Review: Now You See It, Now You Don't
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Book Reviews

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Now You See It, Now You Don't

The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution

By Donald A. Norman. Cambridge, MA: MIT Press, 1998. 302 pp. Cloth, $25.

The subtitle of this book is "Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution." Briefly, the answers that Donald Norman provides are as follows:

> Good products can fail because good products may be technologically sophisticated, but not what the consumer wants to use or pay for, and not-so-good products may become dominant and hard to dislodge because they make up a nonsubstitutable infrastructure.
>
> The personal computer is so complex because the personal computer is expected to do too many things, and this does not allow it to do any one thing well. In addition, its design is driven by technologists, who do not pay enough attention to what consumers or potential users want.
>
> Information appliances are the solution because information appliances are specialized devices, so they can be designed with specific uses in mind and can be more efficient, convenient, and pleasant to use.

That is the argument of the book in a nutshell, and it is worth examining in detail. This review attempts a critical examination. However, it is important to note that the central message of the book is more general: Norman thinks that technology should be servant and not master. He praises a human-centered approach to product design, and rails against those who put technology first. Before considering his central argument, we provide some background and context.

Background

The author is a psychologist and cognitive scientist who left academia and joined the whirlwind of high-tech business. Best known for his critiques of the poor design of everyday things, the author is now sharing with us his insights accumulated over his recent experiences in the business world. Using Thomas Edison as an example, he explains how good technological innovation and inventiveness do not necessarily make for commercial success. Edison expected that his technology-centered phonograph would be an automatic success but

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he found that his competitors, arguably with inferior technology, were the ones who succeeded commercially. The parallel Norman draws is with the personal computer, and his argument is that the PC is too complicated for everyday users. According to Norman, it is the technology that is wagging the people rather than the other way around. The author's proposed solution is that it is necessary to hide the technology behind our everyday products. This camouflage will be implemented most easily in information appliances, specialized devices that will perform very specific functions in a user-friendly manner. According to Norman, people should learn the task and not the technology, so the makers of that technology should be sensitive to what the consumers actually do rather than simply implementing the most recent technological innovations in their machines.

As noted earlier, Norman's central argument is that technology should be servant and not master. He is harsh in his criticism of those who put technology first. This central argument is an appealing one, with both rational and emotional bases underlying it. The question to be addressed in this review, though, is whether Norman is effective in making his case. In other words, even if one easily accepts that his core argument is plausible, the question of whether he has made his case remains important and needs serious attention.

The structure of the review, therefore, is an examination of Norman's answers to the three central questions he poses and an analysis of Norman's central concern about the appropriate role of technology in our lives.

Why good products can fail

Good products may be technologically sophisticated, but not what the consumer wants to use or pay for. This problem may arise because the innovator does not pay attention to what consumers want and what they are willing to pay for. Basically, the innovator (by which we mean the organization, not just the individual) makes a mistake. Norman attributes many such mistakes to bias toward technological solutions: the "gee whiz" factor. Norman supplements his argument with pejorative remarks about the people behind such technology bias, but we consider that issue later in the review because it has more to do with Norman's core views on humans and machines.

Such mistakes could also result from other kinds of biases caused by optimism or inexperience. One could argue that in such cases, the product does not really qualify as a good product. That is what an economist would say; the economic theory of market value is based not just on the intrinsic quality of a product or its cost of production (supply factors), but also on what people are willing to pay (demand factors). Is lack of attention to consumer tastes more valid for technology-intensive goods? Maybe (Norman uses Thomas Edison as his prime example) but similar mistakes could be found in goods that are not high tech or particularly innovative. The Ford Motor Company introduced innovations in automobiles that worked well at the time, but then it lost ground by not paying attention to consumer tastes (for variety, for example) when the automobile was no longer such a novelty. Ego is a problem common in the corporate world—common to humanity—and picking on high-tech companies seems a bit unfair. Norman is on weak ground here, it seems.

Alternatively, this problem may arise because the innovator tries to figure out what consumers want, but simply gets it wrong. This must surely be more common in high-tech industries, simply because of the degree of innovation, the technological complexity of products (on the inside, even if this complexity is invisible to the consumer), the pace of competition, and the need to get products out there (partly for first-mover advantages, which we discuss later). There are many examples of the same person or the same company having great hits and abysmal misses at different times, but all in the same product space (Steve Jobs at Apple, with the Lisa and the Macintosh, for example). To just pick on the failures is what statisticians would call sample selection bias, and one must be aware of this when judging examples such as those chosen by Norman.

The complexity of products raises another important point that is well recognized in the industry, but not perhaps clearly enough by Norman. High-tech products work in systems (i.e., in combination with other products); this is true of technology in general, not just high-tech products. Light bulbs require compatible fixtures, together they require compatible voltage, fixtures require compatible outlets and wiring—all the components of the system have to exist and work together. Different firms make different complementary components of a system. A good product may fail simply because your estimate of the pace of innovation in complementary products is off. The simplest generic example is PC hardware that does not sell because there are no good software applications for it. Few companies can successfully do it all. These are areas in which strategic alliances can help (see Teece's classic 1986 treatment of this issue), but this characteristic of high-tech systems puts more things beyond a single firm's control. A "good" product may fail because all the components of the system are not sufficiently developed. But this has nothing to do with a bias toward technology over customer preferences.

Not-so-good products may become dominant and hard to dislodge because they make up a nonsubstitutable infrastructure. The second problem may arise because the products in question make up a nonsubstitutable infrastructure. If not-so-good products make up, or are part of, a nonsubstitutable infrastructure, then switching to a better product cannot be done piecemeal, or at least not at low cost. High switching costs prevent switching, even if the result after the switch would be better. The argument here is subtle, however. If the total switching costs are too high, then it is indeed not collectively optimal to switch. The problem arises if early switchers bear high switching costs. Then no one may be willing to set the ball rolling, even if collectively the switching costs are lower than the benefits of the switch. This is a classic collective action problem, much analyzed by economists. Economists have also suggested that it can be overcome: Firms may cooperate to set new standards, for example, or the government (another kind of collective action agency) may impose the switch or induce it with transfer payments to overcome inertia (see Farrell & Saloner, 1987). Economists have also questioned the empirical force of theories of not-so-good products dominating, suggesting that such stories have exaggerated the relative merits of products that do not succeed, such as the Dvorak keyboard versus the standard QWERTY keyboard (see Leibowitz & Margolis, 1990).

This argument leaves unanswered the question of how the dominance arises in the first place. This is where the idea of path dependence comes in (Arthur, 1989, 1994; David, 1985). A product may succeed in becoming dominant simply because it happens to be first (first-mover advantage). As its installed base grows, and as incremental innovation follows and reinforces this increased use, it becomes harder and harder for it to be challenged by competing products, which, if they had come first, would have been better in the long run. Time horizons may play a role here also. A product may be better initially, but worse in the long run, because the scope for innovation is lower. But it may become entrenched because individual users have short time horizons, and the competing product is never able to attract the resources for innovation.

Economists are still sorting out the theoretical possibilities and the empirical relevance of path dependence caused by increasing returns. If one looks at the personal computer industry, however, it does not seem to be a serious issue. We may be stuck with the QWERTY keyboard (the most famous example of path dependence and a seemingly suboptimal outcome), but its inefficiency has not been demonstrated to be more than marginal, and its layout is hardly the binding constraint on the speed of two-finger typists. We may be stuck with a clunky operating system and bulky application packages for PCs, thanks to nonsubstitutable infrastructure effects, but one also sees that when something better comes along, it is embraced quickly. Witness the quick rise of Linux as a server operating system. A word processing application such as MS Word may be bulky and lack certain features that once-dominant WordPerfect has, but it is better in other dimensions of performance, and the free fall in the cost of memory has meant that bulk does not matter. In other words, when products are not seriously deficient in dimensions that users care about, they will do fine. If they are deficient, they are unlikely to be around for long, nonsubstitutable or not. Therefore, nonsubstitutable infrastructure seems to be a weak argument to pursue for the very dynamic and innovative PC industry.

Why the personal computer is so complex

The personal computer is expected to do too many things, and this does not allow it to do any one thing well. The argument Norman makes here is superficially a reasonable one: Anything that is required to be multipurpose may not be as efficient or effective for any single task. But again, Norman's argument misses two points. First, the problem is not confined to high-technology products such as the PC; second, cost matters. Both of these points are illustrated by the automobile. The automobile is a multipurpose transportation device. A family with one car might use it for commuting and for vacations. The fact that it has to hold the whole family and luggage for vacations means excess capacity and inefficient fuel usage during commuting. Ideally, the family would have a small car for individual commuting and a large one for vacations and other family activities, but that means investing in two cars. A family that cannot afford two cars must have a vehicle that serves as a multipurpose one. The four-seater family sedan may not be great for hauling home trees for the garden or a new sink for the kitchen, but it will have to do.

Two-car families were once a rarity. However, as incomes have risen (so that the real cost of automobiles—as measured by how many hours one must work to earn the price of a car—has fallen), they have become more and more common, and often the two vehicles are very different in style and size and serve different purposes. One may be a pickup truck. The primary reason families have two cars, however, is because two family members require use of a car at the same time, in which case the vacation-configured car still may be used for commuting.

The parallel with the PC is that when the basic PC infrastructure (CPU and memory) was expensive, it made sense for cost reasons alone to share these across applications in a multipurpose machine. As processors and memory have become cheap, they can proliferate in specialized appliances such as organizers and communication devices.

In the case of computers, there are additional factors at work. The multipurpose nature of the computer may actually be what I want because it allows me to shift easily between tasks, perform more than one task at once, and share information among the different tasks I am undertaking. This may make it harder for the software and hardware designers, but in only two decades, they have produced machines that are quite robust. The fragility and clumsiness of the Windows operating system may have more to do with the particulars of Microsoft's position in the industry and its historical evolution from DOS than the complexity of the task of programming for multipurpose machines, as open-source systems such as Linux are demonstrating. It is also true that specialized information appliances must communicate with each other, and such protocols are only now being developed fully. To chastise the developers of PCs for not providing streamlined specialized appliances when the means to usefully connect them were not there seems disingenuous on Norman's part.

Finally, as we discuss in considering what information appliances are, even specialized appliances now handle more functions or tasks than the earlier multipurpose PCs. How many PCs had sophisticated e-mail capabilities 10 years ago, something now built into tiny digital wireless phones? We may be able to do more things on this so-called specialized information appliance (the digital wireless phone) than on the "complex" PC of the past. Of course, we have to learn how to send e-mail, listen to voice mail, do calculations, and play games on the phone. We might even have to read the instruction book.

The PC's design is driven by technologists who do not pay enough attention to what consumers or potential users want. Here Norman is saying that even though the PC has not failed because of the arrogant technologists, they have made it complex to use. So we have a not-so-good product that people are buying because they have nothing better. And the product is not so good (too complex) because of technologists' hubris. There might be something to this. Engineering often does drive product design. But sometimes it may be because of physical, technical, and economic constraints that have nothing to do with the egos of technologists. Norman's response is to discuss how these constraints arise and to challenge their inevitability. Much of what he says on this topic is perfectly true. But note that the Japanese have been practicing for a long time

what Norman preaches, with organizational structures that seem to be good at producing elegant, simple, and useful designs. In the case of the PC, however, the Japanese do not seem to have made any great strides. Sony's entry into the market made little difference to the ease of use of PCs. What does seem to have mattered is competition. Anyone who can innovate in ways that someone along the value chain (and ultimately, therefore, consumers) is willing to pay for should ultimately come out on top. The iMac has been a success partly because of its promise of simplicity: everything comes in a single box, so you can just plug and play (or surf, or even compute).

Why information appliances are the solution

Norman argues that information appliances are specialized devices, so they can be designed with specific uses in mind, and hence can be more efficient, convenient, and pleasant to use. Norman is on firmer ground here—so much so, in fact, that events have overtaken him. Even before this book was published, information appliances were becoming firmly established in the marketplace. (In fact, the quintessential information appliances, video game machines, have been around for a long time). What made this happen, though, was not some revelation about the importance of user experience that came to the benighted technologists and marketers, nor was it the pressure of "crossing the chasm" to reach the majority of consumers. Instead, it was technological change that made these information appliances feasible and affordable; "cheaper, faster, smaller" is driven by the technologists that Norman scoffs at. Of course, information appliances that are more efficient, more convenient, and more pleasant to use are going to be more attractive to consumers, but only (as economists tend to say) ceteris paribus: other things (here, cost and performance capabilities) held constant. The case of video games illustrates the importance of competition in this context also. Sega's post-Genesis misstep in terms of providing what customers wanted most was punished heavily by existing competitor Nintendo and new entrant Sony.

It is important to realize that convenience, simplicity, and pleasure of use cannot mean quite the same thing when one is talking about information appliances as it does with kitchen appliances. Norman uses the analogy of electric motors being now invisibly embedded in specialized kitchen appliances, whereas earlier a single (then expensive) motor had to be used with many attachments (although it should be noted that the Cuisinart has been very successful with multiple attachments for a single, high-quality motor). The analogy seems to be to the operating system of the PC, which is obtrusive, rather than the CPU and other hardware, which is invisible. The attachments are explicitly compared by Norman to applications that run on top of the operating system. But when the motor is invisibly embedded in the kitchen appliance, all the user may have to do is press buttons that turn the appliance on or off, control the speed, and perhaps perform one or two other functions.

If we examine the PC and application analogy further, a specialized information appliance pushes the operating system into the background, and all we have to do is push a button or two. This, indeed, is what we can do at a basic level with a specialized information appliance such as a VCR or a CD player.

However, if we want to program the CD player to play tracks in a particular order, or have the VCR record a TV program, then we, the users, must do more; this is in the nature of information appliances, and it makes them fundamentally different from kitchen appliances. In some cases, technology can help make the user experience more convenient; in the VCR example, we now just have to punch in simple codes for many programs, rather than punch in specific instructions into the VCR (note again that technology aids convenience, it does not hinder it). But we cannot do this for personal selections of the order of tracks for a CD. In such cases, people have to learn a sequence of steps. Designers can make this process as simple and obvious as possible, but they cannot remove it all together. Information appliances are inherently more complex than typical kitchen appliances.

After pushing simplicity for information appliances in chapter 3, where Norman introduces the analogy to kitchen appliances, he admits that "There Is No Magical Cure" in chapter 5 and grudgingly acknowledges that devices such as the Palm Pilot "have become true information appliances." But these are nothing like kitchen appliances in ease of use, and cannot be so. They are certainly not as specialized as Norman would like to claim, being able to perform a large range of the tasks that are accomplished on a PC.

What are information appliances?

Norman shifts his attack at other points in the book, criticizing the complexity of the applications themselves. He says they are too feature-heavy and not always as well designed as they could be for ease of use. He is certainly right on this score, but he hardly seems to give the designers a fair shake in terms of understanding the reasons for the problem. He seems to think the problem is mostly that technologists are focusing on the wrong things ("cool features" rather than ease). He seems to neglect all the other difficulties in designing application software: the fact that it is incredibly complex, the fact that we know so little about how people use it (software companies do not ignore this lack of knowledge, but they cannot overcome it instantaneously), and the fact that it has to work with other applications.

We can once again add the lack of competition in some areas as a contributing factor. Norman uses Microsoft Word as an example in discussing application software. Microsoft's dominance of the office suite market, arguably as a result of leveraging (whether illegally or legitimately) its dominance in desktop operating systems, may also have stifled innovation in such products. The video game market, on the other hand, is intensely competitive, and firms live or die by delivering games (applications) that consumers will play and buy in large numbers.

In any case, the use of Microsoft Word as an example illustrates further that the analogy of PCs with electric motors and applications with attachments can only be pushed so far. A PC that acts only as a word processor (recall that those were sold at one time) is a specialized information appliance, but the gains in ease of use may be minimal; this goes back to our earlier discussion of the inherent complexity of manipulating information (compared to, say, grinding coffee).

Is specialization always the answer?

In summary, Norman's distinction between general-purpose computers and specialized information appliance seems somewhat fuzzy. On one hand, he wants devoted technologies to perform specific functions, but on the other hand he realizes that these technologies have to talk to one another. What we mean by *technologies* must be described more specifically. For example, we may think of fax, e-mail, and voice mail as separate technologies, and currently the market has specialized information appliances for each of those. On the other hand, he is proposing that society would be better served by merging the delivery of all of these forms of messages in one information appliance.

But this is exactly what the personal computer is intended to do: taking many different technologies and allowing them to be used in the context of a single appliance. With the ability to append attachments to our e-mails, we need not assume that e-mails and faxes are essentially different. With scanners costing less than $100, a fax system does not have to be independent of a computer because the computer can do everything a fax system can do. Our e-mail also can be fed to a text-to-speech application to give us voice mail, or the sender can simply append an audio or video file. With the PC, we can retrieve something from the Internet and integrate it into a manuscript, a letter to a colleague, or a casual e-mail. This convenience might outweigh the increased complexity of working with the personal computer. Having many different applications on a single platform enables the user to apply skill in one application to the use of another.

There are advantages to using a single device for a large number of applications. The same operating system used across all different functions allows a positive transfer from the use of one appliance to that of another. If you have used your personal computer for sending e-mail, then you have already learned a lot about how you would use that same computer for doing word processing. This is true to some extent on our current machines, but the isomorphism across the different uses could be improved considerably. If we had separate information appliances and the only concern was the information infrastructure that allowed communication among the appliances, there would be no incentive to have similar kinds of user interactions in the different domains. In this case, the user would be required to learn a new set of actions with each new appliance. Although we have different appliances in our automobiles and VCRs, it would be best to have the same interactive tools in both.

Norman's ideal

Norman's ideal is to make the technology invisible to the user. On the other hand, no matter what we do with the cognitive devices around us, we need to have some kind of model of the device. If the device is completely invisible, how are we going to acquire that device? If you sit down with a pencil to write a letter, it is important to know that the pencil requires a certain kind of paper that will maintain the marks you make. Thus, the properties of the pencil cannot be invisible to the letter writer. Norman seems to be moving away somewhat from his earlier views (Norman, 1988).

The role of user experience

The essence of Norman's positive contribution and conceptual framework is his raising of user experience (UE) as a component of successful product development on par with technology and marketing. The scope and importance of these components is as follows:

> Technology: The product is capable of delivering the required functions and performance at reasonable cost.
>
> Marketing: Product attributes that customers require are highlighted in advertisements, product literature, and product appearance.
>
> User experience: All aspects of the user's experience with the product are considered, including how it is perceived, learned, and used, as well as ease of use and the needs the product fulfills.

Norman connects the relative importance of the above three "legs of the stool" of product development to the phase of the product life cycle, using the Everett Rogers framework popularized and expanded by Geoffrey Moore. Obviously technology is much more important for early adopters, as Norman emphasizes, whereas marketing and UE are more important for late adopters.

Although Norman articulates the difference in his scheme between UE and marketing, in practice the distinction is unclear. For example, Norman says marketing is concerned with whether the customer will actually purchase the product, not with usage. He emphasizes that the purchaser and the user may be different people: "Marketing's primary emphasis is on those characteristics that affect the purchase of the item. UE's primary emphasis is on the usage phases of the product, from taking it home, unwrapping, assembling, and initial learning, through continued daily use to maintenance, service, and upgrading, where required" (pp. 47–48).

But all the things Norman focuses on as UE surely enter into marketing's calculus. They must also enter into the decision-making of consumers, except in the case of impulse buying or psychological hot buttons. When we buy a car, we test drive it, we look it over and test all its features, we read about the make and model's record for reliability, we investigate the ease and cost of service. All these aspects of UE enter into our decisions as purchasers and consumers. Certainly, as Norman points out, in some cases the purchaser and the user may be two different people altogether, but it seems that trying to separate marketing and UE as separate activities is a stretch: They overlap substantially, in concept and in practice.

In complaining about the lack of attention given to UE, therefore, Norman may really be saying something about the inadequacy of marketing as a discipline or about its failure to interact appropriately with design and engineering (or other facets of product development). This point may be valid, even if Norman's attempt at a conceptual trinity is not very convincing. On the other hand, nothing stays still, and one of the main developments in strategic thinking recently, particularly in marketing, is the idea of a continuous circle of development and feedback, involving consumers more intimately in product development and refinement. If anything, it is the high-tech hothouse of Sili-