

Something Changed

**“New rules prevailed
now—and they were**

...and they were
powerful enough to
cost us nearly half a
billion dollars.”

I teach a class strategic management at Stanford University's business school as a part-time departure from my job as president and CEO of Intel Corporation. The way my co-teacher, Professor Robert Burgelman, and I normally grade the students is to go through the class roster right after each session and assess each student's class performance while it is still fresh in our memories.

The process was taking a little longer than usual on the morning of November 22, 1994, the Tuesday before Thanksgiving, and I was about to excuse myself to call my office when the phone rang. It was my office calling me. Our head of communications wanted to talk to me—urgently. She wanted to let me know that a CNN crew was coming to Intel. They had heard of the floating point flaw in the Pentium processor and the story was about to blow up.

I have to backtrack here. First, a word about Intel. Intel in 1994 was a \$10 billion-plus producer of computer chips, the largest in the world. We were twenty-six years old and in that period of time we had pioneered two of the most important building blocks of modern technology, memory chips and microprocessors. In 1994, most of our business revolved around microprocessors and it revolved very well indeed. We were very profitable, growing at around 30 percent per year.

Nineteen ninety-four was a very special year for us in another way. It was the year in which we were ramping our latest-generation microprocessor, the Pentium processor, into full-scale production. This was a very major undertaking involving hundreds of our direct customers, i.e., computer manufacturers, some of whom enthusiastically endorsed the new technology and some of whom didn't. We were fully committed to it, so we were heavily advertising the product to get the attention of computer buyers. Internally, we geared up manufacturing plants at four different sites around the world. This project was called "Job 1" so all our employees knew where our priorities lay.

In the context of all this, a troubling event happened. Several weeks earlier, some of our employees had found a string of comments on the Internet forum where people interested in Intel products congregate. The comments were under headings like, "Bug in the Pentium FPU." (FPU stands for floating point unit, the part of the chip that does the heavy-duty math.) They were triggered by the observation of a math professor that

something wasn't quite right with the mathematical capabilities of the Pentium chip. This professor reported that he had encountered a division error while studying some complex math problems.

We were already familiar with this problem, having encountered it several months earlier. It was due to a minor design error on the chip, which caused a rounding error in division once every nine billion times. At first, we were very concerned about this, so we mounted a major study to try to understand what once every nine billion divisions would mean. We found the results reassuring. For instance, they meant that an average spreadsheet user would run into the problem only once every 27,000 years of spreadsheet use. This is a long time, much longer than it would take for other types of problems which are always encountered in semiconductors to trip up a chip. So while we created and tested ways to correct the defect, we went about our business.

Meanwhile, this Internet discussion came to the attention of the trade press and was described thoroughly and accurately in a front-page article in one of the trade weeklies. The next week it was picked up as a smaller item in other trade papers. And that seemed to be it. That is, until that Tuesday morning before Thanksgiving.

That's when CNN showed up wanting to talk to us, and they seemed all fired up. The producer had opened his preliminary discussion with our public relations people in an aggressive and accusatory tone. As I listened to our head of communications on the phone, it didn't sound good. I picked up my papers and headed back to the office. In fact, it wasn't good. CNN produced a very unpleasant piece, which aired the next day.

In the days after that, every major newspaper started reporting on the story with headlines ranging from "Flaw Undermines Accuracy of Pentium Chips" to "The Pentium Proposition: To Buy or Not to Buy." Television reporters camped outside our headquarters. The Internet message traffic skyrocketed. It seemed that everyone in the United States keyed into this, followed shortly by countries around the world.

Users started to call us asking for replacement chips. Our replacement policy was based on our assessment of the problem. People whose use pattern suggested that they might do a lot of divisions got their chips replaced. Other users we tried to reassure by walking them through our studies and our analyses, offering to send them a white paper that we wrote on this subject. After the first week or so, this dual approach seemed to be working reasonably well. The daily call volumes were decreasing, we were gearing up to refine our replacement procedures and, although the press was still pillorying us, all tangible indicators—from computer sales to

replacement requests—showed that we were managing to work our way through this problem.

Then came Monday, December 12. I walked into my office at eight o'clock that morning and in the little clip where my assistant leaves phone messages there was a folded computer printout. It was a wire service report. And as often happens with breaking news it consisted only of the title. It said something to this effect: IBM stops shipments of all Pentium-based computers.

All hell broke loose again. IBM's action was significant because, well, they are IBM. Although in recent years IBM has not been the power they once were in the PC business, they did originate the "IBM PC" and by choosing to base it on Intel's technology, they made Intel's microprocessors preeminent. For most of the thirteen years since the PC's inception, IBM has been the most important player in the industry. So their action got a lot of attention.

The phones started ringing furiously from all quarters. The call volume to our hotline skyrocketed. Our other customers wanted to know what was going on. And their tone, which had been quite constructive the week before, became confused and anxious. We were back on the defensive again in a major way.

A lot of the people involved in handling this stuff had only joined Intel in the last ten years or so, during which time our business had grown steadily. Their experience had been that working hard, putting one foot in front of the other, was what it took to get a good outcome. Now, all of a sudden, instead of predictable success, nothing was predictable. Our people, while they were busting their butts, were also perturbed and even scared.

And there was another dimension to this problem. It didn't stop at the doors of Intel. When they went home, our employees had to face their friends and their families, who gave them strange looks, sort of accusing, sort of wondering, sort of like, "What are you all doing? I saw such and such on TV and they said your company is greedy and arrogant." Our employees were used to hearing nothing but positive remarks when they said that they worked at Intel. Now they were hearing deprecating jokes like, "What do you get when you cross a mathematician with a Pentium? A mad scientist." And you couldn't get away from it. At every family dinner, at every holiday party, this was the subject of discussion. This change was hard on them, and it scarcely helped their spirits when they had to go back the next morning to answer telephone hotlines, turn production lines on their heads and the like.

I wasn't having a wonderful time either. I've been around this industry for thirty years and at Intel since its inception, and I have survived some very

difficult business situations, but this was different. It was much harsher than the others. In fact, it was unlike any of the others at every step. It was unfamiliar and rough territory. I worked hard during the day but when I headed home I got instantly depressed. I felt we were under siege—under unrelenting bombardment. Why was this happening?!

Conference room 528, which is located twenty feet from my office, became the Intel war room. The oval table there is meant to seat about twelve people, but at several times each day more than thirty people were jammed in the room, sitting on the credenza, standing against the wall, coming and going, bringing missives from the front and leaving to execute agreed-upon courses of action.

After a number of days of struggling against the tide of public opinion, of dealing with the phone calls and the abusive editorials, it became clear that we had to make a major change.

The next Monday, December 19, we changed our policy completely. We decided to replace anybody's part who wanted it replaced, whether they were doing statistical analysis or playing computer games. This was no minor decision. We had shipped millions of these chips by now and none of us could even guess how many of them would come back—maybe just a few, or maybe all of them.

In a matter of days, we built up a major organization practically from scratch to answer the flood of phone calls. We had not been in the consumer business in any big way before, so dealing with consumer questions was not something we had ever had to do. Now, suddenly, we did from one day to another and on a fairly major scale. Our staffing first came from volunteers, from people who worked in different areas of Intel—designers, marketing people, software engineers. They all dropped what they were doing, sat at makeshift desks, answered phones and took down names and addresses. We began to systematically oversee the business of replacing people's chips by the hundreds of thousands. We developed a logistics system to track these hundreds of thousands of chips coming and going. We created a service network to handle the physical replacement for people who didn't want to do it themselves.

Back in the summer when we had first found the floating point flaw, we had corrected the chip design, checked it out very thoroughly to make sure the change didn't produce any new problems, and had already started to phase the corrected version into manufacturing by the time these events took place. We now accelerated this conversion by canceling the usual Christmas shutdown in our factories, and speeded things up even further by pulling the old material off the line and junking it all.

Ultimately, we took a huge write-off—to the tune of \$475 million. The write-off consisted of the estimates of the replacement parts plus the value of the materials we pulled off the line. It was the equivalent of half a year's R&D budget or five years' worth of the Pentium processor's advertising spending.

And we embarked on a whole new way of doing business.

What happened here? Something big, something different, something unexpected.

For twenty-six years, every day that we did business, we decided what was good and what wasn't when it came to our own product. We set our own quality levels and our own specifications, and shipped when we decided a product met our own criteria. After all, we had designed and conceived these products, and along with the product came our implicit right—and obligation—to decide when the product was good and when it wasn't. Nobody ever questioned that we had the right to do that and generally we were on target. Over twenty-six years, we pioneered one classic product after another: DRAMs, other types of memory chips, microprocessors, computers on a board. Our products had become the basic building blocks of digital electronics. But now, all of a sudden, we were getting strange looks from everyone that seemed to say, "Where do you get off telling us what's good for us?"

Furthermore, since we generally don't sell microprocessors to computer *users* but to computer *makers*, whatever problems we had in the past, we used to handle with the computer manufacturers, engineer to engineer, in conference rooms with blackboards, based on data analyses. But now, all of a sudden, 25,000 computer *users* were calling us every day, saying, "Give me a new part, period." We found ourselves dealing with people who bought nothing directly from us yet were very angry with us.

What was the hardest to take was the outside world's image of us. I still thought of us as a creative, dynamic start-up that had just grown a bit bigger than the other creative, dynamic start-ups. We could still turn on a dime. Our people still put the interests of the company ahead of their own interests and, when problems arose, employees from all different divisions would still rally around and put in incredible hours without anyone ordering them to do so. Yet now the world seemed to treat us like some typical mammoth corporation. And, in the public view, this corporation was giving people the runaround. That outside image didn't jibe with my view of us.

What had happened? And why now? What was different this time? *Something* was, but in the middle of those events it was hard to tell what.

What Happened to Us

A year or so later, as I reflect on it, I see two big long-term forces doing their work on us, creating the conditions in which a tiny flaw in a microprocessor's floating point unit could mushroom into half a billion dollars' worth of damage in less than six weeks.

The first involved our attempting to change how our products were perceived. A few years back, we had introduced a major marketing campaign, the "Intel Inside" program. It was the biggest campaign the industry had ever seen—in fact, it ranks up there with big-time consumer merchandising campaigns. Its aim was to suggest to the computer user that the microprocessor that's inside his or her computer *is* the computer.

Like all good merchandising campaigns, this had the advantage of reinforcing the truth. Even before the campaign, when you asked someone what kind of a computer he had, the first thing he tended to say was, "I have a 386"—which was the microprocessor chip inside the computer—and then he would go on to identify the computer manufacturer, what kind of software it had and so on. Computer users knew instinctively that the identity and class of the computer were determined more than anything else by the microprocessor within. This was obviously very good for us. It gave us distinction, an identity, and helped build computer-user communities' awareness of us and our products.

We aimed our campaign at driving this point home to a wider consumer base and to future computer buyers. We created a distinctive logo and we worked with manufacturers who used our microprocessor in their product to display this logo in their advertising, often with a sticker on the actual computer. Hundreds of manufacturers, domestic and international, participated in this campaign.

We spent a lot of money ourselves promoting this brand. We had billboards displaying the "Intel Inside" logo all over the world and we ran television commercials in many languages. We had even distributed many thousands of "Intel Inside" bicycle reflectors in China. By 1994 our research showed that our logo had become one of the most recognized logos in consumer merchandising, up there with names like Coca-Cola or Nike. So when problems developed with our flagship Pentium chip, our merchandising pointed the users directly back to us.

The second fundamental factor in creating the conditions for the maelstrom was our sheer size. Over the years, we had become the world's largest semiconductor manufacturer. We surpassed the large United States producers, companies we used to consider mammoth and gigantic compared to us just a few years ago, and we surpassed the major Japanese producers who just ten years ago had threatened to put us out of business (more about that in Chapter 5). And we were still growing fast—faster than most large companies. We had also become bigger than most of our customers, companies that I remembered from our earlier years at Intel to be monumentally large corporations. At some point along the way, like a kid who suddenly looks down at his father, our sizes reversed.

This all happened relatively rapidly, in the past decade. And although the recognition of our size fleetingly touched us here and there, largely through the respect we got from other companies in our business, it was hardly something any of us dwelled on. It crept up on us; it just happened.

And now we were dealing with a different and not nearly as pleasant consequence of our huge size and our strong identity. We had become gigantic in the eyes of computer buyers. Unfortunately, it took a blowup to make us realize this.

Given the gradual nature of these changes, which over time added up to a very large change, the old rules of business no longer worked. New rules prevailed now—and they were powerful enough to force us into actions that cost us nearly half a billion dollars.

The trouble was, not only didn't we realize that the rules had changed—what was worse, we didn't know what rules we now had to abide by.

Before this episode, we supplied our computer manufacturer customers well and we guarded the quality of our products as best we knew how. We marketed our products both to the engineers of these computer companies and to computer users. We were fast and agile, as all good start-ups are, we worked hard and everything had worked well in return. But all of a sudden this no longer seemed to be enough.

What happened to us in the course of this event is something that happens to many businesses. All businesses operate by some set of unstated rules and sometimes these rules change—often in very significant ways. Yet there is no flashing sign that heralds these rule changes. They creep up on you as they crept up on us, without warning.

You know only that something has changed, something big, something significant, even if it's not entirely clear what that something is.

It's like sailing a boat when the wind shifts on you but for some reason, maybe because you are down below, you don't even sense that the wind has changed until the boat suddenly heels over. What worked before

doesn't work anymore; you need to steer the boat in a different direction quickly before you are in trouble, yet you have to get a feel of the new direction and the strength of the wind before you can hope to right the boat and set a new course. And the tough part is that it is exactly at times like this that hard and definitive actions are required.

Such phenomena are very common. Businesses are about creating change for other businesses. Competition is about creating change; technology is about creating change. The appearance and disappearance of regulations cause further changes. Sometimes these changes affect only a company, other times they affect an entire industry. So the ability to recognize that the winds have shifted and to take appropriate action before you wreck your boat is crucial to the future of an enterprise.

“That Guy Is Always the Last to Know”

In the three months following the Pentium floating point incident, Microsoft's new operating system, Windows 95, was delayed; Apple delayed the release of their new software, Copland; long-standing bugs in both the Windows calculator and Word for Macintosh were highlighted with substantial publicity in trade newspapers; and difficulties associated with Disney's *Lion King* CD-ROM game and Intuit's tax programs all became subjects of daily newspaper coverage. Something changed, not just for Intel but for others in the high-tech business as well.

I don't think this kind of change is a high-tech phenomenon. Examples from industries of all different kinds stare at me from daily newspapers. All the turbulent actions of investments, takeovers and write-offs in the media and telecommunications companies, as well as in banking and healthcare, seem to point to industries in which “something has changed.” Technology has something to do with most of these changes only because technology gives companies in each of these industries the power to alter the order around them.

If you work in one of these industries and you are in middle management, you may very well sense the shifting winds on your face before the company as a whole and sometimes before your senior management does. Middle managers—especially those who deal with the outside world, like people in sales—are often the first to realize that what worked before doesn't quite work anymore; that the rules are changing. They usually don't have an easy time explaining it to senior management, so the senior management in a

company is sometimes late to realize that the world is changing on them—and the leader is often the last of all to know.

Here's an example: I recently listened to evaluations of a certain highly touted new software from a company whose other products we already use. Our head of Information Technology told of unanticipated obstacles we were running into by trying to adopt this new software and therefore said that she was inclined to wait until the following generation of software was ready. Our marketing manager had heard of the same situation at other companies as well.

I called up the software company's CEO to tell him what I was hearing and asked, "Are you considering changing your strategy and going directly to the new generation?" He said, "No way." They were going to stay the course, they had heard of no one having any problems with their strategy.

When I reported this to the individuals who brought me the news, our IT manager said, "Well, that guy is always the last to know." He, like most CEOs, is in the center of a fortified palace, and news from the outside has to percolate through layers of people from the periphery where the action is. Our IT manager *is* the periphery. Our marketing manager also experiences the skirmishes there.

I was one of the last to understand the implications of the Pentium crisis. It took a barrage of relentless criticism to make me realize that something had changed—and that we needed to adapt to the new environment. We could change our ways and embrace the fact that we had become a household name and a consumer giant, or we could keep our old ways and not only miss an opportunity to nurture new customer relationships but also suffer damage to our corporate reputation and well-being.

The lesson is, we all need to expose ourselves to the winds of change. We need to expose ourselves to our customers, both the ones who are staying with us as well as those that we may lose by sticking to the past. We need to expose ourselves to lower-level employees, who, when encouraged, will tell us a lot that we need to know. We must invite comments even from people whose job it is to constantly evaluate and critique us, such as journalists and members of the financial community. Turn the tables and ask them some questions: about competitors, trends in the industry and what they think we should be most concerned with. As we throw ourselves into raw action, our *senses* and instincts will rapidly be honed again.

The Morphing of the Computer Industry

**“Not only has the
basis of computing**

**...basis of competition
changed, the basis of
competition has
Changed too.”**

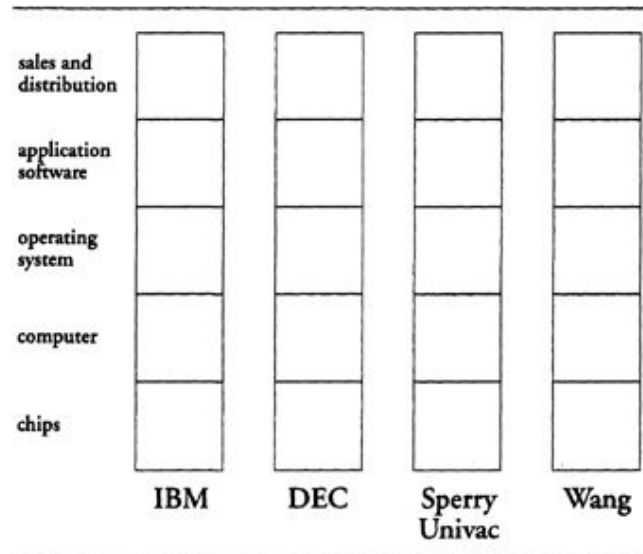
Of all the changes in the forces of competition, the most difficult one to deal with is when one of the forces becomes so strong that it transforms the very essence of how business is conducted in an industry. There are plenty of historic examples, such as how railroads revolutionized transportation, and many contemporary ones, such as how small retailers are being wiped out by superstores. The lessons and the dynamics of what happens seem to be the same, no matter what the industry, no matter where it is located and no matter which era it operates in.

I would like to describe how this all works by going in detail through an example that's close to my heart. When computers could be built around a simple commonly available microprocessor and, consequently, the personal computer appeared on the scene, it brought with it a cost-effectiveness that was easily ten times greater than was available with the type of computing that preceded it. In a little over five years, the cost adjusted by performance decreased by 90 percent, an unprecedented rate of decline. Such an enormous change in the way computing could be done had profound consequences on the computing business.

Before the Strategic Inflection Point

The computer industry used to be vertically aligned. As shown in the diagram that follows, this means that an old-style computer company would have its own semiconductor chip implementation, build its own computer around these chips according to its own design and in its own factories, develop its own operating system software (the software that is fundamental to the workings of all computers) and market its own applications software (the software that does things like accounts payable or airline ticketing or department store inventory control). This combination of a company's own chips, own computers, own operating systems and own applications software would then be sold as a package by the company's own salespeople. This is what we mean by a vertical alignment. Note how often the word "own" occurs in this description. In fact, we might as well say "proprietary," which, in fact, was the byword of the old computer industry.

The Old Vertical Computer Industry— Circa 1980



A company competed in this industry as one vertical proprietary block against all other computer companies' vertical proprietary blocks. Salesmen would show up and offer their vertical combination of things, and the company they were selling to would decide to buy one proprietary line and not the others.

This arrangement had its pluses and minuses. The pluses were that, when a company developed its own chips, its own hardware and its own software, sold and serviced by its own people, all the parts would be made to work together as a seamless total. The minuses were that, once you bought into this proprietary arrangement, you were stuck with it. If there was a problem, you couldn't throw out just one part of the vertical stack; you would have to abandon the entire stack, and that was a big deal. So customers of vertical computer companies tended to stay for a long time with the solution they chose in the first place. Needless to say, competition for the first sale was ferocious in the extreme, because whoever won that sale had the long-term advantage. This was how business was done for decades.

Then the microprocessor appeared, followed by the “10X” force of the personal computer built on it. The “10X” force came about because technology now permitted putting what before had been many chips on one single chip and because the same microprocessor could be used to produce all kinds of personal computers. As the microprocessor became the basic building block of the industry, the economics of mass production kicked in and manufacturing computers became extremely cost-effective, making the PC an enormously attractive tool in both home and business settings.

Over time, this changed the entire structure of the industry and a new horizontal industry emerged. In this new model, no one company had its own stack. A consumer could pick a chip from the horizontal chip bar, pick a computer manufacturer from the computer bar, choose an operating system out of the operating system bar, grab one of several ready-to-use applications off the shelf at a retail store or at a computer superstore and take the collection of these things home. Then he or she fired them up and hoped that they would all work together. He might have trouble making them work but he put up with that trouble and worked a bit harder because for \$2,000 he had just bought a computer system that the old way couldn't deliver for less than ten times the cost. This was such a compelling proposition that he put up with the weaknesses in order to avail himself of the power of this new way of doing business. Over time, this changed the entire structure of the computer industry, and a new horizontal industry, depicted below, emerged.

The New Horizontal Computer Industry— Circa 1995

(not to scale)

sales and distribution	Retail Stores	Superstores	Dealers	Mail Order		
application software	Word	Word Perfect	Etc.			
operating system	DOS and Windows	OS/2	Mac	UNIX		
computer	Compaq	Dell	Packard Bell	Hewlett-Packard	IBM	Etc.
chips	Intel Architecture	Motorola	RISCs			

In this diagram, we have horizontal bars representing fields of both competence and competition. In chips, suppliers of microprocessors using the Intel microprocessor architecture compete with companies such as Motorola and others who supply different types of microprocessors. In computers, a basic computer design is supplied by a variety of computer manufacturers, such as Compaq, IBM, Packard Bell, Dell and many others. These computers are fundamentally similar even if the computer company engineers improve the basic machine as they compete with each other.

In operating systems, again, there are a few well-established types. Over most of the decade of the eighties, Microsoft's early operating system, DOS, prevailed. In the nineties, this was modified to become easier to use and Windows emerged, which competes with IBM's OS/2, Apple's Mac OS and a number of UNIX-based operating systems.

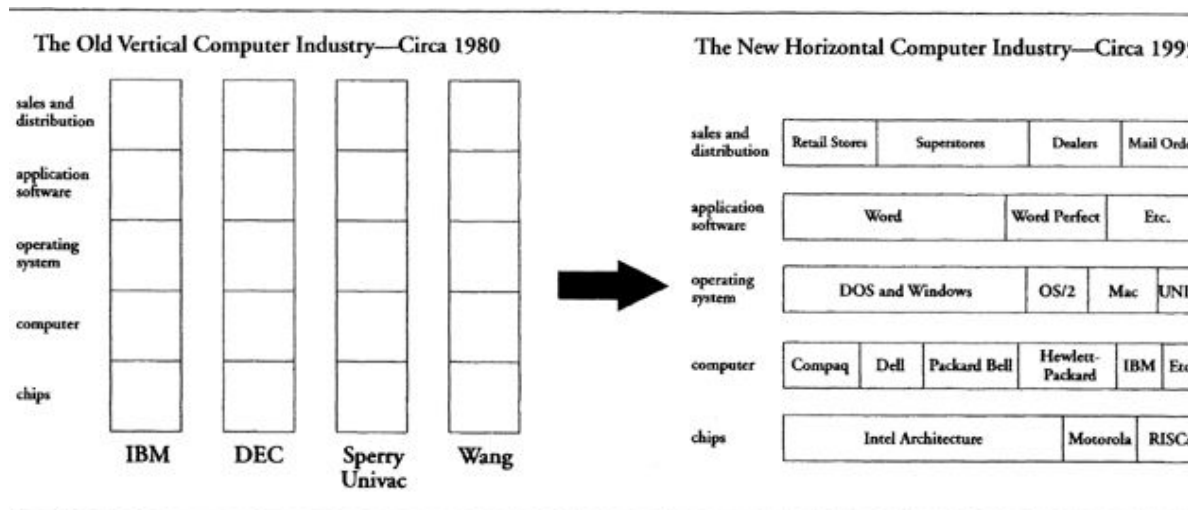
A visit to a neighborhood computer store shows all sorts of applications software competing for shelf space as well as for customers: spreadsheets, word processing, database packages, calendar software and the like. Sales and distribution of computer products have also become enormously eclectic. Retail stores compete with dealers who compete with superstores. Each of these carries a number of manufacturers' computers and software vendors' products, just as many grocery stores carry different brands of toothpaste.

So, throughout the decade of the eighties, the way computing was done changed, from the old vertical way to the new horizontal way. First individuals using computers changed to PCs, then big-time computing increasingly started to be done this way. Over time, the entire structure of the industry metamorphosed to a horizontal structure, as shown on the next page.

Even in retrospect, I can't put my finger on exactly where the inflection point took place in the computer industry. Was it in the early eighties, when PCs started to emerge? Was it in the second half of the decade, when networks based on PC technology started to grow in number? It's hard to say. But some facts are clear: Going into the eighties, the old computer companies were strong, vital and growing. IBM projected that they would be a \$100 billion company by the end of the decade. But by the end of the 1980s, many large vertical computer companies were in the midst of layoffs and restructuring, and a whole new set of players emerged. I keep thinking of a computer-generated image of a person "morphing" from one face to another, one face imperceptibly dissolving and another simultaneously taking shape. You can't tell the precise point when the first face disappears and the new face replaces it. You only know that at the beginning of the process you have one face and at the end of the process you have another face, but you can't identify any point where the image is any more one than the other. So it was here, even in retrospect.

The Transformation of the Computer Industry

(not to scale)



As this transformation progressed, companies that had become prosperous in the old vertical computer industry found their lives increasingly difficult. But at the same time, the new order provided an opportunity for a number of new entries to shoot into preeminence. Compaq became the fastest Fortune 500 company to reach \$1 billion in revenue. They were a company that understood the dynamics of the new industry and prospered by tailoring their business model to it. So did many others, like Dell and Novell. More about these later.

After the Strategic Inflection Point

Not only had the basis of computing changed, the basis of competition had changed too. Competitors in each horizontal bar of competence and competition now fought for the largest share of that bar. The power of this approach to computing is based on mass production and mass distribution. Those that win inevitably get stronger; those that lose, over time, get weaker.

After 1981, when IBM chose Intel to provide the microprocessor in their PC, Intel grew to become the most widely accepted supplier of microprocessors. After that, industry participants in the layers above, i.e., computer manufacturers and operating systems suppliers, found it more economically advantageous to build their business on Intel architecture microchips than on any other. Why? Because there were a lot more of those being produced every year. If you base your business on the volume leader, you will be going after a larger business yourself.

Developers of applications programs were driven toward volume as well. Their alternatives were to develop a product based on Microsoft's market-share-leading Windows or on competitive operating systems with a smaller market share. Over time, they chose to base their work on the former, gradually reinforcing the success of Intel's microprocessors and Microsoft's operating systems.

The transformation of the industry from the old model to the new didn't take place in one instant. It took place over years. It took place in many small steps—as mainframe computers lost new applications to PCs, as programmers shifted their attention, as old software companies shrank and

new software companies grew. Over time, thousands of such individual events made up the transformation.

Let's think about what this transformation from the vertical industry structure to the horizontal must have been like at one of the mainframe computer companies. In particular, let's look at it from IBM's standpoint. IBM had been the strongest player in the old industry. What was the impact of this change on IBM?

First of all, IBM's growth slowed down as much of computing went from mainframes to microprocessor-based personal computers. But that's not all. IBM was composed of a group of people who had won time and time again, decade after decade, in the battle among vertical computer players. The managers who ran IBM grew up in this world. They got selected for their excellence in developing products and competing in the marketplace within this framework. Their long reign of success deeply reinforced and ingrained the thought processes and instincts that led to winning in the vertical industry. So when the industry changed, they attempted to use the same type of thinking regarding product development and competitiveness that had worked so well in the past.

Even something as simple as the choice of the name "OS/2" showed how IBM missed the significance of the horizontal industry. The idea of OS/2, a new personal computer operating system, was introduced in 1987 at the same time as a new line of IBM personal computers called the "PS/2." Even though it wasn't necessarily the case, the inference was that OS/2 worked only on PS/2 computers. That perception alone might have been enough to limit the success of OS/2, since the majority of personal computers were made by IBM's competitors, not by IBM itself.

But there was, in fact, more to it than just that. It took a long while before IBM actually provided the necessary adaptations to OS/2 to make it work with other manufacturers' computers and an even longer time before IBM started marketing their operating systems to other computer manufacturers—their competitors—so that those manufacturers could ship OS/2 with their computers as they were accustomed to doing with DOS and Windows.

I happened to be a witness as an IBM manager who was involved with both the PS/2 line of personal computers and the OS/2 operating system tried to persuade another large personal computer manufacturer to adopt OS/2 for the latter's PC line. It was the oddest marketing meeting ever. These two people thought of themselves, first and foremost, as PC competitors. Even though his primary mission was to popularize OS/2, the IBM person was emotionally hamstrung in his attempt to market to his competitor. At the same time, the representative of the other computer manufacturer was reluctant to rely on IBM—a PC competitor—for such an

important piece of technology as the operating system. The conversation was awkward and tense; the deal never materialized. OS/2 still hasn't gained broad popularity in the industry.

Clearly, the old world was no more. Something had changed. And the more successful the players were in the earlier industry, the harder a time they had to change with it.

Winners and Losers

When an industry goes through a strategic inflection point, the practitioners of the old art may have trouble. On the other hand, the new landscape provides an opportunity for people, some of whom may not even be participants in the industry in question, to join and become part of the action.

I have mentioned Compaq as an example of a computer company that skyrocketed by becoming a practitioner of the new horizontal computer industry. Although their original business model consisted of being a follower of IBM as a maker of IBM-compatible personal computers, when the introduction of a new microprocessor in 1985 provided an opportunity to go for a market-share-leading position, they took the chance and got out in front, ahead of IBM. This initiative propelled them to a growing share of the PC bar and eventually they even passed IBM as the world's largest maker of IBM-compatible PCs.

There were others who, being born into the new order, were unfettered by old concepts or old rules. In the early eighties, Michael Dell started supplying his friends with computers he assembled out of parts in his dorm room at the University of Texas. Basically, he tapped into the desire of customers of the horizontal PC industry for low-cost standard computer systems. Later, Dell built on his experience and started a company based on the premise that people other than his college friends would also be interested in purchasing computers customized to their specific needs and supplied through direct means—in this case, through orders taken over the phone, with computers delivered by parcel post. No member of the old computer industry would have given a chance to a proposition that said that people would buy computers through the mail. It would simply have been seen as an unnatural act: just as dogs don't fly, people don't buy mail-order computers. At least, they didn't in the old world order.

Today, Dell Computer Corporation of Austin, Texas, is doing about \$5 billion worth of business a year, still true to its original premise—selling

personal computers custom-assembled to the individual buyer's specifications, through the mail. This could only happen in a world of computers that is characterized by low-cost, mass-produced, mass-consumed items.

Few of the top ten participants in the new horizontal computer industry rose from the ranks of the old vertical computer industry, bearing testimony to the observation that it is truly difficult for a successful industry participant to adapt to a completely different industry structure.

Some members of the old industry managed to renew themselves in a manner that was consistent with the new industry structure but would not have been with the old. NCR, in the early eighties, before the transition gathered speed, was one of the bigger vertical computer players. It was among the first, if not *the* first, to recognize the forces of change. Over the course of a few years (and before they were acquired by AT&T), NCR moved their entire computer line onto commonly available microprocessors. They abandoned their proprietary chips and hardware design, and made major modifications in their software, so that what was originally designed to run on their proprietary architecture would now run on off-the-shelf microprocessors.

Unisys, a vertical computer company created from the combination of two independent computer companies, Sperry and Burroughs, was another one of the players in the old computer industry, a multibillion-dollar company. They hit hard times as the strategic inflection point wreaked havoc on the vertical companies. In adapting, Unisys, once a proud designer of first-class computers, moved their strategic focus to software and services built around the products of the new horizontal computer industry. In effect, they came to the conclusion that they couldn't fight this industry-wide change, so they adapted to it.

Sometimes the changes are even more dramatic. In the early eighties, Novell was a small company fashioned along the lines of the old computer industry. They built hardware and developed network software to run on their own hardware. They, too, hit hard times. Novell's then head, Ray Noorda, often tells the story that it wasn't very hard to figure out what to do. They simply didn't have enough money to continue to pay their suppliers, so they abandoned their hardware business and concentrated on software where they didn't need to worry about supplier bills. Then they moved their software onto inexpensive standard PCs. By moving quickly into a new way of doing business, Novell became a "first mover" in networking in the new horizontal industry and became a billion-dollar software company by the end of the decade.

There is an important lesson to be learned from Novell's experience. Whereas as a hardware producer Novell had lack of scale working *against* them, by being the first to popularize networking software that runs on PCs and capturing a large share of the emerging networking market, they made scale work *for* them. They turned from losers to winners.

In fact, there are two more lessons here. First, when a strategic inflection point sweeps through the industry, the more successful a participant was in the old industry structure, the more threatened it is by change and the more reluctant it is to adapt to it. Second, whereas the cost to enter a given industry in the face of well-entrenched participants can be very high, when the structure breaks, the cost to enter may become trivially small, giving rise to Compaqs, Dells and Novells, each of which emerged from practically nothing to become major corporations. What's common among these companies is that they all instinctively followed the rules for success in a horizontal industry.

The New Rules of the Horizontal Industry

Horizontal industries live and die by mass production and mass marketing. They have their own rules. The companies that have done well in the brutally competitive horizontal computer industry have learned these implicit rules. By following them, a company has the opportunity to compete and prosper. By defying them, no matter how good its products are, no matter how well they execute their plans, a company is slogging uphill.

What are these rules? There are three.

One, don't differentiate without a difference. Don't introduce improvements whose only purpose is to give you an advantage over your competitor without giving your customer a substantial advantage. The personal computer industry is characterized by well-chronicled failures when manufacturers, ostensibly motivated by a desire to make "a better PC," departed from the mainstream standard. But goodness in a PC was inseparable from compatibility, so "a better PC" that was different turned out to be a technological oxymoron.

Two, in this hypercompetitive horizontal world, opportunity knocks when a technology break or other fundamental change comes your way. Grab it. The first mover and only the first mover, the company that acts while the others dither, has a true opportunity to gain time over its competitors—and time advantage, in this business, is the surest way to gain market share.

Conversely, people who try to fight the wave of a new technology lose in spite of their best efforts because they waste valuable time.

Three, price for what the market will bear, price for volume, then work like the devil on your costs so that you can make money at that price. This will lead you to achieve economies of scale in which the large investments that are necessary can be effective and productive and will make sense because, by being a large-volume supplier, you can spread and recoup those costs. By contrast, cost-based pricing will often lead you into a niche position, which in a mass-production-based industry is not very lucrative.

I think these rules are pretty general for horizontally based industries. I also think that there is a general trend toward horizontally based structure in many parts of industry and commerce: As an industry becomes more competitive, companies are forced to retreat to their strongholds and specialize, in order to become world class in whatever segment they end up occupying.

Why is this so?

In our example, a vertical computer company had to produce computer platforms *and* operating systems *and* software. A horizontal computer company, however, supplies just one product—for example, computer platforms *or* operating systems *or* software. By virtue of the functional specialization that prevails, horizontal industries tend to be more cost-effective than their vertical equivalents. Simply put, it's harder to be the best of class in several fields than in just one.

As industries shift from the vertical to the horizontal model, each participant will have to work its way through a strategic inflection point. Consequently, operating by these rules will be necessary for a larger and larger class of companies as time goes on.