



STATE OF THE ART

» *All the big inventions we made at the  
Laboratory started with new technologies.  
A great technology always finds a market.* «

# Creating the People's Computer

By Marta Sandén

*Wireless will be the most dominant technology in the next decade. Together with intelligent networks and wired embedded systems, wireless will give back to humans the power over machines. Computers will serve people – not vice versa, as it is today.*

Those are some of the prophecies of Michael Dertouzos, director of Massachusetts Institute of Technology's Laboratory for Computer Science. He's the visionary who in 1974 predicted the "Information Revolution", with a personal computer on every desk. In 1981, he foresaw the Internet, and in 1983 the World Wide Web.

The gray, concrete Building 545, in Technology Square, Cambridge, Massachusetts, reminds one of a military headquarters rather than of a scientific center. There are guards in black uniforms, an American flag, and a sign on the wall: *MIT Massachusetts Institute of Technology*. The next glass door is labeled: *Laboratory for Computer Science*. And there's one more door inside, vividly Mediterranean blue, which leads to Michael Dertouzos's little kingdom. Books, photos, comfortable armchairs. Cookies, fruit, candies on the table. Prof. Dertouzos, 63, has been director here since 1974. No sign needed.

## THE UNFINISHED REVOLUTION

Warm, direct and intense: his Greek side. Effective, well structured, no time to waste, a schedule to follow: his American side.

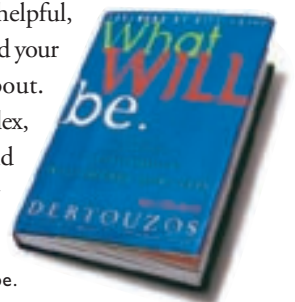
"I am both," he says, as soon as we sit down. "That is why I am able to understand the similarities and differences in both cultures, and I thrive in both."

Dertouzos's new book *The Unfinished Revolution: Human Centered Computers and What they Can Do for Us* will be published by HarperCollins in February 2001. It begins at the end of his 1997 best seller: *What Will Be: How the new world of information will shape our lives*.

"Forty years of slavery to the machine is enough!" he insists. "Using computers should be transparent, like air. It's time to stop being passive victims, to throw out last century's computer models and to create a human centric. It means a computer that's not disturbing but helpful, an invisible computer that both you and your mother can use without thinking about."

"Today's computers are too complex, overloaded with excessive features and constant software upgrades. They

A summary of *What Will Be* can be found at <http://www.lcs.mit.edu/impact/whatwillbe>.



Most proud of?

» *I started talking about the Information Revolution in the mid-70s. It was a dream envisioned. It was opposed in the USA as 'science fiction' by the industrial establishment – by people like John Young, CEO of Hewlett-Packard. When I visited Bobby Inman, director of the National Security Agency in 1974 and talked about an 'Information Marketplace of the future', about an interconnected network of civilians in the 1990s who would need secure communications just as the government needed it at that time, he laughed and said it sounded like 'pie in the sky'. «*

## MICHAEL DERTOUZOS

Pay very close attention to what this tall, white-haired, soft-spoken Greek-American has to say about the future. His predictions have been remarkably accurate. People ranging from Al Gore and Bill Gates to heads of European and Asian governments and CEOs of Fortune 100 corporations listen to him. And they shape their policies and business strategies according to his forecasts.

Born in Athens, Prof. Dertouzos decided he would become a professor at MIT when he was 16. Thanks to a scholarship, he could move to the USA and attend the University of Arkansas. He received his PhD from MIT in 1964 and became head of the Laboratory for Computer Science in 1974. More than 30 companies and consortia have become LCS spin-offs since then, among them 3Com, Lotus, Prime, Apollo Computer, Cirrus Logic, Infocom, RSA Data Security, and World Wide Web Consortium.

Michael Dertouzos is a member of the U.S. National Academy of Engineering and of the Athens Academy of Arts and Sciences. He was co-chairman of the 1997 World Economic Forum in Davos, Switzerland.



MS – There are no traffic rules at the Information Marketplace, there is no general agreement on security and on what is decent behavior on the Net. Is Oxygen a wonder drug?

MD – Oxygen is a framework: people will fill it up with their dreams.

inadequately address our needs and demand too much of our attention. Web sites take forever to download. The hand-held assistants demand that we learn entirely new sets of commands. And e-mail! E-mail overloads us!”

He proposes radical steps: e-mail birth control and e-mail euthanasia. He describes Dertouzos’s Law:

“Just because we have become interconnected does not mean that we are obliged to answer every e-mail we receive – and we do not have the right to bother anybody we want with our e-mails.”

MARTA SANDÉN – Especially when we get e-mail in the limited space of our wireless devices .... Something that you did not predict in *What Will Be* was the explosion of wireless in Europe and Asia.

MICHAEL DERTOUZOS – Yes, it is true, but I wrote *The Unfinished Revolution* because I wanted to take the next big step – a radical shift in Information Technology to make our systems human centered. I think the future is both wired and wireless. Wireless is going to dominate the coming years; there is enough place – and demand – for multiple technologies: i-mode, Bluetooth, WAP, 3G .... Bluetooth is perfect for homes, offices, cars, hospitals, hotels – it works as a control

and communication instrument. But it is a “light” or “thin” standard. It has limited access, little screens, non-intuitive mode of use, small quantities of information, bad quality of pictures and voice transmission.

MS – What can be done then?

MD – People who grow up with the Internet and World Wide Web are going to demand “fatter” wireless access, more powerful functions. We have a lot of standards wars in front of us. Standards wars are not a new discovery, there are going to be big changes during the next decade. The winners are those who can give people “fat” standards.

MS – We do not yet live in the Information Society, as we say in Europe, do we? Not even people in the top ten IT countries in the world: Scandinavia, USA, Canada, Netherlands, Switzerland, Australia, Japan, according to the IDC/World Times Survey 2000. Nor in the Information Marketplace or Agora, as you say, nor in the Information Age on the Information Highway, as you say in the USA?

MD – No, we do not, because we still serve the machines, and we are so accustomed to it that we do not even protest! We have to change the mind-set of users and designers, insist that the new technology reaches many more people. The biggest change affecting every aspect of our lives is still in front of us.

What Prof. Dertouzos is talking about is not simply “user friendliness”. He hates that expression. Instead, he wants everybody to embrace “a new human centric approach”.

“Human centric systems will understand speech, automate human tasks, get us the information we want, when we want it, help us work with other people, and adapt to our individual preferences,” he explains. “Machines will be our servants. The collective benefits of human centric machines will give ordinary people capabilities reserved for the most privileged. The human centric systems will give us the gas pedal, brakes, and steering wheel of the Information Age.”

This is what the Oxygen Project is about. (See separate article.)

## CORE OF ENTREPRENEURSHIP

Being a scientist, humanist and entrepreneur, Prof. Dertouzos is not afraid to speak loudly about his dreams. He has very often and very early seen military innovations applicable for civilian life, such as Arpanet, the Pentagon's pre-Internet system.

He has personally contributed to such ideas, including time-shared computing, the Ethernet, the Multics system (a concept later used to create Unix), the spreadsheet (Lotus), and public key cryptography (RSA). He should be able to describe what creates the core of entrepreneurship.

"That is the most frequently asked question I have heard in the last 25 years," he replies. "I usually talk about four pillars of innovation: Two are obvious, risk aware capital and high-tech infrastructure. But the first one is not at all obvious outside the USA.

In Europe and Asia, people do not make a distinction between money that *is* risk oriented and money that is *not* risk oriented. European and Asian venture capitalists *say* they are ready to take risks. But they are *not* ready. They always ask for guarantees! They do not understand that 90 percent of start-ups are wrong. They are guaranteed failures.

"The worst stupidity I have heard is: 'Do not invent technology – start with the solution, look at what the market wants.'

"All the big inventions we made at the Laboratory started with new technologies. A great technology always finds a market. The majority of venture capitalists look for big solutions. They should be looking for big technologies."

Prof. Dertouzos says the two other pillars of innovation are a creative technological idea that serves a pressing human need – and a passion.

"The entrepreneurial culture is passion-oriented," he says. "All big entrepreneurs are passionate. They are in love with their mission. Money is secondary. Passion is primary." □

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The Laboratory for Computer Science will move to a new futuristic home on the MIT Campus in 2003. Designed by architect Frank Gehry, the Laboratory will be hosted in the Gates Tower, a US \$20 million building sponsored by Bill Gates.

PHOTO: WIT

## THE OXYGEN PROJECT

# WHAT CAN MACHINES DO FOR US?



The Project: Oxygen is a US \$50 million, five year research project, engaging 250 researchers at MIT's Laboratory for Computer Science and MIT's Laboratory for Artificial Intelligence.

The Vision: The goal of the Oxygen Project is to let people do more by doing less. In the past, computers were expensive. In the near future, computation will be freely available everywhere, like batteries and power outlets, or as oxygen in the air we breathe.

Two sample Dertouzos Scenarios – "Ingrid Grabs an Opportunity" and "Gudrun, 78, on her own" – give us an idea of what people will be able to do with the new Oxygen system.

The Oxygen Project is sponsored by the Oxygen Alliance of Companies, established in June 2000. They include Acer Group, Delta Electronics, Hewlett-Packard, NTT, Nokia and Philips. The project was launched in the Autumn of 1999, with seed funding from the U.S. Defense Advanced Research Projects Agency, DARPA.



## DERTOUZOS SCENARIO 1: INGRID GRABS AN OPPORTUNITY

You are on business in Paris. You excuse yourself from the meeting, go outdoors, pull out your "handy" and ask it to contact Gunnar. It "sniffs" the electromagnetic surroundings, finds the local GSM cellular net, and calls Gunnar in Stockholm. Gunnar's in-the-wall computer answers. You tell it that the call is urgent, and since the machine also recognizes your "handy", it forwards the connection to Boston, where Gunnar, seated in an office of your subsidiary, is chatting with the local vice president. The wall machine of that office, sensing that the door is open, and based on an automation script Gunnar gave a year ago, determines that it can interrupt him. A pre-stored, life-size image of yourself flashes on the wall, as if you had poked your head through the open door. The image clears its throat: "Hi."

Gunnar says, "Hello, Ingrid. How's Paris?" You explain that an attractive site for your French office has materialized, but you have only six hours to grab it. Gunnar understands and says, "Oxygen, get Johan, Michael and Marie." The machine finds the first two via their home machines. Marie is driving to work in Chicago, and is connected via her car-trunk computer.

Within seconds, the Oxygen network creates a secure "collab region" for these five co-workers. As they confer, they say things like "Oxygen, get me the map that came with Lori's long message about two months ago," or "Get all the Web info you can on this new site." At the end of the meeting, Gunnar says, "We'll do it, unless I see an obstacle in the next hour." He points his "handy" to the printer saying, "Oxygen, send a copy of all the documents we reviewed." You rush to set up the closing.



## DETOUZOS SCENARIO 2: GUDRUN, 78, ON HER OWN

Gudrun has been living alone since her husband died. To help her maintain her independence, her children have been connecting an Enviro21 in her apartment to an increasing number of devices and appliances. Gudrun no longer misses calls or visitors because she cannot get to the phone or door in time; microphones and speakers in the walls enable her to answer either at any time. Sensors and actuators in the bathroom make sure that the bathtub does not overflow and that the water temperature is neither too hot nor too cold. More recently, the Enviro21's vision system, using cameras in the walls, recognizes and records patterns in Gudrun's movements. Gudrun uses this system now to jog her memory by asking simple questions: "Did I take my medicine today?" or "Where did I put my glasses?"

When she visits her doctor, she can show him the vision system's records to see if there are any changes in Gudrun's gait that might indicate the onset of medical problems. Later, but not yet, she may allow the vision system to alert her children when she falls and has a hard time getting up. For the present, however, she feels she can handle an occasional fall without causing alarm. Gudrun's children have been encouraging her to connect a home entertainment system to her Enviro21, but she much prefers reading books to watching movies.

### ...AND HOW TO DO IT?

**The Method:** *Hand-held or embedded devices will bring computation to us, no matter where we are. By capturing the human utility of new technology, Oxygen should encourage application developers and users to bend machines toward human needs. The Oxygen system provides eight technologies:*

**Wireless Handy21** is a portable universal device that Oxygen users carry. It looks like a cell phone but also has a small screen, a camera, a GPS module, an infrared detector, and a powerful computer. Except for a tiny analog part connected to its antenna, the entire innards of the handy are software controllable: Like a chameleon, the unit can change at the flip of a bit, from a cell phone, to a two-way radio, a TV, a beeper, a hand-held computer, a pointing device and more.

**Wired Enviro21** device, which, unlike the person-centered hand-held, is space-centered – in the office wall, the car trunk, or the home basement. Enviros bear the same relationship to handys as do power outlets to batteries – they mimic the handys, but with greater storage capacity, processing power and communication speed. Many Enviros are also connected to sensors and actuators, and can therefore raise the room temperature, operate a fax machine and tell if the door is open.

**N21 network** links all Oxygen devices to each other and to the world's networks, and creates secure collaborative regions that rise and collapse as needed.

**Spoken-dialog software** is built deep within Oxygen rather than attached as a mere interface or a fashionable afterthought. Together with some additional visual resources that observe Oxygen users, it is responsible for making Oxygen natural and easy to use.

In addition to these four core technologies, Oxygen also provides four user technologies:

**Knowledge-access technology** helps you find the information you need, in your own familiar way, among your own data, the data that friends share with you, and the vast info-terrain of the Web.

**Automation technology** lets you tell the machine what routine human work it should off-load from your brain and eyeballs – for example, when to interrupt you.

**Collaboration technology** helps a group work together by tracing the discussion and keeping an accessible trail of issues, documents, and conversation fragments.

**Customization technology** adapts Oxygen to the needs of individual users and it ensures that all software is downloaded automatically to all devices when new versions have become available, errors have been detected, or users have asked for new capabilities.

These enabling technologies still have a way to go. For example, vision technologies are good at recognizing faces, but not small objects. Longer-lasting batteries and circuits must be developed as well as speech-recognition software.

And even more important: there are social and psychological concerns which may be Oxygen's greatest challenges, like the feeling of Big Brother's ear and eye always being present in the walls around us. On the other hand, any new technology is neither better nor worse than the people who create it and who use it. The control and security mechanisms should be built into the Oxygen system from the very beginning, according to Michael Dertouzos. □

