# International Electronic Journal For Leadership in Learning

### A refereed academic journal

### Volume 4, Number 11

### July 19, 2000

### ISSN 1206-9620

http://www.ucalgary.ca/~iejll

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# REVIEW ESSAY:

## THE INVISIBLE COMPUTER by DONALD A. NORMAN

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Norman, D. A. **The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution.** (Book). Cambridge, MA: MIT Press, 1998, 302 pages (cloth)  $38.95 (Cdn., at Chapters.ca)  ISBN 0-262-14065-9
(Also available in paperback, 1999, $21.95 (Cdn., at Chapters.ca)

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**The Invisible Computer** (1998), is subtitled "Why good products fail, the personal computer is so complex, and information appliances are the solution," and the book proceeds to examine these three points. Norman has discussed aspects of these questions in two previous books, notably The Design of Everyday Things (1990) and

Things That Make Us Smart (1993). The previous books need not be read to appreciate The Invisible Computer, but they do reinforce the depth of the argument. The The Invisible Computer is somewhat different from the first two books, in that it follows Norman's involvement in the private sector, at Hewlett-Packard and as a Fellow and VP of Research at Apple Computer, and thus draws some insights from the non-academic, industry perspective as well as from academic psychological principles. As a result, the book is more grounded in the present than those in the more general cyberculture genre (Silver, 1998; URL: http://otal.umd.edu/~rccs/biblio.html). Others have taken the computer industry to task, but usually just by focusing on why profits do not reliably increase following computerization (e.g., Gibbs, 1997) -- in fact, these often draw upon Norman's trilogy, implicitly or explicitly. And, thankfully, this is not yet another book on how to do business on the Internet.

The preface makes it clear that Norman believes that problems with the personal computer are yet another instance of a more general phenomenon: problems associated with the transition of a product (and industry) from being technology-centered to being human-centered, that is, to a product that is usable by the average consumer rather than an object to be revered and mastered for its own sake; a means to an end rather than a goal. This perspective provides far more than yet another bow at the altar of "user friendliness:" *"We have even been told that "being digital" is a virtue. But it isn't: People are analog, not digital; biological, not mechanical. It is time for a human-centered technology, a humane technology"* (Preface, viii).

Originally to have been titled *Taming Technology*, this book embraces a simple but profound philosophy: *"Tools should be noticed only when they break"* (p. 243 and elsewhere). This point is illustrated by examining several previous innovations, not just computers. For example, it is amusing (and a little frightening) to realize that Edison's interest in developing the phonograph was the paperless office -- how many devices have failed to yield that result (including e-mail)! But I suppose we should keep the faith, as there must have been a similar transition period earlier, lost in the mists of antiquity, when there were repeated promises of the stone-tablet-less office.

A common thread among new devices is that in the salad days of a new technology, the early adopters are those who actually enjoy the challenge of dealing with the breakdowns, but the potential buyers who would rather not be bothered always outnumber the early adopters. However, for other prospective users, Norman's philosophy applies: *"Difficult tasks will always have to be taught. The trick is to ensure that the technology is not part of the difficulty"* (p. 182). Humans are very adaptable, but at some point it is more appropriate to design the product to minimize the training need. As it now stands, users have had to adapt for over 50 years as computers have evolved to suit engineers and early adopters. So much for the rapid rate of technological innovation.

Norman's book is not so much about computers per se, as it is about this diffusion of innovation throughout society, and the social and economic forces that expedite or impede the diffusion. The technology life-cycle has been discussed by others, but

usually in terms of how to impose the values of the early adopters on the masses (e.g., Moore, 1995, Rogers, 1995). Historically a "**blame and train**" orientation (p. 168) has characterized the computer industry. Early adopters find the product adequate, so all the industry needs to do is coax the reluctant masses to buy in and accept the responsibility for learning to live with expensive, inadequate solutions. Marketing is seen as the way to reach the masses, not assessing user needs and redesigning the product -- build it, then convince them they need it. From this perspective, the computer industry controls innovation, with user-friendliness defined to satisfy the early adopter, at best.

Norman reviews the arguments that have been used to justify this strategy, but then challenges them. An alternative view emerges here, **the user as victim**, rather than the problem. He identifies the real solution as designing the products to meet the needs of the masses in the first place; used-centered design, rather than educating the masses to tolerate the inconveniences that excite early adopters. In other words, don't try to just market immature technology to the masses, but instead change the product to meet the actual needs of the masses. Norman's user-centered design says that the lack of acceptance is because the technology doesn't address a user's needs or does so in an intrusive fashion. So, instead of the computer industry just designing cool things to suit engineers, and then brain-washing and blaming the end user, the end-user's needs must enter the design process very early. In truth, considering the haphazard historical development of the personal computer (e.g., Cringely, 1996), it should not be surprising that user-centered design has only belatedly become a concern of the industry.

The three components of the book's subtitle form an outline for Norman's user-centered perspective.

### Why do good products fail?

From one perspective this is about why industries do not adopt new and superior technologies (e.g., Christensen, 1997; previous IEJLL review by Angus, 1999). Edison turned down the radio. Kodak turned down the Polaroid, and then later the Xerox machine. The phonograph industry ignored radio. Western Union saw no use for the telephone. In the computer industry, perhaps the best example is the difficulty that Xerox had making the transition from a photocopier company to a computer company (Hiltzik, 1999). Presently we are watching recording companies play the ostrich with regard to electronic distribution of music. And why this computer industry preoccupation with delivering television to my computer screen? Changing from what has worked is a difficult step for a business, perhaps the economic equivalent of what gestalt psychology labeled "functional fixedness" -- we're making money, why innovate? Once a technology becomes entrenched in an industry, it is difficult to change; it creates infrastructure problems and a business model problem.

The other perspective on this, however, is why the mass market doesn't accept a new technology when industry is promoting it. Norman uses computer and non-computer examples to illustrate that cutting edge technology alone is not enough for mass acceptance. The Beta videotape format was technically better than VHS. Edison's cylindrical phonograph lost out to the flat disk. It is not enough to "design it, they will

come," but rather "what is it they need, then we design a solution." It is not just a matter of being patient while the engineers improve the technology (more RAM, larger hard drive, faster processors and connections, and so forth). User-centered success instead requires matching the tool to the human activity to be done in the first place, and this applies to both the hardware and the software. *"It isn't enough to be first. It isn't enough to be best. It isn't even enough to be right. ... it is essential to understand why customers buy products ..."* (p. 47). And that understanding does not mean how to market to reluctant customers, but how to solve actual customer problems -- user-centered design.

The problem for Norman is not that the user has to be blamed and then trained, but instead that the user needs to educate or inform the design process from the beginning. This derives from the fact that changing technology is actually easier than changing social, cultural, and organizational practices -- which is why we still have the paper trail instead of the paperless office. Psychologists have made similar arguments before (I am reminded of the work of Chapanis, 1982, and Nickerson, 1982), though not with the visibility of Norman's trilogy. Nonetheless, the computer industry has generally paid more attention to engineers and thus we still had the technology-centered product stream and the self-serving dependence on human adaptability.

Occasionally the end user gets enough satisfaction from a lesser technology to forego the problems associated with the superior technology. This serves to illustrate that the heart of the mass user is accessed by technology that is "good enough" to satisfy an actual need, rather than superior technology that is not suited to actual user needs. That a product with fewer features would be more useful is blasphemous to the technology enthusiast. Very seldom does a product emerge with enough novelty and value that users will ignore primitive technology to pursue it; the VisiCalc spreadsheet was such an exception, but it is hard to think of many others.

### Why is the personal computer so complex?

> *"(Those who have grown up with a technology) .... believe that it is natural and correct to spend a large portion of every day redoing one's work, restarting systems, inventing 'work-arounds'"* (p. 90).

One part of the answer, according to Norman, is that the personal computer tries to be all things to all people, and at some point ends up doing nothing very well, just as a Swiss Army knife is hardly a match for a toolkit of specialized tools each designed to do a specific task (p. 71). Obviously this position can be applied to integrated "Office" products, and do-it-all web browsers: at some point they require more time to master and then use than the benefits they provide to the typical user. Rampant featurism has been an important benefit for marketing and for product reviewers, but has little to do with providing the right features for a given activity in a transparent manner. Products are defined and marketed by a "bigger/more is better" model, whereby if enough features are provided a user can surely find something they need. Sure, but in the manner of a needle in a haystack; busy users may not find this attractive at all. In fact, it isn't just the computer industry that makes this mistake, but modern telephones vs. older models, for example (p. 165). Sadly, many of the features requested in the next

upgrade often exist in the present version but users didn't know they were there (Head, 1998)!

Another part of the answer, according to Norman, is that the graphical user interface does not scale to the present level of complexity (p. 74). One can have more icons on the desktop or menu bar than there are buttons in the space shuttle cockpit! Yet now each one has its popup cue to indicate what it does, so much for transparency!

And complexity is important to the present business model in the industry. For one thing, the industry's revenue stream presently derives from the need for regular "upgrades," or the subscription model. A complex, buggy product is replaced with a more complex, buggier product, with the assurance that the upgrade will solve the problems in the former. This has at least assured a generation of consultants and trainers that there will be steady work. The computer industry did not invent planned obsolescence, but it has turned it into a fine art. The transition to an alternative route to revenue, from selling a product once (or infrequently, e.g., a camera) and then regularly selling services (e.g., developing) or supplies (e.g., film) has been very slow to emerge in the computer industry.

Another strategy in the computer industry is to avoid user feedback by differentiating the "user" from the "customer" or buyer (e.g., p. 45). For example, in the workplace, the buyer is often not the end user, but a procurement officer who buys for the entire organization (a person who often is neither a user nor an early adopter, rather a bean counter). What this means is that the industry may sell hundreds or thousands of copies with one contact. Bulk purchases are very efficient, however, this also means that feedback to the industry comes from that one person, even though hundreds or thousands of users are involved. The end user is not in a position to vote with their pocketbook and feet by choosing a different product, so the market forces that might otherwise drive inappropriately complex or useless products out of the market are blunted by separating the user from the buyer. When individual users can choose alternatives, bad products do disappear: remember Bob, and PC Junior? Push technology? Barbie computer?

To some extent, this purchasing strategy may in part be a legacy of the mainframe era, where a company bought a single machine to be stored in a vault distant from many of its users, and only the computer priesthood (early adopters) provided feedback. Furthermore, this isolation of the end users from the industry also applies to the integration of computers into schools as well as business offices, where bulk purchases are made. Kids complain, teachers blame and train; teachers complain, school boards blame teachers, but the industry is sheltered from feedback. No wonder it is so hard to show productivity benefits from computer investments (e.g., Landauer, 1995), as bulk purchases do not include user feedback regarding problems, so engineering continues to be the loudest voice for development.

Norman also considers and rejects many of the stock answers for dealing with complexity. For example, we have often been assured that speech recognition will solve all these problems. However, Norman points out that "speech recognition" is not "language understanding," much less "mind reading" by the computer, and that the

latter is really what's needed to reduce human-computer misunderstandings (p. 97-100)! As a solution to complexity, speech recognition seems to share many features with the paperless office -- I don't expect either to happen in my lifetime.

Even common business strategies are implicated in answering why we continue to get complexity rather than simplicity. For example, instead of focus groups with users of your product to see what they (early adopters) want in the next "upgrade," the computer business should talk to **non-users** to see what it would take for them to buy in (p. 245). In this context, as an update, perhaps one might note the apparently large percentage of iMac buyers who are first-time computer owners? There is an entire chapter (10) that discusses how organizational structure can and must be changed to accomodate user-centered design -- including an endorsement of the way the US Navy operates effectively using an informal chain of command that is very different than the formal hierarchy (Chapter 7). Best procedures dictate outcomes, not methods. Quality means letting much of the control go to employees. Technology permits both, but management practices still resist such devolution.

### Why information appliances are the solution

> *"In the appliance model of computing, ... Learning how to use it is indistinguishable from learning the task"*
> (p. 57).

In cars, telephones, microwaves, and so forth, the computer is embedded, hidden, invisible. Norman sees more special-purpose devices, sharing a common infrastructure, as the solution to problems created by a progressively more complex single device. By this view, digital convergence will mean multiple, simple devices sharing a standard infrastructure, the network, not a single device that does everything (in a difficult, inelegant manner). For example, we standardize on TCP/IP, not the material in the wire carrying it, etc. I'm sure that we will see more special-purpose networked devices, but I fear that it will be a challenge for the industry to leave them alone, to let them remain special-purpose.

Norman distinguishes his appliances from the trend toward hand-held computers (e.g., Palm) that merely represent efforts to "miniaturize the all-purpose device" (p. 57). ... *The device should be built for the job, and no more difficult than it needs to be ... one device per activity* (p. 182). I think here of the remarkable early involvement of Federal Express (UPS, etc.) in using a simple scanner to build searchable databases via the Internet, and other uses of the bar code scanner. A simple device, to communicate with another device elsewhere, transparently -- not a do-all device that takes a couple of bulky help manuals and a 24/7 support line.

I am reminded here of a cartoon I saw recently, where a new computer user was calling Information on her telephone, and asking to get someone's e-mail address. I laughed at the time, but now, well, why is that funny? After all, the phone company also provides Internet access, aren't the phone-number and e-mail databases linkable? Novices expect it. Maybe they know something the industry should attend to. This seems a failure to attend to what users are actually doing, what they would actually benefit from. Or

perhaps the telco is waiting to find a way to make money from it, like charges for calling to ask for a phone number?

In a similar incident, local cell phone companies have recently been promoting wireless e-mail access via your cell phone. No, I don't know why, I don't know anyone who has asked for it, and I don't see the point of yet another device (viz. Palm) with no real keyboard or screen. But in one commercial re the virtues of going wireless, part of the pitch was that you would in addition be able to listen to the radio through your cell phone, yet another feature of this wonderful new wireless world. I was listening on my car radio at the time, and laughed out loud when I realized that I couldn't remember a time when radio hadn't been wireless! This complication of the cell phone seems another case of the strategy of trying to make a device do more than is really optimal. No matter how cool it seems to early adopters, it becomes like the VCR for most of us -- lots of unused, unwanted "features." Yes, I DO have a cell phone, but just for outgoing/emergency calls from my car. It gets used very little, thankfully, but it is somewhat comforting to have, like low-tech jumper cables. I confess that I never owned a wristwatch with a built-in calculator either, though I have owned chronographs with so many functions I always had to look up which buttons do daylight-savings time and which ones do stopwatch functions, etc.

Finally, speaking of early adopters, don't you just love it at the end of a meeting, when it's time to schedule the next meeting, to watch the paper daytimer crowd (myself included) flip open quickly and then wait for the Palm crew to fiddle with their schedule? Norman speaks hopefully of the Palm, from the perspective of a couple of years ago now. PDAs may yet satisfy some need, but personally I don't see the niche yet, and in fact the PDA industry segment now seems to be going in the same direction as cell phones, trying to be a miniaturized full-purpose device to entertain the techno enthusiasts. I say, wake up folks, the problems with the personal computer are not that it is physically too large!

As the book was written, circa 1997, Apple Computer, which is known for its efforts to make computers easier to use, was not winning market share (to put it gently). Norman discusses the failure of Apple at several points, from the perspective of a former insider, attributing Apple's problems to, among other things, pursuit of short-term gains at the expense of long-term viability (p. 225). At this point, Apple has staged a stunning recovery, and users choosing devices by non-technological features such as design and color (p. 36) sounds rather like the iMac world to me. Have we crossed a hurdle with computers becoming more like information appliances, or at least more consumer-oriented devices? Time will tell.

Likewise, the confrontation between Microsoft and the USA Department of Justice has occurred since the book was written. Microsoft may not have invented the upgrade model, but they certainly perfected it, along with sales to purchasing agents rather than individual end users, the absurdly long feature-list marketing scheme, and other practices that blame the user and move user-centered design to the bottom of the list. Bill Gates' bank account may be the one thing to give pause to all the sensibility of Norman's arguments about the importance of simple, well-designed information

appliances. Perhaps, as James Thurber said, "You can fool too many of the people too much of the time"? Or perhaps a transition to a consumer-driven market will eventually do what Janet Reno and the U.S. Department of Justice dreams of doing. Time will tell.

In sum, taming this technology will require: (1) a shift to user-centered design, (2) a shift to simpler information appliances that can communicate seamlessly, and (3) a shift in the business model of the computer industry from the subscription (upgrade) model to providing consumables and services as the basis for profits (e.g., selling film instead of cameras). This implies that the economics of information appliances will be driven by the mass consumption market, rather than sales to early adopters.

Norman is a Professor Emeritus of Cognitive Science at the University of San Diego, with a long history of research and publication in human cognition. He is involved in other enterprises that attempt to deal with taming technology. He is a partner with Jakob Nielsen in the Neilsen-Norman Group, a consulting firm that works with companies on issues such as human-centered web-site design and other user advocacy issues. He also is President of a distributed-learning company, UNext.com, using the technology of the Internet as an enabling tool, without dispensing with books and other media.

Norman has adopted **jnd.org** as his domain name. JND is an acronym for "just noticeable difference," a psychophysical concept describing how much a situation has to change before we notice it has changed. We can all hope that his efforts in this trilogy take us at least a JND toward the invisible computer. Norman does offer solutions here, as he has for over a decade, not just complaints, and we can only hope that the computer industry takes heed -- better late than never.

If tools should be noticed only when they break, could we say a good book is noticed only when you finish it? If so, this one fits that bill for me. Geeks may complain that it isn't enough about computers, but that is precisely the point for most of us who just want a transparent tool. Obviously I am a fan of most of his arguments, and while this review is somewhat an homage, nonetheless this is a thoughtful, readable book (with a clever dustcover).

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