


# *The Design Challenge of Pervasive Computing*

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By John Thackara

**W**hat happens to society when there are hundreds of microchips for every man, woman, and child on the planet? What cultural consequences follow when every object around us is “smart” and connected? And what happens psychologically when you step into the garden to look at the flowers—and the flowers look at you? These controversial questions were the focus of the keynote speech by John Thackara, director of *Doors of Perception*, at the opening of the Interaction Design Institute Ivrea ([www.interaction-ivrea.it](http://www.interaction-ivrea.it)) last December. John’s talk develops ideas first explored in his keynote speech to the 2000 Conference on Human Factors in Computing Systems (CHI2000) in The Hague.

I want to tell you about a frog. I am sure you know the story about its relationship with boiling water. If you drop a frog into the pan when the water is boiling, it will leap out. But if you put the frog into a pan of cold water, and then heat it steadily towards boiling point, the frog, unaware that any dramatic change is taking place, will just sit there and slowly cook. The frog story, to me, is symbolic of our relationship with technology at this time. If you could transport someone from the year 1800 straight into a western city today, I’m pretty sure he or she would leap straight back out in terror and shock. But we, who live here, don’t do that. We have a vague sensation that things seem to be getting warmer and less comfortable, but nothing more alarming than that. 

But I think the pan is about to boil. Two state changes are happening in technology. The first is that computing is penetrating every aspect of our lives—to a degree few people seem to realize; second, the rate of change in technology, which was already fast, is accelerating. These state changes define the context in which this new institute is being created—and confront a dilemma in innovation: we can do amazing things with technology, and we're filling the world with amazing systems and devices, but we find it hard to explain what this new stuff is for, or what value it adds to our lives. I don't think we can evade these questions any longer. The good news is this: I

believe interaction design can help us unlock this innovation dilemma by shifting the focus of innovation from pure technology to the contexts of daily life.

First, let me draw your attention to the technological landscape. It's not so much that technology is changing quickly. Change is one of the constants we have become used to. What shocks me is the rate of acceleration of change—right now. In daily life almost everything man-made will soon combine hardware and software. Ubiquitous computing spreads intelligence and connectivity to more or less everything around us. Ships, aircraft, cars, bridges, tunnels, machines, refrigerators, door handles, lighting fixtures, shoes, hats, packaging. You name it, and someone, sooner or later, will put a chip in it. There's a microprocessor, or chip, in a bathroom scale with a digital readout. There's a chip in an iron that turns itself off automatically. There's a chip in a smoke detector that calls the fire department. It takes 3,000 lines of computer code to drive an electronic toothbrush, for goodness sake!

Now, for most people “computing” is what happens inside the ugly boxes that sit on our desks. But those desk-top boxes are old news. They are the steam engines of computing.

Today's computing is everywhere—but nowhere to be seen. The world is already filled with 30 computer chips for every man, woman, and child on the planet. In 1998 some 4.8 billion microprocessors were sold; only 2.5 percent of those were for personal computers. The other nearly 4.7 billion chips went—where? They went everywhere. They're like cockroaches. Only smarter.

Increasingly, many of these chips sense their environment in rudimentary but effective ways. The way things are going, as the science fiction writer Bruce Sterling so memorably put it, “you will go to look at the flowers in the garden, and the garden will look at you.”

But do all these chips make for better products? Or a better life? Let me tell you a strange thing. Hardly anyone is asking that question. When it comes to innovation, we are looking down the wrong end of the telescope: away from people, toward technology. Industry suffers from a kind of global autism. Autism, as you may know, is a psychological disorder that is characterized by “detachment from other human beings.” This autism probably explains the fiasco over third-generation (3G) Internet. In the United Kingdom alone, the auction of radio spectrum raised \$25 billion. That's an awful lot of money to pay for fresh air! And what did these companies think they were buying? They thought they were buying the latest technological Holy Grail—the capacity to send broadband “content” to people on their mobile phones. Did these companies talk to people in the street, to their future customers, about this fantasy? No. They went to Comdex and talked to each other. Talk about the blind leading the blind. This whole sad 3G story is an exact repetition of 1993 when everyone said that the destiny of the Internet was to transmit Hollywood movies into our homes.

Software bloat is the tendency, as bandwidth expands, to fill it up with “content”—just because bandwidth or processor speeds are improving. My friend Ezio Manzini calls this phenomenon “semiotic pollution.” Just because broadband makes it possible to send large amounts of data down the pipe, or wirelessly, does it follow that you have to send peo-

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ple great gobs of data to deliver meaningful content and rich experiences? I don't think so. It wasn't true then and it isn't true now. When it comes to communication service design, less is more.

There are scenarios for wirelessness in Europe other than Hollywood in the palm of your hand—but they don't fill me with joy, either. Ericsson and Electrolux are developing a refrigerator that will sense when it is low on milk. Imagine the scene. You'll be driving home from work in your car, and the phone will ring. "Your refrigerator is on the line," the car will say. "It wants you to pick up some milk on your way home." To which my response will be "tell the refrigerator I'm in a meeting."

Tens of billions of dollars may have been wasted on 3G licenses, but the effects of those billions of dollars will still be felt as the dollars gurgle down the drain. The most amazing prediction I heard recently was that by 2010 *seventy five percent* of teenagers will wear com-

puting on their body in the "always on" mode. My daughter, who is 11, will probably be one of them. We are designing a world in which every object, every building—and nearly every human body—becomes part of a network service. We may not have set out to design such an outcome, but that's what we're going to get. Unless things change, we'll achieve pervasive computing and ubiquitous networking without having forethought the effects this will have or the quality of life we are bequeathing our children.

I talked earlier about industrial autism, about companies fixated on technology rather than on people. We know how to make amazing things, technically: mobile devices, Internet traffic, processor speeds, whatever. Our dilemma is this: we do not know what needs these new technologies are supposed to meet. In fact, we don't even think about that question, the why. We've created an industrial system that is brilliant on means but pretty hopeless when it comes to ends. We can

deliver amazing performance, but we find value, and meaning, too hard to think about.

The result is a divergence in technological complexity and perceived value. We're sitting uneasily between an infatuation with technology on the one hand and unease about its actual value to us on the other. Our unease is one consequence of what I call Thackara's Law: if you put smart technology into a stupid product, the result will be a stupid product. And sooner or later, people—us, me—will get fed up with them.

So what are we to do? In what way might interaction design help us resolve this innovation dilemma? Interaction design is about the why as well as the how of our daily interactions using computers. Interaction design cre-

ates value in three ways: first, by designing new ways to connect—with family, friends, lovers, and colleagues. These new ways to connect will be the communication services of tomorrow. People are by nature social creatures, and huge opportunities await companies that find new ways to improve communication and community among people in their everyday lives. Social computing, it has been called.

Second, interaction design creates value by allowing us richer and more varied forms of interaction. Interaction design favors all the senses and allows us the power to hear and taste and see and touch and feel. It's about communication that is playful, intuitive, moving, surprising, and fun. This kind of communication

### **Articles of Association Between Design, Technology, and The People Formerly Known As Users**

#### **Article 1**

We cherish the fact that people are innately curious, playful, and creative. We therefore suspect that technology is not going to go away; it's too much fun.

#### **Article 2**

We will deliver value to people, not deliver people to systems. We will give priority to human agency and will not treat humans as a "factor" in some bigger picture.

#### **Article 3**

We will not presume to design your experiences for you, but we will do so with you, if asked.

#### **Article 4**

We do not believe in idiot-proof technology, because we are not idiots and neither are you. We will use language with care and will search for less patronizing words than "user" and "consumer."

#### **Article 5**

We will focus on services, not on things. We will not flood the world with pointless devices.

#### **Article 6**

We believe that "content" is something you do, not something you are given.

#### **Article 7**

We will consider material end energy flows in all the systems we design. We will think about the consequences of technology before we act, not after.

#### **Article 8**

We will not pretend things are simple when they are complex. We value the fact that by acting inside a system, you will probably improve it.

#### **Article 9**

We believe that place matters, and we will look after it.

#### **Article 10**

We believe that speed and time matter, too, but that sometimes you need more, and sometimes you need less. We will not fill up all time with content.

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has value not found in today's services.

Third, interaction design creates value by emphasizing service and flow. Redesigning business according to the service-and-flow model means we stop thinking of ourselves as being in the product business. We become, instead, deliverers of service. These services are carried by long-lasting, upgradable durables. Material products become a means, not an end in themselves.

In this new design space, the real and the virtual, matter and information, co-exist. The Spanish economist Manuel Castells calls this space the "space of flows." This is not to say that interaction design is immaterial. But as computing migrates from ugly boxes on our desks and suffuses everything around us, a new relationship is emerging between the real and the virtual, the artificial and the natural, the mental and the material. Interaction design improves the quality of these in-between zones.

These are big claims for interaction design. If I am correct, interaction design can transform the ways we innovate new communication services, and the economic consequences of that would be immense. But the question arises: if interaction design is so important, what difference can a single institute, however lively and successful, make? My answer is: a lot. I believe Institute Ivrea will punch above its weight because of something called the "edge effect." In biology the edge effect is the tendency of a greater variety and density of organisms to cluster in the boundaries between communities. As in nature, so too in a networked economy: variety and interaction are success factors. These success factors do not occur naturally inside large companies, or even in small ones. On the contrary: the tendency in most companies is for people to get stuck in specialized boxes, where they are required to focus on a narrow part of the picture.

But history is filled with examples of small organizations, apparently on the edge of mainstream thinking, that influenced the bigger picture and the many people in it. I'm thinking of the 19th-century salons of avant-garde artists and writers. I'm thinking of the Bauhaus during the early part of the 20th cen-

ture. I'm thinking of the Santa Fe Institute in more recent times. These small groups of people had a huge influence because they addressed crucial issues at moments in history when culture was ready to change. The Bauhaus unleashed modernism; it did not create it out of thin air. The Santa Fe Institute did not invent complexity, but put complexity science on the intellectual agenda at a moment when the world was ready to think about it. I'm pretty sure Institute Ivrea will benefit from the edge effect, too. The world is ready for a new approach to innovation.

Mind you, change won't come easily. Companies are just like people; if you want them to change, criticizing is not the best way to start! As with a person, a company can best learn new skills, and new ways of thinking, by example and by association. New examples and association with new people are

what Interaction Ivrea, at heart, will be about. It will exemplify the edge effect by looking in new places for ideas and inspiration. Under Director Gillian Crampton Smith's leadership the institute will share its expertise and knowledge in new ways, too. Collaborative innovation is the way of the future. New ways to create, share, and distribute design knowledge are an exciting new trend in these times. Peer-to-peer networking, file-sharing, open-source software, and the like are transforming the speed with and manner in which knowledge, including design knowledge, can be distributed.

The institute, I am sure, will be part of this trend.

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