

*Universal lessons every manager can learn
from Andy Grove's paranoia.*



INSIDE intel

by Adam M. Brandenburger and Barry J. Nalebuff

*Only the Paranoid Survive:
How to Exploit the Crisis Points
That Challenge Every Company
and Career*
Andrew S. Grove
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1996

In 1965, Gordon Moore, chairman of Intel, put forth a law of technology: The number of transistors on a chip doubles every 18 months. Moore's law has held up. Indeed, chips are now 500 times faster than

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they were when IBM brought out its first PC, in 1981. While the increase in chip processing power is an engineering marvel, the increase in Intel's market value has been an equivalent financial marvel. A \$1,000 investment in Intel stock made in the days of the IBM PC and the Intel

8086 chip would be worth more than \$30,000 today.

Intel's track record is due in no small part to the performance of its CEO and chief visionary, Andrew Grove. In his new book, Grove reflects on his experiences as the leader of Intel. The title is Grove's now famous management dictum: *Only the Paranoid Survive*. You might call this Grove's law of management. Intel's history of close calls and spectacular successes suggests that there's much to learn from Grove's paranoia.

It's all too easy to forget that Intel's success wasn't always so assured. In 1985, the company's earnings were a mere penny per share; in 1986, Intel lost \$173 million.

Those two years were marked by layoffs, plant closings, salary cuts, and time off without pay. In fact, Intel is one of the few survivors from the early days of computing. Remember Unisem, Mostek, or Advanced Memory Systems? Grove does: "If you don't recognize the

names, it's because these companies are long gone." Reason enough for Grove to be a touch paranoid.

At Intel, Grove, now 60, has experienced a series of crises and upheavals—and survived. He took Intel out of the memory chip business and into microprocessors. Along the way, he bet on a chip technology (sticking with CISC versus switching to RISC), preempted the commoditization of chips (with the Intel Inside campaign), suffered a public relations disaster (the Pentium flaw), and survived a personal crisis (prostate cancer). Time for a breather? Hardly. For Grove, success

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is "only a disaster away," and potential disasters are always looming on the horizon.

Today Intel, like many other companies, faces new opportunities—as well as threats—created by the Internet. And there's another, even more immediate, challenge. Intel's Pentium chips are almost too powerful for their own good. Given the power of the Pentium, why should people upgrade to Intel's latest chip, the Pentium Pro? And if they don't, how will Intel continue to grow? (Don't worry. Grove has a plan.)

Only *the Paranoid Survive* offers practical advice on how to bridge that narrow line between catastrophe and opportunity, and seize the opportunities. That's why this book isn't just for managers of high-tech businesses. Although the illustrations come primarily from Intel, it's truly a general management book. Grove focuses on his decision-making and thought processes—and the lessons apply broadly.

As for the decision-making process, Grove analyzes his own track record with disarming honesty. In spite of all his accomplishments, he doesn't take the line that he has gotten things right because he's so smart. Quite the contrary. Grove's approach is, Here's how I almost got it wrong, how I sometimes did get it wrong, what saved me, and what I learned. Only the *humble* survive? Or, at least, the complacent get killed.

Many a SIP Twixt the Cup and the Lip

Grove has a two-step approach to making strategic decisions. The first step is to identify what he calls strategic inflection points, or SIPs. A SIP arises when there's an order-of-magnitude change in a company's environment. These are times when management must act. These are opportunities to go way up—or way down—in the world. How do you spot a SIP?

Grove offers a "six forces" framework for identifying SIPs. He starts with Michael E. Porter's five-forces model: customers, suppliers, competitors, potential competitors, and providers of substitutes. He then in-

corporates some of our own work, which adds complementarity to the strategy map. After all, what is Microsoft to Intel? It isn't a customer, a supplier, or a competitor, and yet there's clearly a critical interdependence between the two companies. Intel and Microsoft are what we've termed *complementors*. Microsoft's Windows 95 operating-system software complements Intel's Pentium chips, and vice versa—that is, each product makes the other more valuable. Complementors, then, are Grove's sixth force. To identify a SIP, Grove suggests scanning the environment to look for order-of-magnitude, or "10X," changes in any of these six forces that affect a business's fortunes.

So you do a six-forces analysis and discover that something in the world has fundamentally changed. You're at a SIP. It's time to make a decision. That's the second step.

Grove's approach to decision making is highly analytical, almost scientific. His case studies illustrate his method, which also relies on a healthy attitude. Grove is remarkably good at not letting pride or ego get in the way. He recognizes the need to step outside Intel, so to speak, and analyze a situation from the perspective of someone who doesn't have a vested interest in the status quo. He regularly tries to prove himself wrong by looking for counterexamples to his current thinking. Trained as an engineer, Grove positively enjoys immersing himself in the data and being the scientist again. For example, when diagnosed with prostate cancer, he used this approach to challenge the conventional wisdom of treatment. (See "Taking On Prostate Cancer," *Fortune*, May 13, 1996.)

Grove doesn't agree with management guru W. Edwards Deming's call to end fear in organizations. Indeed, Grove believes that at least *some* fear is healthy—especially in organizations that have had a history of success. Fear can be a healthy antidote to the complacency that suc-

cess often breeds. A touch of paranoia—a suspicion that the world is changing against you—is what Grove prescribes.

Grove realizes that another kind of fear often rules organizations—one that is unhealthy and counterproductive to good decision making. He is well aware of the meltdowns that occur when employees know that something big is happening out

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there but are too cowed to tell management ("I don't think they want to hear that"). Grove doesn't want Intel's management to be among the many that failed to respond to challenges because "bad news never reached them." He favors open dialogue at Intel and proudly reports a conversation in which he was told, "Hey, Grove, you're out of your depth here; let me teach you a few things." (In academia, professors say that all the time to their deans, but they have tenure.)

Forget Memories

Probably the most critical decision Grove has had to make at Intel was one prompted by a dramatic increase in competition from Japanese memory-chip makers in the mid-1980s. Memory chips were Intel's original business.

Life in the memory business was tough. As Grove describes it, the Japanese semiconductor manufacturers decided to win this business with the 10% rule: They would undercut Intel by 10% to get the customer. If Intel matched, they would undercut by another 10%—and so on until they got the customer.

This policy created a crisis, or SIP, for Intel. A decision had to be made, and various options were proposed. One suggestion was to build a giant new dedicated factory in the hopes of establishing a cost advantage over Intel's Japanese competitors. An-

other was to push the technology envelope and develop a new and superior memory chip. Another was to target niche markets.

After almost a year of frustrating debates and much dithering, Grove came to realize that none of those options were the answer to Intel's problems. In fact, there was *no* solu-

Grove tries to prove himself wrong. If there's a problem with his mental model, he wants to find it.

tion to be found within the memory business. Even then, Grove didn't find it easy to imagine abandoning the business in which Intel had gotten its start: "Intel equaled memories in all of our minds." To come to grips with the crisis, he had to take himself and his own baggage out of the picture.

Here's how he did it. In the midst of the doldrums of 1985, Grove posed a hypothetical question to his colleague Gordon Moore: "If we got kicked out and the board brought in a new CEO, what do you think he would do?" Moore answered without hesitation, "He would get us out of memories." To which Grove responded, "Why shouldn't you and I walk out the door, come back and do it ourselves?"

That's just what they did. They redirected Intel's resources away from memories and into its microprocessor business—which, at the time, played second fiddle to Intel's memory business. True, Intel had invented the microprocessor back in 1971, but in the mid-1980s, second sourcing had created multiple competitors, and a downturn had led to excess capacity. Microprocessors weren't an obviously attractive business. The bold decision to commit Intel's future to microprocessors nevertheless saved the company and started it on the road to today's greatness.

Aware of his own struggle over the memory chip crisis, Grove argues that, very often, it takes fresh blood

to overcome management's attachment to the status quo. It's not that fresh blood is necessarily smarter than existing management. Rather, the practice of replacing corporate heads is motivated by the need to bring in someone who is not invested in the past. For Grove, this process is almost a biological imperative. People succeed in a certain corporate environment precisely because their mind-set fits that environment. Those same people are therefore unlikely to be quick at adapting to a changed environment. Grove issues the following challenge:

"If existing management want to keep their jobs when the basics of the business are undergoing profound change, they must adopt an outsider's intellectual objectivity."

Self-Paranoia

According to the *American Heritage Dictionary*, the definition of *paranoid* is "showing an unreasonable distrust or suspicion." Grove often distrusts his own ideas, suspects himself of being wrong. That's another source of strength.

It's easy to fall into the trap of looking for confirming evidence of one's views. This is one of several decision traps identified by Max H. Bazerman, a professor at Northwestern University's Kellogg School of Management, in his book *Judgment in Managerial Decision Making* (Wiley & Sons, 1994). When people believe something to be true, they tend to look for more evidence in support of their theory. Prior successes often reinforce this behavior. Almost by definition, a track record of success means there is lots of evidence confirming what one believes.

However, collecting confirming evidence—no matter how much—will never prove a hypothesis. On the other hand, we can *disprove* a hypothesis by finding a counterexample. To test a hypothesis, we need to actively seek data that would disprove it. That is always hard to do because we don't like to be proved wrong—it's simply human nature. But at Intel, Grove goes out

of his way to try to prove himself wrong. He runs experiments with a view to challenging his current thinking. If there's a problem with his mental model, he wants to find it. (See the insert "See a Pattern?")

Back in the late 1980s, there was a split at Intel. Some people thought the future lay in the more powerful RISC (reduced instruction set computing) chip architecture. They thought RISC could be a "10X" change. Others argued that there was still plenty of room for improvement to the existing CISC (complex instruction set computing) chips. Grove didn't believe that RISC would replace CISC in PCs, primarily because it was backward incompatible, so he thought Intel should continue with the CISC architecture. But he was willing to run an experiment just in case he was wrong. Accordingly, he supported a project to develop an Intel RISC chip. As things turned out, Intel went on to have a huge success with its next-generation 486 CISC chip and has stayed with CISC ever since. But the RISC chip it developed was a sensible insurance policy and even turned into a moneymaker.

Today the big debate in the computer industry is, of course, about the Internet. Some people—most notably Larry Ellison of Oracle—are talking about a \$500 network computer (NC) that will replace today's more expensive Intel-based machines. Grove doesn't think such a change will happen. Indeed, his view is that the Internet will result in "new players on the scene to be sure, but they are just as likely to play the role of complementors as competitors." Still, just in case he's wrong about NCs, the ever paranoid Grove is running another experiment. Intel itself is testing out the NC concept. As Grove puts it, "You can't suddenly start experimenting when you realize you're in trouble unless you've been experimenting all along."

Flawed Logic

Every now and then, even the best of us miscalculate. Andrew Grove—and the Pentium chip—are no exceptions. In fact, this embarrassment is the first story in Grove's book.

In October 1994, Thomas Nicely, a math professor at Lynchburg College in Virginia, posted a notice on the Internet describing a flaw in the way the Pentium chip did division. In fact, Intel had known about the problem since the summer and was well on the way to fixing it. The company hadn't told people about the flaw, in part because its engineers had estimated that the chances of their encountering it were vanishingly small. But after CNN picked up the story, an avalanche of negative publicity started. Intel argued that the flaw was essentially irrelevant to users, though it did offer to replace Pentium chips on a case-by-case basis. Then, in early December, IBM asserted that the chances of encountering a problem with the Pentium were much greater than Intel was saying and that, to protect customers, it was halting shipments of Pentium-based computers.¹ That forced Intel's hand. A week later, Intel reversed course and offered a no-questions-asked return policy. In the process, it took a write-off of \$475 million.

How could a minor flaw in the Pentium cause a public relations disaster and a half-billion-dollar write-off? Looking back, Grove sees that

this time he failed to step outside Intel and analyze the situation from the outside in. He was still thinking of Intel as an engineering company and as something of the underdog to boot. He wanted to debate the Pentium issue on its technical merits and to decide whose chips to replace on a technical basis. The problem was that this approach didn't take into account how other people viewed Intel.

What Grove missed, he now realizes, was that, as a result of its very successful Intel Inside campaign, Intel had effectively transformed itself from an engineering company into a consumer products company. It had created a direct relationship with consumers—even if consumers didn't buy from it directly. People identified their computer by the type of chip (a 486 or a Pentium), not just by who made the box. There also was the fact that Intel had grown to be the world's largest semiconductor manufacturer, overshadowing the Japanese companies that had almost put it out of business a decade earlier. The public perceived Intel as top dog, not underdog. This new reality didn't sink in fast enough at Intel. As Grove writes, "[We were]

like a kid who suddenly looks down at his father, our sizes reversed."

So, in handling the Pentium crisis, the relevant yardstick for Intel should have been how leading consumer-products companies handled similar crises. In fact, the standard had been set by Johnson & Johnson during the Tylenol poisoning episode. Johnson & Johnson went above and beyond the call of duty, replacing all Tylenol pills in the country, even in regions where there was no apparent threat. That response raised the bar. From then on, consumer products companies have had no choice but to go to enormous lengths to protect their customers from any harm—real or perceived. Anything less isn't good enough.

Against that yardstick, Intel's actions didn't look very good. First, the company didn't announce the existence of the problem as soon as it knew there was one. Had it done so, there would probably have been no story. By letting someone else disclose the problem first, Intel under-

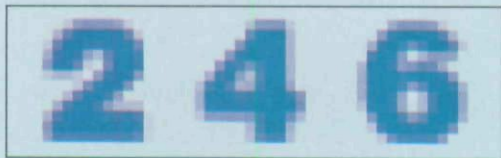
1. IBM's strategy ultimately backfired. Once Intel announced its free-exchange program, consumers flocked back to the Pentium-based machines. Meanwhile, IBM continued to lose market share with its 486-powered machines.

See a Pattern?

Here's a short exercise that illustrates the idea of trying to prove yourself wrong. We've chosen a rule that some sequences of three numbers obey. We'll start by telling you that the sequence 2, 4, 6 obeys the rule. Can you guess what the rule is? You can produce any sequence of three numbers you wish, and we'll tell you whether the sequence obeys the rule. Once you think you know the rule, make your guess. But be aware that you get only one guess. If you want to give the exercise a shot before reading on, you can go to our Web site and do the exercise interactively; the address

is <http://mayet.som.yale.edu/coopetition>.

When people play this game, they usually proceed in the following manner: They ask, "Does 4, 6, 8 satisfy the rule?" Yes. The



adventurous then ask whether 1, 2, 3 satisfies the rule. Yes, again. How about 5, 10, 15? Once again, yes. At this point, people decide that they've seen enough data and can guess the rule: The three numbers have to increase

by a constant amount. Was that your guess?

If so, then before making your guess, you would have done well to ask whether the sequence 1, 2, 47 satisfies the rule. Surprise! It does. How about 3, 2, 1? It doesn't. As you've probably realized by now, the rule is a really simple (okay, dumb) one: Any three increasing numbers will do. The point is that the vast majority of people stop and guess the rule incorrectly before they've asked a question that could discriminate between their hypothesis and various alternatives. To test a hypothesis, try to disprove it.

mined its credibility just when it needed it most. Then there was the case-by-case return policy. Although Intel wasn't denying applications for replacement chips, the policy created the *perception* that the company, not the customer, was deciding who would and wouldn't get a new chip. None of this looked too good coming from the people who make the brains of the computers we all rely on.

The Pentium episode reminds us of an academic seminar at which the speaker began by laying out all the shortcomings of his model. Evidently, he wasn't worried that admitting to some flaws would negate the value of the model. This was an act of confidence. The audience saw the model's overall value and had only nice things to say. After all, all the negative points had already been made – by the speaker himself! There was no reason for the audience to repeat them. We think there's a general lesson here. When you criticize yourself, you preempt criticism by others. If someone else does repeat the criticism, you can point out that you agree – you've even said the same thing yourself. In the case of the Pentium, when Intel discovered the flaw, it could have announced, "We've identified a prob-

lem; we're working to fix it. In the meantime, here's what we know." Chances are there would then have been no crisis at all.

The Next Chapter


Can Grove finally relax? Afraid not. Today Intel is facing another SIP. What's making Grove a little paranoid today is the processing power that people already have on their desktops.

Over the years, Intel's engineers have done a brilliant job of developing increasingly powerful chips. And that's the problem. Intel's current chips are so good that most people don't feel any pressure to upgrade. They already have more processing power than they need to run their favorite applications.

Grove recognizes that, right now, people don't have a strong enough incentive to buy Intel's next-generation chips – such as the newly released Pentium Pro. He knows that he must actively engineer demand for the new chips. If he doesn't, the market will become saturated and Intel's competitors – AMD, Cyrix, and others – will catch up. That is why Intel is currently at a SIP.

Grove has a plan. He's teaming up with several of Intel's complemen-

tors to develop products that will push the limits of processing power. Thus, Intel is working with MCI to provide more bandwidth for networks. After all, without more bandwidth, people can't access the large quantities of data that require the number-crunching power of a Pentium Pro. For the same reason, Intel is working with others to develop "hybrid applications" such as interactive games on the Web. It is even venturing outside its core business to ensure that essential complementary products get developed. The company has invested more than \$100 million in ProShare, a video-phone product. If desktop videoconferencing takes off, so, too, will demand for the Pentium Pro.

To see what Intel is doing to develop the market for its future-generation chips, go to its Web page. There you can read not only about Intel's microprocessors but also about all the complementary products that the company is promoting. Among them are interactive games, Inter-cast, and an Internet phone that's a precursor to Internet videophones. This is where the next chapter of the Intel story is unfolding. 

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"I'm doing my geography homework – what are the principal exports of your country?"

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