Oct. 15, 2004 Issue of CIO Magazine

INTERVIEW

Machine Dreams

When software runs inside our brains, what will happen to us? Ray Kurzweil, who helped invent the IT present, explains to Web Editorial Director Art Jahnke how humans fit into the IT future. You may not like it.

INTERVIEW BY ART JAHNKE

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Ray Kurzweil grew up in Queens, N.Y., where, he says, schoolwork was never so challenging that it kept him from doing what he really wanted to do: build computers.

That was also the case at Kurzweil's next school, MIT, where the young student skipped so many classes to work on inventions that his classmates nicknamed him The Phantom. They should have called him The Natural because, as it turns out, Kurzweil is an intuitive inventor.

He helped invent the first optical character reading technology, the first text-to-voice synthesizer, computer-based musical instruments, and the first large-vocabulary speech-recognition system. His inventions have made him famous. He has founded several companies and written hundreds of articles. He has also authored and coauthored a number of books, including *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*, and the forthcoming *Fantastic Voyage*, which he cowrote with Terry Grossman, founder and medical director at Frontier Medical Institute.

In recent years, Kurzweil has shifted from inventing technologies to tracing the arc of technology progress. Want to know how technology will change our lives, our jobs and our bodies over the next two decades? Kurzweil is a good person to ask. So we did.

CIO: Recently we've been hearing about increases in productivity without a corresponding increase in jobs. Could technology continue to improve productivity without creating new jobs?
Ray Kurzweil: This is part of a process that began at least 200 years ago, when we automated the English textile industry. You had a machine that could replace 10 or 20 or 30 weavers. But the resulting prosperity from automation created whole new industries. We had industries to create machines and maintain them. Demand increased for things the machines made. The common man or woman didn't want just one shirt, and so on.

The broad history of automation shows that we have actually increased the number of jobs. One hundred years ago, we had about 30 percent of the potential workforce employed; we now have about 60 percent. Wages, in constant dollars, have increased by a factor of six to eight over the past century.

Can we expect that trend to continue?
The relative wealth that we now have comes from productivity, and we're going to see dramatic productivity enhancements in the future. If you jump ahead 20 years or so, we will be able to create virtually any physical product at almost no cost, just from information and fabrication techniques. In fact, we're not that far today from being able to create physical products with software because we have computer-assisted inventory control systems, just-in-time procurement, computer-controlled movement of materials and assembly.

Everyone agrees that increased productivity is great, but what about increased productivity without an increase in jobs, which is what we've been seeing recently?
Right now we're dealing with relatively small unemployment in the United States—about six percent—and we're seeing a reallocation of jobs around the world. National boundaries don't count as much as they used to. It used to be that you had to be in New York to work in New York. But now that we can really work effectively in cyberland, we have a reallocation of mental work. In terms of the world economy, that's a positive thing. It's not a zero-sum game. Just because India and China benefit doesn't mean that's to our detriment. But these types of trends do have short-term dislocations, so there may be some short-term issues with employment.

What about the longer term?
We're seeing international competition for the first time in types of work that require education and skills, and that's going to continue. And I think it's a good thing. China is committed to building 50 MITs, as they put it. That's not an exaggeration. They're creating scores of world-class technology universities. But these people are going to create intellectual property from which we'll all benefit. If somebody creates a breakthrough in bioengineering, we all benefit. It may also result in China respecting intellectual property more, if they are heavily invested in creating intellectual property. Still, I believe the United States retains an edge in terms of innovation. We still lead the world in terms of creating new paradigms, new business models, new ways of creating products.

Speaking of new models, what will be different about the IT department 10 years from now?
Let's look at a few trends. A lot of the equipment that IT departments concern themselves with now—routers and servers—will all be gone. There won't be computers on desks. We'll eliminate most of that clutter, certainly by the end of this decade. Technology will be very mobile; it'll be so small that it'll be virtually invisible. Everybody will be online. Images will be written right to our retinas. We'll have very high-speed bandwidth connections at all times. The computing substrate will be everywhere.

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So, what will the IT department be doing?
It will be concerned with security, privacy and protection—particularly protection against software pathogens. These are important issues today, but they're going to be the profound issues civilization struggles with in the future. Eventually, we're going to have software processes running close to our bodies and, ultimately, *inside* our bodies, in our brains, so detecting pathogens is going to be extremely important.

I also think information professionals should take a broad view of the power of information, because information will be the only thing that has value to the corporation. Consequently, there will be no more important department than the information department.

What about people? What will we be like? What will we be doing?

Technology progresses at an exponential pace because we use the latest generation of technology to create the next generation. That's a process that began with biology. It took billions of years to create DNA, but once it had evolved an information processing capacity to store and record the results of evolutionary experiments, the DNA could use that for the next stage. That was the Cambrian explosion.

We see that also in technology. The first computers were designed with pen on paper, and they were put together with screwdrivers and wires. Today, a designer sits down at a workstation and puts in formulas that look very much like software programming. The chips are laid out automatically and fabricated automatically, so the process takes days or weeks rather than years. That's why the products of technology grow exponentially in price, performance and capability. So the creation of technology is already very much a collaborative process between humans and machines.

I think it's important to understand that technology and human civilization are deeply integrated and that that integration is going to become more intimate. We're getting closer to our computers. I was talking to a woman yesterday who said her 10-year-old son's notebook is an extension of him. She said it might as well be inside him. Well, soon computers will be inside us. Within one to two decades, we will be able to place nonbiological intelligence inside us, noninvasively.

By the 2020s we will be placing millions or billions of nanobots—blood cell-size devices—inside our bloodstream to travel into our brains and interact with our neurons. We will be extending our cognitive capability directly through this intimate merger of biology with machines.

Right now, there's a restricted architecture to the way our brains work. The brain uses electrochemical signaling for information processing, and that's a million times slower than electronic circuits. You can make only about 100 trillion connections in there. That may seem like a big number, but the way in which we store information is inefficient, so that a master of an area of knowledge can really remember only about 100,000 chunks of knowledge. If you use Google, you can already see the power of what machines can do. In the future, we will be able to expand the 100 trillion connections we have with new, virtual ones. Once nonbiological intelligence gets a foothold in our brains, it will grow exponentially. As we get to the 2030s, human beings will have biological brains enhanced with more powerful nonbiological thought processes.

So the answer to your question is, if we remain unenhanced, if you just had machines developing on a distinct track, they would surpass humans. But that's not what's happening. We are merging.

As technology changes our world—and us—that radically, won't we suffer shock upon culture shock?

No. It's a very smooth process. If I describe the world of 2030, it would seem quite different from the world today, but we get from here to there in 200 little steps. Each step is benign and conservative and makes sense and addresses some compelling need.

Of course, there's already a reaction to this change. We see a strengthening of a kind of antitechnology movement. There is basic philosophic debate about whether we are intended to be masters of our world or whether the world should master us, whether we should fit into the so-called natural order.

My view is, what's unique and compelling about human beings is that we seek to surpass our limitations. Other people would rather celebrate our limitations, but we didn't stay on the ground. We won't stay within the limits of our biology.

I plan to expand my intelligence along with the available machine intelligence.

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Aren't you smart enough now?
Absolutely not. Are you kidding? A major focus of my interest is in tracking technology trends, which requires me to get my intellectual arms around a lot of diverse fields. It's really an opposite activity to what a lot of scientists do, which is to become more and more narrow. So I'm a neophyte in just about every field I run across.

You seem to have unbounded faith in the power of machines to help us, yet recently there's been talk of failure, especially in biotech. No cures for cancer. No cure for AIDS. Has technology let us down?
That's complete nonsense. We're in the early stages of biotechnology. We just finished the genome. We haven't finished reverse-assembling it yet, and we don't understand how the genes express themselves in proteins. Just now, we're getting machines powerful enough to simulate protein folding. We're learning the information processing methods underlying biology, disease and aging. We're finding very finely tuned interventions to reverse aging and to reverse disease processes. And there are very profound bio-technology-based therapies in the pipeline already. There are drugs in the pipeline that will enable us to eat as much as we want and remain slim, that will reverse type-2 diabetes by getting rid of excess glucose. I'm very confident that over the next decade we'll largely eliminate the diseases that kill 95 percent of people today. We've identified a dozen or so aging processes, and we have strategies for reversing them all. I believe that within 10 years we'll produce a mouse that doesn't age, and we'll translate that into human therapies within another five to 10 years after that.

Do you think that someday there'll be legal limits on how long people can live?

Not if I have anything to say about it. But there's a very powerful "death-ist" need. People really have it deeply ingrained. Life is short. You can't live forever. The only things that are certain are death and taxes. We have this whole so-called normal lifecycle; certain things happen at certain ages. We've rationalized death, which in my view is a profound tragedy and a tremendous loss of knowledge and expertise. And we have rationalized it as a good thing. I guess if there's nothing you can do about it, the best thing you can do is rationalize it, but there will be things that we can do about it.

I have a book coming out in the fall, Fantastic Voyage. And in it I say that right now we have the means to slow down aging to such an extent that even baby boomers like myself can remain healthy and vital long enough for the full blossoming of the biotechnology revolution, at which point we will be able to rebuild our bodies and brains.

You look like you're in good shape.
Well, I take this very seriously. I'm very aggressive in terms of reversing aging, or slowing down aging. I recently took a biological aging test with my health collaborator (who is also my coauthor), and based on 20 different tests—memory and sensory acuity and response times—it had me at age 40. I'm 56.

What do you do to slow the aging process?
I eat a certain diet. I take 250 supplements a day. I'm really reprogramming my biochemistry. A lot of people think it's good to be natural. I don't think it's good because biological evolution is not on our side.

It's in the interest of our species for people past child-rearing age not to stick around, at least in an era of scarcity, and our biological program hasn't changed since we lived in an era of scarcity. We have a lot of outmoded programs in our genes. One says, "Hold on to every calorie because the next hunting season might be fallow." These are all programs that need to be changed. We have a lot of

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aging processes that really accelerate when we get into our 50s and 60s, and I'm working aggressively to reverse those.

Who needs a bunch of 120-year-olds hanging around, especially when so much knowledge will be stored in machines?

Well, ultimately, there's going to be very little difference between a guy who's 120 and a guy who's 30. And with so much of our lives spent in virtual reality, we'll able to express ourselves in many different ways. It's not a matter of the knowledge that a 120-year-old would have. We all have an opportunity to create knowledge, and we'll expand that opportunity, which, I think, is really the mission of our civilization. CIO

PHOTO OF KURZWEIL BY CHRISTOPHER HARTING

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