Act of 1993 (S 1086) proposes lifting restrictions on the regional telephone companies and cable television companies, allowing them to compete. The services these companies would provide have sometimes been referred to as the "on ramps" to the data superhighway.

2. Ensure Affordable and Available Access. The Communications Act of 1934 established a concept of universal access to telephone service. The Department of Commerce's National Telecommunications and Information Administration (NTIA) will begin hearings on extending this to include access to the NII.

3. Promote Technological Innovation. The High-Performance Computing Act of 1991 established the high-performance computing and communications (HPCC) Program to fund research and development in the areas of more powerful computers, faster networks, and more sophisticated software. The 1994 fiscal year budget included $1 billion for continuation of HPCC program, plus an additional $96 million to start a new component of HPCC, the Information Infrastructure Technologies and Applications (IITA). An NII Pilot Programs Project, which would provide matching grants to state and local governments, health care providers, school districts, libraries, universities, and other nonprofit entities, has also been proposed.

4. "Promote Seamless, Interactive, User-Driven Operation." I won't even try to explain this, but will instead rely on the *Action Agenda*'s description:

> Because the NII will be a network of networks, information must be transferable over the disparate networks easily, accurately, and without compromising the content of the messages. Moreover, the NII will be of maximum value to users if it is sufficiently 'open' and interactive so that users can develop new service and applications or exchange information among themselves, without waiting for services to be offered by the firms that operate the NII. In this way users will develop new 'electronic communities' and share knowledge and experiences that can improve the way that they learn, work, play, and participate in the American democracy.

The administration proposes to accomplish this by establishing a panel that will review the role of government in establishing standards.

5. Ensure Security and Reliability. If the NII is to be successful, it must be both secure and reliable. The administration proposes to have the Information Infrastructure Task Force (IITF), headed by Ron Brown, the Secretary of Commerce, investigate both the policies necessary and the role of government in the protection of individual privacy. Encryption standards will also be reviewed. Reliability concerns will be coordinated by the Federal Communications Commission's Network Reliability Council, the National Communications System's National Security Telecommunications Advisory Committee and the Advisory Council on the National Information Infrastructure.

6. Improve Frequency Management. One of the key components of the NII will be the use of wireless technologies. The streamlining of government use of the radio frequency spectrum was included in the Omnibus Budget and Reconciliation Act of 1993. An additional provision of the NII is the establishment of "spectrum auctions" to allocate the frequencies.

7. Protect Intellectual Property Rights. A key concern of the administration is that copyright and intellectual property rights may be violated on the data superhighway. The IITF has been given responsibility for reviewing domestic and international copyright and intellectual property laws and proposing new means for the identification and payment of royalties.

8. Coordinate with Other Levels of Government and with Other Nations. This is self-explanatory. The NII, and eventually a global network, will cross numerous political and legislative boundaries. Just as with other forms of commerce, there needs to be an examination of foreign and domestic trade regulations and a coordination among the parties at interest.

9. Provide Access to Government Information and Improve Government Procurement. Once again, I'll rely on the *Agenda for Action*:

> Thomas Jefferson said that information is the currency of democracy. Federal agencies are among the most prolific collectors and generators of information that is useful and valuable to citizens and business. Improvement of the nation's information infrastructure provides a tremendous opportunity to improve the delivery of government information to the taxpayers who paid for its collection; to provide it equitably, at a fair price, and as efficiently as possible.

But have we really defined the buzzword or merely the government guidelines surrounding it? And what does the government see as the benefits of the National Information Infrastructure? Unfortunately, the administration has done little to limit our expectations of the potential benefits of the NII:

> This infrastructure can be used by all Americans, not just by scientists and engineers. As entrepreneurs, factory workers, doctors, teachers, federal employees, and citizens, Americans can harness this technology to:
>
> - Create jobs, spur growth, and foster U.S. technological leadership
> - Reduce health care costs while increasing the quality of service in undeserved areas
> - Deliver high-quality, lower-cost government services
> - Prepare our children for the fast-paced workplace of the 21st century
> - Build a more open and participatory democracy at all levels of government.

As if this weren't enough to drive expectations through the roof, the administration says that current estimates are that the NII will "create as much as $300 billion annually in new sales across a range of industries" while increasing GDP by $194-321 billion by the year 2007. But what is it? How can it reduce health care costs, make government more efficient, and all these other planned, or at least promised,

benefits? What is this "seamless web" and where are the "on ramps?" The easiest way to describe the NII is to describe one of the city wide highways.

Glasgow, Kentucky, is a 13,000-resident city with its own data superhighway. Several years ago, the municipal power company needed to upgrade its consumption monitoring capabilities, but instead of using a simple link to each consumer's meter, it capitalized on its omnipresence by installing coaxial cable and providing over the same link cable television service to its electricity customers. Next it added a municipal area network (MAN) or more widely dispersed LAN, and, for the cost of an Ethernet card, customers now have access. So far, E-mail is the most widespread use of the highway's MAN, but short-range plans include online banking and shopping services, an electronic version of the local newspaper, and file sharing among health care providers.

Is all this necessarily good? The administration has identified security and reliability as concerns. Are there any others? I'd like to end by reading a quote from the book *Technology* by Neil Postman. Mr. Postman argues that no technology, whether computerized axial tomography (CAT) scans or writing, is universally beneficial, and that blind acceptance of new technology is dangerous.

> In the United States, we have 260,000 billboards, 11,520 newspapers, 11,556 periodicals, 27,000 video outlets for renting videotapes, more than 500 million radios, and more than 100 million computers. Ninety-eight percent of American homes have a television set; more than half our homes have more than one. There are 40,000 new book titles published every year (300,000 worldwide), and every day in America 41 million photographs are taken. And if this is not enough, more than 60 billion pieces of junk mail (thanks to computer technology) find their way into our mailboxes every year.
>
> From millions of sources all over the globe, through every possible channel and medium -- light waves, airwaves, ticker tapes, computer banks, telephone wires, television cables, satellites, printing presses -- information pours in. Behind it, in every imaginable form of storage -- on paper, on video and audiotape, on disks, film, and silicon chips -- is an ever greater volume of information waiting to be retrieved. Like the Sorcerer's Apprentice, we are awash in information. And all the sorcerer has left us is a broom. Information has become a form of garbage, not only incapable of answering the most fundamental human questions but barely useful in providing coherent direction to the solution of even mundane problems. To say it still another way: The milieu in which Technopoly flourishes is one in which the tie between information and human purpose have been severed; i.e., information appears indiscriminately, directed at no one in particular in enormous volume and at high speed, and disconnected from theory, meaning, or purpose.
>
> All of this has called into being a new world. I have referred to it elsewhere as a peek-a-boo world, where now this event, now that, pops into view for a moment, then vanishes again. It is an improbable world. It is a world in which the idea of human progress, as Bacon expressed it, has been replaced by the idea of technological progress. The aim is not to reduce ignorance, superstition, and suffering, but to accommodate ourselves to the requirements of new technologies. We tell

> ourselves, of course, that such accommodations will lead to a better life, but that is only the rhetorical reside of a vanishing technocracy. We are a culture consuming itself with information, and many of us do not even wonder how to control the process. We proceed under the assumption that information is our friend, believing that cultures suffer grievously from a lack of information, which, of course, they do. It is only now beginning to be understood that cultures may also suffer from information glut, information without meaning, information without control mechanisms.

Perhaps, then, it is more than the fact that words, especially buzzwords, need definition and context, as Lewis Carroll pointed out, more than just the overly high expectations that buzzwords generate, which so profoundly troubled Weizenbaum, but it is the glamour of new technology and the blind acceptance of anything new, as Postman argues, that are the real dangers in buzzwords.

MR. JOSEPH T. BROPHY: I grew up just a few blocks from this hotel. While attending college, I worked as a paramedic during the 1950s at St. Clare's Hospital. With all the talk about technology and health care, I am somewhat amused by the fact that in the 1950s, the most complicated thing in the hospital was the elevator.

If you are ever down at the Texas Heart Institute, with DeBakey and his crowd, with the open heart surgery, you can't help notice the personal computers in the background. It's exciting to see what technology is allowing us to do.

I retired earlier this year from the Travelers. But let me tell you how I got into computers. Nate Jones, who is in the audience and retired from The Prudential more than ten years ago, probably remembers when The Prudential acquired its first 650 computer back in the 1950s. I started at The Prudential as an actuarial student when I finally decided to work for a living. I have great memories of The Prudential, and particularly the 650 computer, which was about the size of a refrigerator. We used it for asset-share calculations, and I got involved in programming the 650; it was my introduction to computing.

I made a calculation once, probably more than ten years ago, to answer the question: how many 650 computers would it take to equal the computing power in the Travelers' data center. I remember the number was incredibly large, requiring an eight-story building that covered as much space as the entire city of Hartford.

We have made a whole lot of progress with computers. In fact, Allen Rothman mentioned Joe Weizenbaum, who I knew. He was a professor at MIT. He made a statement years ago that influenced my thinking. He said something like this: Never before in the history of science has there been a phenomenon of exponential growth that has continued inexorably. He was describing the price performance improvements in computing technology, and he made the statement sometime in the early 1970s. I call it the computer-capacity theorem.

The formula reminds me that there are three types of actuaries. Class A actuaries invent formulas like this:

$$2^n > \sum_{t-1}^{n-1} 2^t.$$

Class B actuaries can understand the Class A actuaries and explain what they are saying to Class 3 actuaries like me who barely understand.

The formula says that the N-th term of geometric series of two is greater than the sum of all the preceding terms in the series. That's what is happening with computer technology. It is like the idea that there are more people alive than have ever died.

Back in 1965 when IBM was introducing the 360 series of mainframes, the company also introduced the miracle chip. IBM had bet the corporation on that chip, which makes for good B-School reading. Actually it was a $5-billion investment, moving transistor technology to chip technology. And, of course, the transistor had replaced the vacuum tube, which was the technology in use when I started at The Prudential.

The new chips were about the size of your fingernail and contained one circuit. (If you've ever been though an IBM manufacturing plant, it's an experience to see them mass produce chips.) The following year, they put two electronic circuits on the chip and in the following years, they were able to put 4, 8, 16, and so forth.

In fact, every year the number of components they can put on a chip has doubled. Weizenbaum observed this phenomenon a long time ago, and I've been talking about it and will continue to talk about it for the next 10 or 15 years, or as long as I'm healthy.

One of the important things in pricing a computer (as actuaries I know you'd appreciate this) is the weight of the computer. I asked the question of Dr. Bertram, one of the very senior executives at IBM and the architect that really delivered the 360 line of computers. I asked him, how do you price computers? He said it is very simple, you weigh them; it's the cost of the metal. That's why a million staples cost more than a million bytes of memory.

Getting back to the doubling phenomenon: 2^{10} is 1,024; and 2^{20} is $1,024^2$; and 2^{30} is $1,024^3$, and that's about where we are. After 30 years we're producing chips with a billion components.

If you ask people like Arno Penzias, the Nobel Laureate at Bell Labs, who discovered blackbody radiation, which supports the big bang theory of the universe, or Ralph Gomery, the former chief scientist of IBM, about the continuation of the doubling phenomenon, you'd hear sentiments like there's no end in sight.

So if we have another doubling each year for ten years, then we would see chips with one trillion components per chip. Or think of it another way, we will experience a 1,000-fold improvement in the price performance of computing. An article in the June 1993 issue of *Scientific American* on the issue of computer productivity by a senior scientist at IBM indicates "there's no end in sight."

Dr. Carver Meade, the revered computer scientist at Cal Tech, wrote an article in the April 18, 1988 issue of *Forbes Magazine*, that's still worth reading. It's titled "You Ain't Seen Nothing Yet."

Carver Meade said we're going to realize a 10,000-fold improvement in technology during the 1990s. Now Meade has to be taken seriously because everybody knows that he has been making predictions for the past 30 years and has always been right. Moreover, he's invented the technology to make all of his forecasts self-fulfilling.

What does it all mean? It means that we're in the midst of an incredible revolution. Most of us don't know what's really happening and what's being put in place all around us. We have difficulty visualizing how it is going to come together. At the same time that we are realizing exponential gains in computer productivity, we are seeing something similar with respect to the growth in data.

Every 20 months, the amount of data in the world doubles. Every 20 months the amount of data that we're dealing with doubles. So we have another exponential force at play, based on a recent MIT study.

Professor Kaku, a theoretical physicist, who I believe is from New York University, wrote a book *Beyond Einstein.* He gets into superstring theory and the theory of supersymmetry and talks about its potential origins with Galois way back in 1825, and group set theory. Near the end of the book, Kaku asks why did it take us so long to go from Galois in 1825 to supersymmetry? Kaku said the problem is that we think in a linear fashion; the human mind is now good at thinking in geometric terms. Therefore, you cannot predict the next five years by using the last five years as the yardstick; you'll fall short of the mark.

During the next five to ten years, we will witness explosive growth in two areas: first, the continued improvement in computer/communications and information technologies and second, in the area of impact from DNA research. We will search DNA strings in a matter of minutes, not years.

MR. ROBERT J. ARONSOHN: You mentioned there were so many thousands of databases available. What do you base your count? Can anyone go in and access those systems? Are they on some sort of a 800 number to anyone with a modem, or were you talking about databases used by individual companies with no other external links?

MR. BROPHY: There are many databases that are available publicly, but there are probably 100 times as many available in electronic form or on tape, but you need to go and search for them. I don't have the answer yet. I'm beginning to document this because I think it's incredible. There are sources of information out there from the government and they're available for your use.

MR. ROTHMAN: Let me just elaborate a little bit on that response. For example, the document that I kept on referring to, the *Agenda for Action* on the National Information Infrastructure, is available from the Department of Commerce electronically. I found out about it as I was reading an article that mentioned the phone number. Right now everything seems to be word of mouth. There is the Internet, which is

going to be one of the many pieces of the National Information Infrastructure that connects a lot of individual computers. Many companies have computers that allow access by noncompany employees. With the Department of Commerce bulletin board, you dial in with your modem just like you log on to any other bulletin board. It has certain documents available. You can get the President's budget, you can get the *Agenda for Action* and other things. There are manufacturers such as Microsoft, Logitech, and many of the other computer and software manufacturers who have bulletin boards that are available to anybody who wants to dial in, and phone numbers of other bulletin boards are listed. This is one of the big problems. There isn't one place where you can look up where you have to go. You have to go from computer to computer trying to pick up lists of other bulletin boards until you finally find the source you want.