THE INVISIBLE COMPUTER
CHAPTER 2

2

Growing Up: Moving from Technology-Centered to Human-Centered Products

Let me tell you about Gertrude. Gertrude disliked technology and, above all, computers. Nonetheless, in the early 1970s Gertrude went out and purchased one of the first personal computers, an Apple II, despite her lack of enthusiasm for technology, despite her skepticism. She became an early adopter because the new devices provided a service that could not be had in any other way. I learned an important lesson from Gertrude.

In the early days of the personal computer, I was one of the skeptics who failed to see the importance of this new and, to me, disruptive technology. I was a comfortable and long-term user of computers, starting with mainframes, such as the Remington-Rand Univac and minicomputers, such as Digital Equipment Corporation's PDP and VAX lines. This was long before the days of the graphical user interface: I was an expert user at Unix, arcane commands and all. When I saw the first Apple II, I considered it as a giant step backward. Information was stored on audio cassette tape. The display was a low-quality, low-resolution home television set. The keyboard was deficient. The machine was slow and woefully lacking in power compared to the minicomputers and mainframes. It all seemed so primitive—how could these new, limited systems be of any value?

Figure 2.1
(top) Miss Evelyn C. Lewis, the 1922 "Miss Washington," listens in with her radio set. She is tuning in by adjusting the condenser at the left. (Photograph courtesy of Corbis-Bettmann.) *(middle)* A Stromberg Carlson table-top radio, 1945. (Photograph courtesy of Corbis-Bettmann.) *(bottom)* A Sony Sports Walkman. (Courtesy of Sony Electronics Inc.)

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Gertrude changed my mind. I was chair of the Department of Psychology at the University of California, San Diego, and Gertrude was the department's accountant. She refused to use computers. I tried hard to get her to use my laboratory VAX, but no, she was adamant. She pored over the huge printouts provided at regular intervals by the university financial department, reconciling the numbers with her manual adding machine. She was a whiz at her hand-operated calculator.

But one day she went out and bought an Apple II specifically so that she could use Visicalc, the first spreadsheet. This technology-hater fell in love with the spreadsheet, technology quirks be damned. The command set was complex and, even to me, a long-term computer user, intimidating. But Gertrude was determined; for her, the value was worth the pain. One of her duties was to do budget projections: Assuming we hired this many people or bought these pieces of equipment or supplies, what would be the impact on our budget? These were tedious to do by hand, especially as her clients, me and the grant-writing faculty, would often ask for revisions: "Suppose we increased this and got rid of that, what would it do to the budget?" For Gertrude and many others like her, it was worthwhile to buy a computer just for this one program, just for this one task, much to Apple Computer's surprise and delight.

In the early days of a technology, it doesn't matter if it is hard to use, expensive, or ungainly. It doesn't matter as long as the benefits are sufficiently great: if the task is important, valuable, and can't be done in any other way.

Technology Life Cycles and the Consumer

Technological products have a fascinating life cycle as they progress from birth through maturity. The same product that was attractive and desired in its youth can be irrelevant and ignored at maturity. Once through the unstable days of adolescence, everything changes. Customers view products in a new light, seeking very different things. The dimensions upon which the product is judged change. As a result, the way the product is conceived, developed, and marketed must also change.

The very talents of a company that made it successful in the early stages of a technology are exactly wrong for the latter phases.[1]

In the early days of a technology, some people will buy because of the functions it offers. These are called *early adopters*, people who buy because they are in love with technology and will buy almost any new item, or whose needs for the newly developed functions are so great that they are willing to put up with any other problems. Gertrude is a classic example.

New technology, functionality—that's what these early adopters purchase. Products are advertised and sold on the basis of their feature lists and technological claims. Marketing becomes the act of beating the competition's claims. Marketing teams go out and ask customers what new features they require, and then return to the company to implore the technologists to provide them in the next release of the product. Each company works hard to demonstrate that its products are technologically superior, that they have some new advantage that causes them to be faster, smaller, more powerful, or unique in whatever way seems appropriate to the audience. After a while, these claims take on a life of their own.

The result is technology-driven, feature-laden products. Each new release touts a new set of features. Advertisements proudly list them all, extolling their virtues. Seldom are the customer's real needs addressed, needs such as productivity, ease of use, getting the job done. Instead, the feature lists proclaim the technological feats, as if the mere purchase of enhanced technology thereby makes everything else OK. The notion that a product with fewer features might be more usable, more functional, and superior for the needs of the customer is considered blasphemous.

The situation is not helped by the product reviews in the press. Every field of technology spawns its own set of industry conferences and technical and popular journals. Financial analysts, whose job is to write about the minute differences among the companies, and the popular press, who write the reviews of new product releases, need some way of differentiating among the products they write about, so they take to

inventing measurements. There seems to be some belief that their personal opinions are suspect. If they were simply to say "I liked this feature" or "I hated that feature," it would be regarded as personal opinion and carry little weight. As a result, they have created the myth that quantitative measurements are superior, for, after all, they are not subject to personal bias. All the reader has to do, goes the claim, is notice that the numbers measured for one product are better than those for another. Now the reviewer can say "When I held the scroll bar down in product X, it took 11 seconds to go from the start to the end of a document, but only 6 seconds with product Y." No matter that no user ever goes from the start of a document to the end in this way; here is a measurable, if irrelevant, difference between products.

Quantitative measurements are indeed valuable. They are at the heart of the scientific method, for they are precise and repeatable. But the choice of what is to be measured and what not is just as personal and just as biased as any other opinion. What is measured is deemed important, making what is not measured appear to be of little value. Reviewers measure what is easy to measure, regardless of whether these reflect any real utility for the users. Companies labor to improve on these highly quantifiable, highly marketable measures of performance, no matter that they are inapplicable to real life. Fortunes are won and lost, companies climb and collapse on the basis of such irrelevant measures and marketing claims.

I've just described the computer industry, although the general trends are common to the first few generations of products from many technology areas, from automobiles around the turn of the century to early televisions. This is where the computer industry is today; it still believes in technological frenzy. Megabyte, gigabyte, terabyte. Kilobaud, megahertz, gigahertz. New software releases gobble up speed and capacity, demanding more and more and more. But does the consumer understand what all these mean? Is the consumer well served? Strange you should ask.

When a technology matures, the story changes. You could even claim that a mature company is no longer a "technology" company—it's a

products or a service company. After all, in everyday speech, we use the word *technology* to refer to things that are new, where the technology dominates over usability and usefulness. We call the digital computer "technology." We call the internet "technology." But what about a pencil or paper? How about a gas stove or a safety pin? In actuality, all are technologies, all follow advanced scientific and engineering practice in their design and manufacture. But pencils, paper, stoves, and pins are so commonplace that we take them for granted. We assume the technological features are reliable and robust, and so, on the whole, we ignore them.

Once technologies mature, we take their basic performance for granted. We assume it works just fine for our purposes. As a result, we look for other properties: price, value, prestige, appearance, and convenience. We purchase by brand name as much as by actual product. Even large, costly items such as automobiles and television sets are purchased more by price, appearance, prestige value, and brand reputation than by technical distinctions.

Marketing tries hard to make one product different from another by touting minor technical differences, often by giving them fancy names: "Only PixelTech has black-matrix, diagonal pixel-plating," they will proudly proclaim, even if we, the everyday users, are unable to understand, let alone evaluate, the claim.

The computer industry is still in its rebellious adolescent stage. It is mature enough that its technology, functions, and reliability should be taken for granted, but it still has a good deal of immaturity. It keeps trying to grow bigger, faster, more powerful. The rest of us wish it would just quiet down and behave. Enough already. Grow up. Settle down and provide good, quiet, competent service without all the fuss and bother. Ah, but to make this change from youth to maturity is to cross the chasm between the technological excitement of youth and the staid utility of maturity. It is a difficult chasm to bridge.

A vast chasm separates the requirements of the people on the early side of a product life from those on the late side. The first, the early adopters, want technological superiority, and they will suffer any cost,

whether initial purchase price or cost of maintenance and usage, for the benefits. The other, the conservative late adopters, want reliability and simplicity: Their creed is "turn it on, use it, and forget it."

Products have to be developed, marketed, and sold very differently for these two groups of people. Alas, the aging teenagers who rule the computer companies of the world are still stuck on the youthful side of the chasm and they seem unable to make it across. It is time for computers to grow up, to enter the mature world of consumer appliances. The appliance argument is all about the consumer's comfort zone—the mature side of the chasm. It is all about ease of use, dependability, attractive appearance, prestige, and brand. The consumer world is a very different world than the high-tech world of technology-addicted developers and reviewers.

There are many ways to judge a product, many dimensions. Different dimensions are important at different phases of a product's life cycle. Similarly, different customer segments become relevant. In the early days of a product, what matters is that it provides unique capabilities. This is where the early adopters come in, the people who will buy regardless of the complexity or other difficulties just to be on the cutting edge. Early adopters are important—they help establish a market. But they are not the typical buyer—they have more technical abilities, they will put up with more grief, and they are willing to spend more money.

As the market develops, competition arises, the technology matures, and quality improves. This is the adolescent stage of a product. At some point, the technology can be taken for granted; that is, everyone has roughly comparable technology, so other dimensions of the product take on added relevance: reliability, maintenance, cost. This is where the pragmatic wave of adopters comes in, people who wait until they see whether the new technology stabilizes, whether it can actually deliver on its promises.

Eventually, the product reaches adulthood. It is mature, stable, reliable. Now, new dimensions are important; cost, appearance, and convenience play more important roles, with the technology and its functionality and reliability taken for granted. Now we get the late adopters, conservative purchasers who wait until the product has

reached consumerhood, the final state of maturity. Now, the product provides real value. The technology moves to the background. Convenience and reliability are more important than technological superiority. Appearance, prestige, and pride of ownership start to matter.

Consider the wristwatch. Do you buy the one that keeps the most accurate time? Not usually. You assume they all keep accurate time, at least accurate enough for everyday purposes. In fact, some of the cheapest watches keep better time than some of the most expensive; the cheap electronic watches have time controlled by a precise, quartz crystal whereas the expensive watches are mechanical and hand made. Do you buy the watch that is most rugged? Not usually. They all are very rugged, at least rugged enough. Moreover, a cheap watch is so inexpensive that if it breaks, it is easier and less expensive to buy a replacement than to fix it, and cheaper to buy several new watches rather than one expensive one.

Although a watch is actually a piece of precision machinery, accurate to around 10–20 parts per million (one to two seconds a day), watches have long ago passed through the stage of being technology centered to the current stage of being entirely market driven, human centered. Watches are high-technology marketed as jewelry, as fashion, as objects of emotion. And yes, some are sold as functional, useful timepieces. Watchmakers have learned to manufacture a wide variety of watches to fit the varied requirements of their customers. They divide up their markets very carefully and then work at getting customers to buy from more than one category.

Digital watches tend to be inexpensive but capable of advanced functions, so these cater to the cost conscious and the gadgeteer. It is no surprise, by the way, that these are the watches favored by the engineers in high-technology computer companies. Note that although digital watches could be made to be attractive, with jeweled cases and precious metals just like analog watches, they seldom are, because these watches appeal to the practical.

Other watches are sold for their beauty, for their fashion, for their prestige value. Some are fun, some cute, some folksy, some sleek and sophisticated. Almost all the expensive watches display the time with

mechanical hands, not because this is better, but because this is what the market demands. The cheaper analog watches are actually digital inside, powered by batteries and controlled by quartz crystals and stepping motors, not that the average user knows or cares. These are sold as jewelry, and the consumer is encouraged to own multiple watches, wearing the one that fits the mood, the activity, or the outfit.

The most expensive and most prestigious watches are those that are completely mechanical, some still hand made. Watches can be made expensive in two ways: One is through the addition of jewels and expensive metals, the other through "complications," added mechanical functions that show several time zones, phases of the moon, or the passage of the stars. These are complex and difficult functions to accomplish in analog, mechanical watches, hence the high cost. The fact that the same functions could be done cheaply in a digital watch is quite irrelevant to this market; these people would never wear an inexpensive plastic watch.

One brand, Swatch, brings out multiple versions of its watches with different design themes, encouraging users to collect them. This scheme is so successful that some purchasers never wear their watch, for an unused, unopened box has more value on the collector's market. Finally there are luxury, prestige watches, where the prices range from $2,000 for a luxury watch to over $10,000 for the most prestigious ones. Prestige, yes, that is what it is all about. This highly technical industry sells jewelry, fashion, and prestige. One company, SMH, has 14 different brands, the better to target the various market segments (Swatch is one of them). One of SMH's subsidiaries, ETA, makes most of the watch movements in the world.

SMH's annual report makes it clear that they consider three major factors to be of prime importance in the sales of their watches: innovation, public relations, and emotion. The computer business certainly understands innovation and it thinks it understands public relations. But emotion? When a highly technological product such as a watch is sold on emotion, then you know the technology has matured, that it is a true consumer product. When the most expensive products are actually less accurate, with fewer functions than the least expensive, then you know you are no longer in a technology-driven market—you are in a consumer market. When the technology becomes good enough, then technology is no longer the variable that controls purchases. Emotional reaction, pride of ownership, and pleasurability can all become major selling points. The computer industry has a way to go.

Moving from a Technology-Centered Youth to a Consumer-Centered Maturity: A Graphical Depiction

In its early days, a technology cannot meet all the needs of its customers. Leading-edge adopters, the early adopters, need the technology, and they are willing to suffer inconvenience and high cost to get it. Meanwhile, they keep demanding better and better technology, higher and higher performance. With time, the technology matures, offering better performance, lower price, and higher reliability. These phases are shown in figure 2.2. Note that when the technology exceeds the basic needs of most of its customers, we are at the transition point shown in figure 2.2; now there is a major change in customer behavior.

When the technology reaches the point where it satisfies basic needs, then improvements in the technology lose their glamour. Now customers seek efficiency, reliability, low cost, and convenience. Moreover, new kinds of customers keep entering the market as the product matures. In the early phases were the early adopters, those who were willing to gamble on the new technology because they felt the benefits far exceeded the costs. More conservative customers held back, waiting for the technology to prove itself, to become reliable. This is the cycle of market adoption described by Geoffrey Moore in his book *Crossing the Chasm* (see figure 2.3).

For many years, those who study the way innovative ideas and products enter society have classified the people who are the targets of innovation into five categories: innovators, early adopters, early majority, late majority, and laggards.[2] Each plays a different role in the development of a technology, with the innovators and early adopters driving

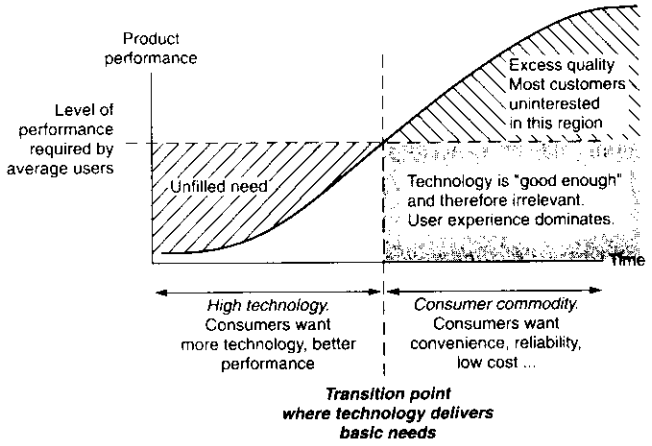

Figure 2.2
The needs-satisfaction curve of a technology. New technologies start out at the bottom left of the curve, delivering less than the customers require. As a result, customers demand better technology and more features, regardless of the cost or inconvenience. A transition occurs when the technology cannot satisfy the basic needs. (Modified from Christensen [1997].)

the technology and the early and late majority sitting on the sidelines, waiting until it is safe to jump in. Note, however, that in terms of the sheer size of the market, it is these latter customers who dominate—hence the term *majority*. These customers demand convenience, ease of use, reliability; they want solutions that simplify their lives, not technologies that complicate them. To Moore, there was a chasm between these two kinds of adopters. On each side of the chasm, a company must take a very different attitude toward its market, toward how it conceives of its product.

In truth, of course, this segmentation of the customer base is highly oversimplified. The world market consists of billions of people, with a wide variety of interests, skills, socioeconomic and educational levels, and concerns. Which products are necessities, which luxuries, depends upon the culture, the lifestyle, and a host of other variables. The needs

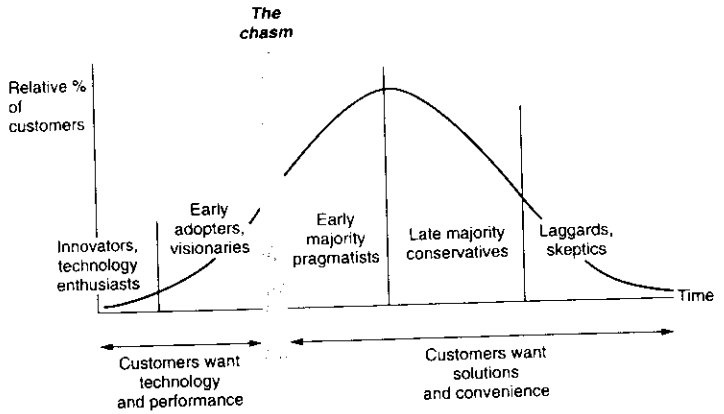

Figure 2.3
The change in customers as a technology matures. In the early days, the innovators and technology enthusiasts drive the market; they demand technology. In the later days, the pragmatists and conservatives dominate; they want solutions and convenience. Note that although the innovators and early adopters drive the technology markets, they are really only a small percentage of the market; the big market is with the pragmatists and the conservatives. (Modified from Moore [1995]).

vary, the threshold being low for some, high for others. Any individual plays multiple roles in society: parent or child, student or worker, employee or manager, serious adult or playful youth. Each role can have different levels of technological needs or lie at different parts of the adoption cycle. Note, too, that the time axes of the diagrams are measured in years or decades. The digital computer industry is just now crossing the chasm, although the computer has been with us for more than fifty years, the personal computer more than twenty. The internet started over thirty years ago. A technological product can take longer to mature than a person.

Oversimplifications are useful if they capture the essence of a phenomenon. The distinction between early and late adopters may be oversimplified, but I have found that it resonates with people all around the world. It captures well the changes in attitudes about a technology as it matures and becomes integrated with a society's culture.

Note how the analyses of figures 2.2 and 2.3 fit nicely with one another. What do late adopters want? Convenience, low cost, a good user experience. When is this possible? When the technology exceeds the transition point of figure 2.2. This corresponds to the location of the chasm in figure 2.3. As figure 2.4 illustrates, once technology reaches maturity, the entire nature of the product changes; it has to be designed, developed, and marketed differently.

Although early users are relatively few in number, they drive the technology. These are the customers who love a challenge, who want to be on the leading edge. The technology enthusiasts and visionaries see the promise offered by the new technology and are willing to take some risks, for, in their eyes, the benefits outweigh any difficulties they might face. This early group includes the product reviewers for the industry journals and the popular press. Product reviewers like to be viewed as visionaries; their job is to spot trends and extol their virtues. Moreover, product reviewers don't have to live with the products they recommend; they write their columns and go on to the next thing.

The vast majority of people are pragmatic and conservative. They are the late adopters who take a more realistic view of the world. They tend not to buy new technologies. Instead, they watch and learn from the experience of the early adopters. They wait until things have settled down, the prices have dropped, and the technology has stabilized. They wait until the product is truly capable of meeting their needs, wait for firm evidence that it brings economic value without disruption of their existing way of doing things. These buyers want convenience, reliability, and value. They do not want disruption.

The problem faced by the technology company is that the strategy for dealing with the customers in the early phase of a technology is contradictory to the strategy required in the mature phase. At first, the selling point is the technology and the list of features. At maturity, the selling points require that the attributes of the technology be minimized. The buyers now focus on solutions and convenience, on their experience with the product. They want to talk with experts in their problem

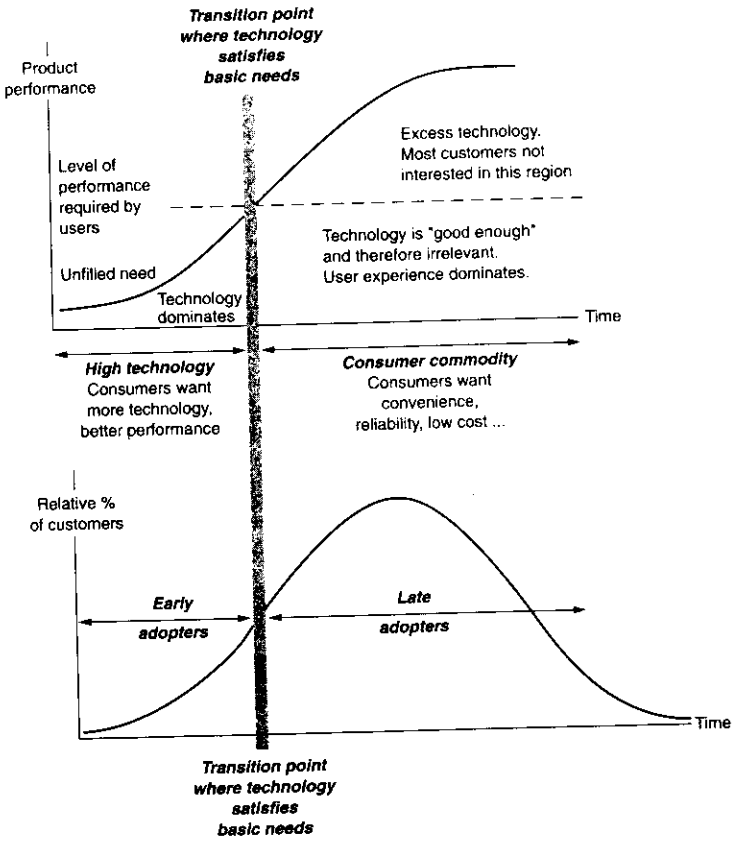

Figure 2.4
The change from technology-driven products to customer-driven, human-centered ones. As long as the technology's performance, reliability, and cost fall below customer needs, the marketplace is dominated by early adopters: those who need the technology and who will pay a high price to get it. But the vast majority of customers are late adopters. They hold off until the technology has proven itself, and then they insist upon convenience, good user experience, and value.

areas, not experts in technology. What impact will it have on their business, their life?

Now picture a company that has introduced a successful product, that has achieved great success with the early adopters. These are just a small part of the potential marketplace, and if the company wants to grow, it must change its entire approach in order to satisfy the needs of the late adopters. They have to transform themselves from a technology-driven company into a customer-driven or, in my terms, a human-centered one. But the companies who have become successful with the early technology often find that success makes their old skills obsolete. Much of what brought them success is exactly the wrong behavior now. They aren't ready to deal with the requirements of this new kind of market. They don't know how. Many don't even know they have to change; they fight the transition every inch of the way, introducing more elaborate technologies more laden with features to a marketplace that no longer cares.

Making the Transition to a Customer-Driven Company

In mature markets, technology is taken for granted. Convenience, price, and prestige are the driving forces. Among other things, convenience means ease of use, that the product can be purchased, turned on, and used, with no lengthy learning cycles, no need to call telephone support services, no need to consult complex manuals or to take classes. And no feeling of puzzlement, no loss of control. Prestige is measured in many ways, often by the brand reputation, often by the physical appearance: attractive, sophisticated design, texture, and color.

In the youth of a technology, a company can survive on pure engineering. The products are conceived and built by technologists. A small marketing and sales group takes care of advertisement and sales. Growth is fueled by technological enhancements. Customers and reviewers love it, crying out for more and more features, faster performance. At the same time, the market rises rapidly, profit margins are high. Technology reigns.

In its turbulent adolescence, as the technology matures, as the major needs of customers are able to be satisfied, the early pragmatic buyers enter the marketplace. These customers have greater demands: They want to be shown that the product is worth the investment. Moreover, they have a set of market requirements, not just technological ones. The technology company discovers it needs marketing. As a result, marketing organizations are formed to convince the customers of the product's worth. In turn, these marketing representatives come back to engineering asking for more and different kinds of features in the products. This may be the first time that the company has had representatives whose job is to talk to customers. It requires a change in perspective on the part of the engineers, the technical community. Mind you, we are still in the technology-driven phase of the market, transitioning to a feature-driven technology.

Marketing soon establishes itself as equal to engineering in influence and power. Before long, individuals from the marketing side of the company make their way up the executive ladder, in part because they understand the business side of the enterprise. Marketing starts to be represented on each technology team, usually resulting in tension between them and the engineering staff. Marketing representatives consult the company's customers and return with lists of necessary and desirable features. These lists drive successive releases of the products. Engineers often resent the influence of marketing. They feel that marketing people do not understand the technology and that their lists ask for outrageous things. In turn, marketing may feel that the engineers don't understand the needs of the customers, that they simply want to build neat gadgets, regardless of true market needs. The company is slowly maturing, but at a cost of internal tension.

But what happens when the product hits the mainstream, when even the conservative customers are starting to buy? Here is where the mass market is, here is where the most demanding customers are. And here is where the old style of doing business simply does not work anymore. The company must change the product, change the way things are done. The transformation is not easy. All the old skills are wrong for the

new marketplace. The tensions between marketing and engineering were the early signs of trouble, but now that even greater changes are required, war can erupt.

As the marketplace matures, other pressures build. In the early days, there was little competition, and in any event, it was often difficult for a company to keep up with the demand. Profit margins were high. In the mature phases, there are multiple competitors, each of which is capable of satisfying the customer's technical requirements. Products can no longer differentiate themselves by features; other means are required. Now comes the importance of style, ease of use, reliability, convenience. Cost becomes a major factor in purchase decisions. With the advent of multiple competitors, often international, and with the advent of cost-sensitive buyers, profit margins drop rapidly. The financial market, which once thought of the company as the daring, pioneering leader, growing at a rapid pace and bringing in high returns, suddenly turns hostile; market share is dropping, and although sales may be rising, profits are often declining, sometimes out of existence. The financial community blames the company and lowers its predictions of future earnings; the stock prices crumble.

At the very time when a company needs to step back and take a new look at itself, when it needs to reorganize and restructure, the financial story puts severe pressures on its ability to do this. Time is the one thing it does not have. Suddenly, it has to meet market requirements, but the old guard wants to do it by adding yet more new technology, bringing out new products at an ever-faster rate, and fighting the falling revenues by cutting back on the size of the company. It is a tumultuous time. Geoffrey Moore called it a "tornado."[3]

Toward a Human-Centered Product Development

In the beginning stages of a technology, products are driven by the needs of technically sophisticated consumers. When technologies mature, however, everything changes. Now, the technology is no longer

exalted; it has long since passed the stage of being "good enough" for most consumers. Moreover, the technology is commonplace enough that many competitors can produce roughly equivalent performance. As a result of the increased competition, prices drop. In the mature market, new classes of customers emerge: the mass market. These are the pragmatic, conservative customers who wait until the technology settles down, who wait until they can get value for their money with a minimum of fuss and bother. They want results. The new customers are less technically sophisticated than the old. The same product that satisfied the early adopters now creates confusion. They require assistance, hand-holding. Companies must build up elaborate service organizations to handle the customer needs. Yet this service is so expensive and the profit margins so low that a single call to the service desk can be costly enough to wipe out the entire profit from the item.

The computer industry has responded to these pressures by doing more of the same, only more forcefully. After all, their most successful strategies in the past were to increase the number of functions and features of each product. This is only natural human behavior. But it is the wrong behavior in these circumstances.

Changing times require changing behavior. The entire product development process must change. The strategy of the industry must change. No longer can sheer engineering suffice. Now, for the first time, not only must the company take marketing seriously, it must introduce yet a third partner to the development process: user experience. Moreover, the entire development process has to be turned around so that it starts with user needs and ends with engineering.

Why is everything so difficult to use? The real problem lies in product development, in the emphasis on the technology rather than on the user, the person for whom the device is intended. To improve products, companies need a development philosophy that targets the human user, not the technology. Companies need a human-centered development.

The Three Legs of Human-Centered Product Development: Technology, Marketing, and User Experience

Many skills are required to build successful products. Obviously, there must be an appropriate technology, one capable of delivering the required functions and performance at reasonable cost. For a product to sell, marketing experts must ensure that the product provides the features that customers require and that the product attributes are highlighted in advertisements, product literature, and product appearance. An enjoyable and effective user experience does not come about accidentally; it requires considerable focus and attention to the needs, abilities, and thought processes of the users. Finally, if the company is to remain profitable, the product must be built upon a solid economic foundation, providing the required attributes for a price that is acceptable to the consumers but that still yields a profit to the company.

Human-centered development requires three equal partners, three legs to the triad of product development: technology, marketing, and user experience. All three legs provide necessary and complementary

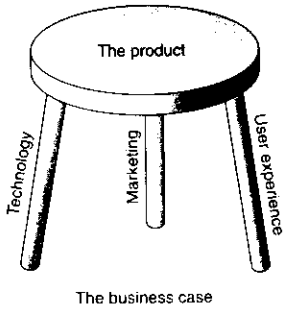

Figure 2.5
The three legs of product development in the mature, customer-centered phase of a product. When the technology matures, customers seek convenience, high-quality experience, low cost, and reliable technology. A successful product sits on the foundation of a solid business case with three supporting legs: technology, marketing, and user experience. Weaken the foundation or any of the legs and the product fails.

strengths. Weaken one leg and the product falls. The three legs stand upon the foundation of the business case and support the product itself. Weaken the foundation of sound business practices and the company may not succeed. And finally, the product must be appropriate for its position in the technology life cycle. An emphasis on technology is inappropriate for products in the consumer cycle of a technology.

Early in life, the stool does not have to be balanced. Early adopters care most about the technology, so this is the leg that must carry the weight. User experience and marketing simply have to be "good enough." As the product matures, marketing plays a more important role, tracking the technological needs of the customers and ensuring that the product is differentiated from the competition. User experience starts to increase in importance, but it does not drive the product requirements.

Things change dramatically during the mature phase of a product when it has crossed the chasm and is being marketed and sold to late adopters, those practical and conservative members of the market who seek convenience, a positive user experience, efficiency, reliability, and prestige. Here, a product fails if it is easy to use and understand but has deficient technology so that it is too slow and limited in ability. Here, a product fails if it has wonderful technology but is too difficult to use. And here a product fails if it has wonderful technology, accomplishes wonderful things, and is easy to use but is too expensive. All three legs must be in balance.

The Xerox Star is a case in point, a product that failed despite superb user experience; it had insufficient technology and marketing. This was the world's first commercially available computer with a graphical user interface. It was brilliantly designed, so much so that it set the standard for the entire second generation of the PC. It developed the high-level design principles that motivated the development of the Apple Lisa and Macintosh hardware and software and the Microsoft Windows operating system. In some ways it still surpasses current systems. The Xerox Star had ease-of-use features and a philosophy that has not been

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equaled since. Many of the developers of systems in the marketplace today would do well to study the Star.[4]

Despite all its virtues, the Xerox Star suffered a number of faults. It was ahead of its time[5]—it was a consumer product in an era of technology-driven ones; it was designed for late adopters before the market was ready. The sales force didn't know how to sell it. At first, they targeted the information technology professionals, technology addicts all. This customer segment failed to understand why ease of use should matter. Although the Star was intended for the late adopters, the end-users of a technology who care about convenience and use, it was premature for them; they weren't yet ready to adopt such new technology. And because the Star was a product category that was still early in the technology life cycle, the technology itself wasn't quite ready. The Star was slow, painfully slow. It had hardly any software, so it didn't really do much. Most important of all, it lacked a spreadsheet. And it was expensive. Brilliant design, but so what; it failed in the marketplace. The same, by the way, holds for the Apple Lisa: Brilliantly designed with features that have still not been equaled. And a failure in the marketplace.

The Apple II and the IBM PC illustrate another case in point: products that succeeded despite limited technology and poor user experience. They had great marketing, but more important, they handled tasks of sufficient value that their users were willing to tolerate the deficiencies. In many respects both the IBM PC and the Apple II were miserable machines. They were clumsy and, by today's standards, difficult to use. But they had a piece of software—the spreadsheet—that made it all worthwhile: Visicalc for the Apple II and Lotus 1-2-3 for the IBM PC. The spreadsheet didn't exist prior to its invention as Visicalc for the Apple II computer. It became possible to do accounting and budget projections in ways that simply could not be done before. A large number of people purchased the Apple II or the IBM PC solely so that they could use the spreadsheet. Gertrude was not alone.

These were machines for the early adopters, for those who were willing to overlook the deficiencies because of the great benefits. Superb functionality can conquer, can make for a viable business, but without

full support for all three legs of the tripod, it will never stand as a business for the everyday consumer. There is a vast difference between the product that sells to the early adopters and the one that attracts a loyal following among the many. The sophisticated, easy to use, easy to understand Xerox Star and Apple Lisa were wrong for the early adopters. These people were quite happy with the clumsy, awkward Apple II and IBM PC. In turn, today, now that the market has reached maturity, ease of use and customer features are required; for today's customers, the philosophy that underlay the Lisa and Star is completely appropriate, whereas that of the Apple II and IBM PC is completely wrong. The entire design philosophy and development process changes once technologies mature. In a mature market, a human-centered development process is not only appropriate, it is required.

Human centered development requires three different skill sets, three legs of product development: technology, marketing, and user experience. Let me now review the properties of each.

Technology

For the high-technology, information-based products that are the focus of this book, it hardly seems necessary to justify the role of the technologist, for that role is well understood. It is technology that allows it all to happen, that drives the product by making possible new functions, better quality, and lower costs. As we saw from the story of the Xerox Star, the lack of sufficient technology can be a factor in a product's downfall. When the Star came out, the technology was still too expensive and limited. As a result, the machine was far too slow to be useful.

My students and I conducted some early studies of the Xerox Star at a company near my university that was one of the early large adopters of the Star. We found that despite the users' acceptance of the concepts and the principles of operation, the universal complaint was about the limited functions available and, above all, the slowness. The Star's help function, brilliantly conceived and excellently implemented from the user's point of view, was so slow as to be worthless. One user complained

that after requesting help, you could leave and go get a cup of coffee, brewing a new pot if necessary, and after you leisurely returned to your desk, the help function might be ready. An exaggeration perhaps, but the story well illustrates the level of frustration.

One of the factors militating against the Apple Lisa was the high cost of the technology. The Lisa required a lot of memory for those days (an amount that today would be considered pitifully small), and this drove up the costs more than most people were willing to pay, especially as the early Lisa had very few applications of value to the user.

In the mature days of a technology, ease of use and convenience are key, but that is because the technology is taken for granted. The Xerox Star and the Apple Lisa came out in the early days of the industry. They didn't yet have the technology, neither the appropriate speed nor a sufficiently powerful set of applications. First things first: first technology and proper functions, then reliability and cost, then ease of use.

Even the Apple Macintosh was thought to be too expensive in price and too limited in capability. It, too, almost failed. It was saved by the development of yet another new technology, the laser printer and page description languages (Adobe Postscript, in this case), that made desktop publishing possible. The Macintosh had its "killer application," an ability to produce high-quality publications literally "on the desktop." Prior to the Macintosh and its associated laser printer, it took a highly skilled technical crew to produce quality publications.

Without proper technology, even the best of ideas fail. It is the technologists who determine what is and is not possible, how much time it will take, and what it will cost. All are critical determinants of product success. Without the technology there is nothing. With the technology? Well, there may still be nothing without the other two legs of marketing and user experience.

Marketing

The marketing organization fulfills many roles within a company, but the one of most concern during the development process is expertise in understanding the pulse of the customer. Marketing, of course, is not a single concept, it covers a wide range of activities, requiring a wide range of skills. But above all, it is the role of marketing to provide expert information on the customers themselves: who they are, what they buy, and how much they will pay.

In many cases, when customers first encounter a particular product at the store, they have no way of distinguishing among competing manufacturers except by what is visible in front of them, by what the sales literature and salespeople tell them, and by their perceptions of the product based on the reputation of the brand. One of the more important tasks of the marketing organization is to ensure that the product be presented in the best possible light; the visual appearance, the capabilities of the product, the reliability, and the brand reputation all play a critical role. Nothing should be left to chance, not the design, not the packaging, not the appearance, not even the training of the salespeople.

It is important to distinguish between users and customers; they are not necessarily the same. A good marketing organization understands and exploits these differences. Customers are those who purchase the products, users are those who use them. In many situations, products are bought by purchasing agents or managers, often choosing on the sole basis of initial cost. Wholesalers and channel distributors determine what retail stores will be given to sell, based on their particular beliefs of what people will buy. Contractors purchase kitchen appliances for the houses they are building, usually on the basis of price and perceived prestige, which may have little to do with the desires of the home purchasers. And even when the customer will be the actual user, the criteria that are used at the time of purchase often have little to do with those that matter when the product is actually in use.

Customers buy products for many reasons, not necessarily the ones the product developers care about or that companies would prefer. Exciting technology? Yawn. Great ease of use? Yawn. Great visual design? Well, this usually gets their attention, but not necessarily their purchase. They choose on the basis of features that may have little or nothing to do with how they will actually use the product. Moreover, the

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reasons for purchase vary with the nature of the industry and the type of purchaser.

One critical aspect of marketing is the positioning of the product in the marketplace.[6] Positioning is the act of establishing what the customer thinks about the company and the product. It determines how the customer perceives the products of the company. Customers buy on perceptions, not on reality; unless they have used the product themselves or have referred to friends or consumer testing organizations that have experience with the differences among the products, all they have is perception. That's one reason the concept of positioning is so important in marketing.

It's essential to position the company, the brand, and the product so that it has desirable connotations. Positioning determines the customer's perception of quality, prestige, value, reliability, and desirability. In high technology, there are many positioning options. Some computer manufacturers aim to position themselves as the quality leaders, enabling them to charge a slight premium in price. Some try to position themselves as broad industry leaders, providing much more than mere technology: "the document company," "the solutions company," "the information company," the "imaging company," all in the guise of establishing the perception that this is a company that you can trust for all of your needs. "Buy everything from us and you can be assured that it will all work together harmoniously." This argument relies on the customer's perception that a company is a single entity, and anything under its brand name comes from the same group of people.

The reality is that companies often consist of independent, warring divisions whose members do not cooperate with one another. Different divisions in the same company can be in active competition with one another. Sometimes companies have more harmonious relationships with their partners from other companies than with divisions of the same company. Many products are made by one company, but carry the label and brand of another. The internal parts of a product may be made by a different company than the one who made the exterior, and whose brand name appears on the faceplate. No matter what the real story is,

the customer's perceptions are what determine the sale, and the customer's perceptions are determined by how the company has positioned itself.

Marketing plays an essential role in creating products that people will buy. Good marketing ensures that the product meets market expectations, that it is priced properly, and that it has features that appeal to users at the point of sale. The tools of the marketing organization are many, from market surveys, analyses of customer segments with attention to their purchasing power and habits, and the collection and analyses of actual retail sales from leading stores and distributors, to continual interaction with customers through visits, focus groups, questionnaires, and other sampling methods. Marketing is a critical leg in the tripod of product development.

Edison failed at marketing. Recall that his analysis of musicians indicated that there was little or no difference between the world's most famous musicians and those just below them. He may have been right. Edison also believed he had the superior technology. He may have been right. But he failed at understanding just why people buy specific products; he failed at marketing.

It is not enough to be first. It isn't enough to be best. It isn't even enough to be right. In the ideal situation a company should be all of those, but in addition, it is essential to understand why customers buy products, what they are looking for, and how their needs and perceptions drive sales. Having the best product means nothing if people won't buy it.

User Experience

The user experience group (UE) deals with all aspects of the user's interactions with the product: how it is perceived, learned, and used. It includes ease of use and, most important of all, the needs that the product fulfills.

Note the contrast with marketing and technology. Marketing is concerned with whether the customer—who is not always the same person who uses the device—will actually purchase the product. 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. UE affects point of sale primarily through appearance, the graphical and industrial design, and the brand reputation for ease of use, convenience, and quality.

Ease of use has many benefits for a company. Not only are customers more likely to be satisfied with the product, but the need for service desks should decrease. In most high-technology companies, and especially in the computer industry, each manufacturer spends a huge amount of effort and money providing help services, large numbers of experts who sit at their telephones all day (and night), trying to aid the frustrated users who call with problems and complaints. Each call can be time consuming, a frustrating experience for caller and helper both. In the mature marketplace, where there is fierce competition, relatively low prices, and low profit margins, a single call from a customer can often cost the company enough to wipe out any profit from the sale of the item. Here is where one of the largest economic impacts of good product development can be measured.

Companies are concerned about the cost of their help-line services. They put much time and effort into improving the efficiency and usefulness of the telephone calls handled by the service. But this is treating the symptom, not the cause. Why not put the effort into revising the product so the calls would be unnecessary in the first place? That's the role of user experience: to develop products that fit the needs of their users, that satisfy their needs, both in terms of function and aesthetics, and to ensure that the products are easy to understand and to use. In addition, satisfied users become repeat purchasers, likely to recommend both the product and the company to friends and colleagues, enhancing the overall reputation.

User experience covers a wide range of attributes of the product. Some are technical, such as developing a conceptual model for the user that guides the developers in their design decisions and even the choice of

technology, the better to ensure that the entire product development presents a cohesive, understandable face to the user. Some come from the experimental, social, and behavioral sciences, using field and observational methods to observe potential users to understand their real needs and to determine just what products might be of value. Experimental procedures and controlled observation can be used to test the initial product concept and prototypes to ensure that they are indeed usable and understandable, and that they deliver on their promise.

Some parts of user experience concentrate upon the aesthetics, ensuring that the perceptual properties are attractive and enticing: appearance, feel, sound, size, and weight. These require the skills of the graphical and industrial designers, whose contributions can transform products into "objects of desire."[7] Elegant, aesthetic, visually pleasing products not only sell better, they even appear to work better. Whether it be a fountain pen, a watch, or a computer, appearances matter.

Alas, a full-fledged UE group is rare in today's technology companies. Most companies have a few people scattered here and there who work on the user interface (variously called *human interface groups* or *human factors*). There are technical writers and industrial designers, perhaps a few graphical designers. But these people are seldom in one organization, seldom given much power. They are usually relegated to the junior, minor ranks, called upon at the tail end of product development to "make it easy to use," "make it pretty," "explain how to use it." This is not the way to deliver quality user experience. I return to this topic in chapter 9.

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