



Photograph by Matthew Septimus

Clayton M. Christensen, The Thought Leader Interview

The innovator's educator looks at why great companies fail and why theory trumps data.

Thought Leader
by Lawrence M. Fisher

The inspiration for Clayton M. Christensen's seminal theory on disruptive technology came from watching the Digital Equipment Corporation's fall in 1988. How could the management team that had been rightfully lauded for its brilliance by every popular business publication have stumbled so badly?

As Digital's star fell, the business press blamed the ineptitude of Digital's management. But Dr. Christensen observed that every other minicomputer company collapsed at the same time. Since no one colludes to fail, something more was at work. He concluded that the ultimate reason for the implosion of the minicomputer industry was not just the rise of the personal computer, but what the PC represented: a disruptive technology to which the minicomputer companies could not respond.

His theory of disruptive technology became the basis of *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Harvard Business School Press, 1997). Named the best business book of that year by the Financial Times/Booz Allen Hamilton Global

Business Book Awards, its impact was all the more potent because it prescribed no new management rules or standardized solutions, but instead confronted companies with Dr. Christensen's chilling vision of how the world works. A company can do all the right things — listen to its customers, invest in research and development, compete aggressively — and yet fall victim to a new technology or business model that seemed, at first, almost irrelevant.

Whether it was Digital Equipment and the PC; Sears, Roebuck and Company confronting Wal-Mart Stores Inc.; or the makers of cable-activated earth excavators encountering hydraulics, leading companies declined and sometimes died not from competitors' advances, but from new players with lower-quality solutions.

Conventional wisdom holds that as companies get big and successful, they become risk averse and avoid innovation. Dr. Christensen found that this was not the case.

Large companies successfully embrace innovations that are what he calls *sustaining* technologies, which are often responsible for performance breakthroughs. He defines a sustaining technology as any inno-

vation that enables an industry's leaders to do something better for their existing best customers. A *disruptive* technology, on the other hand, is a product or service that your best customers can't use and that has substantially lower profit margins than your business can support. Companies ignore disruptive technology innovations for perfectly rational reasons, but to their ultimate peril.

Businesses get blindsided because they focus on their best, most profitable customers, and ignore other potential markets, or customers seeking lower-cost products. This narrow view, Dr. Christensen says, ignores the fact that every market is characterized by three distinct change trajectories:

- Performance improvement that customers can readily utilize (i.e., it matches their own changing needs).
- Technology advances driven by sustaining technological improvements.
- New performance introduced by a disruptive technology, which typically begins at a lower level of performance, but rapidly improves until it meets the majority of customers' needs.

It is the tendency of all successful companies to match their performance to their most demanding customers, exceeding the needs of most of their customers, which creates an opening for disruptive technologies, he says.

A successful entrepreneur before returning to Harvard Business School in his early 40s, Dr. Christensen cofounded the Ceramics Process Systems Corporation, a manufacturer of products made from injection-molded powdered metals, high-performance ceramics, and ceramic-metal composites.

He bases his theory on a rigorous observation of business phenomena, a meticulous classification of the conditions that affect those phenomena, and an endless cycle of testing the theory against the observations. Too many business theorists, he says, indulge in what he calls academic malpractice, propounding theories and selecting cases to support those theories without ever subjecting them to the rigors of the real world.

Lanky and soft-spoken, Dr. Christensen delivers his message with a dry wit that would be disarming were the message itself not so devastating. He emphasizes that

understanding disruptive technologies is a highly valuable way for managers to frame how the world works and to create consistently innovative businesses. Companies that align their processes and values with the actions of innovators need not repeat the past, and can, indeed, seize wave after wave of new opportunities. And despite their power to bring down great companies, disruptive technologies serve the greater good, Dr. Christensen believes, noting that although established companies may suffer, customers usually benefit, as does humanity, in the broader context.

S+B: Let's start way back, by talking about your observation of Digital Equipment in the late '80s. What I found remarkable at the time was the speed with which it went from being on top of the world to being a disaster. How did you take a situation that seemed so extraordinary and extrapolate a more general rule for what happens to companies?

CHRISTENSEN: I didn't know the answer at the beginning. But in my first career I had founded my own company, with a group of MIT professors, before coming to Harvard to finish my doctorate, and so I had a deep respect for the brains, talent, and dedication of managers. That made it hard for me to believe the attributions in the business press that stupid management was to blame. So I looked elsewhere for an explanation.

S+B: You went looking for an explanation for Digital's rapid fall from grace and came up with a theory that appears to apply equally well to disk drives, excavation equipment, and consumer retail. How did you go about it?

CHRISTENSEN: Let me go back, if you wouldn't mind, and give you a "theory of how theory is built."

In the first stage of insight-building, all that researchers can do is observe phenomena. Second, they classify the phenomena in a way that helps them simplify the apparent complexities of the world so they can ignore the meaningless differences and draw connections between the things that really seem to matter. Third, based on the classification system, they propose a theory. The theory is a statement of what causes what and why, and under what circumstances.

Next, they use the theory to go back and say, "Now if this theory is right, when I go back into the world and look at more phenomena, under this particular circumstance, this is what I ought to see, and under that circumstance, that is what I ought to see."

If the theory accurately predicts what they see, it confirms that it's a good theory. If they see something that the theory didn't lead them to believe, that's what Thomas Kuhn calls an anomaly. The anomaly requires a revised theory — and you just keep going through the cycle, making a better theory. Ultimately, when you come up with a classification scheme that is collectively exhaustive and mutually exclusive, then the theory can become what Kuhn called a paradigm.

In the study of management, unfortunately, many writers have been so anxious to articulate a theory in the form of, "If you do this, this will result," that they never go through this careful effort.

S+B: You mean they don't take the time to observe the phenomena and derive a classification.

CHRISTENSEN: Right. Often they have a point of view based upon intuition and experience. They then offer a cadence of two-paragraph examples carefully selected to "prove" their theory, and then they write "one size fits all" books. The message is, "If you'd do what these companies did, you'd be successful too."

One reason there are so many short-lived management fads is that their prescriptions were derived and advocated in precisely this way. So managers read about a fad and try it, find that it doesn't work, abandon the effort, and move on to the next thing. In reality, it is usually the case that the faddish prescription was indeed sound advice in certain circumstances, but actually was poor advice in other circumstances.

Year after year after year, people write books about managing innovation or about leadership, for example, without ever going through the pain of saying, "This kind of leadership will cause this result in these circumstances and a very different result in those circumstances." This is academic malpractice of the worst kind. I've concluded that getting the categories right is an absolutely crucial step to build-

ing useful management theory, and unfortunately too few writers do this. You've got to engage in serious scholarship, and then figure out how to write it in a way that lots of people can understand.

I was lucky enough to build on the work of a number of people who had already run laps around this theory-building track. The original classification scheme, years ago, distinguished radical from incremental change. The theory said that established firms managed incremental change well, but would be expected to founder when their industry encountered a radical change.

Then Rebecca Henderson, who teaches at MIT, studied the photolithographic aligner industry, where the leader had failed in each of three product generations. She observed that when the architecture of the product changed, the leaders failed. As long as the technological changes involved were at the component level rather than the architecture level, the leaders did fine.

She proposed a classification scheme and theory that asserted, "In modular change, the leader will succeed. But in architectural change, the leader will fail, because organizations are structured and people have

learned to interact in patterns defined by the product architecture." This is a simplification of her profound work.

S+B: From that theory you progressed to your concept of disruptive versus sustaining innovations?

CHRISTENSEN: Right. So I used Rebecca's theory, and studied the disk-drive industry to see if her theory held up in another circumstance. If you want to make better theory, you've got to use the best that's available and look through the lens of another discipline to see if you can uncover more anomalies. By looking at the phenomena of failure from the perspective of sales, marketing, finance, general management, and the equity markets, I was able to see things that Rebecca hadn't. I owe her a huge debt.

When I was writing my doctoral thesis about disk drives, I could see that this related to the computer industry and Digital Equipment's demise. But it wasn't yet clear how robust this classification scheme of disruptive versus sustaining was for other industries.

S+B: Disk drives and computers are really two branches of the same industry. It's much more of a leap to excavators or steel mills.

CHRISTENSEN: Absolutely. It took time for it to dawn on me that I had discovered something more general, and in many ways I was just lucky.

I remembered, for example, that [when I was] a child these huge cable excavators made by Northwest Engineering were moved in next door to dig a big ditch; and it hit me that Northwest, Bucyrus Erie, and all the other brands I remembered weren't around any more. So I researched the industry and saw the

same thing — hydraulic machines disrupting cable ones.

I then presented this to the faculty in our area, saying, "Hey, it looks like the same thing happened in hydraulic excavators as in disk drives." One of my most trusted senior colleagues said to me afterward, "You need to get off this disruption stuff. If you're going to get tenure you've got to do another research project."

It wasn't apparent to them — it was just becoming apparent to me — that I had discovered a much more robust classification system. What I mean by robust is that whether it's an excavator or a disk drive doesn't matter. The important distinction, for purposes of predicting the winners and losers, or where there's growth and where there isn't, is whether the innovation is sustaining versus disruptive.

S+B: And you found that established companies are actually rather good at embracing technological change if it sustains their current business model and delivers an improved product for their customers. The innovator's dilemma arises with technological change that disrupts the model.

CHRISTENSEN: Yes. And as I started to understand this, I remembered that the company I had founded, the Ceramics Process Systems Corporation, had Chaparral Steel, a big minimill, as a major customer. The minimills had a huge cost advantage, and I wondered why the big integrated steel mills like U.S. Steel hadn't adopted minimill technology.

So I asked U.S. Steel if we could write a case study about why they didn't invest in minimill technology for rolling sheet steel. It

“The important distinction for predicting winners and losers is whether the innovation is sustaining versus disruptive.”

became clear through this that the theory built upon the distinction between sustaining and disruptive technologies was generally useful. There was no grand vision or understanding at the outset. I'm just lucky that I ran around the track a few times, after some really smart scholars had run their laps.

S+B: That brings to mind Hewlett-Packard, which was much like Digital back then. HP made a proprietary minicomputer, ran its own software, made its own processor, and somehow it didn't get stuck in the mire; HP jumped on the RISC/Unix bandwagon and had a good run with it. Is HP an anomaly?

CHRISTENSEN: This is a wonderful question to which I think there is a very interesting answer. If you ask the average guy on the street to name five companies that have truly transformed themselves over the last 20 years, Hewlett-Packard would be on everybody's list. You'd also put on this list GE and Johnson & Johnson.

In each of these instances, the transformation at the corporate level was achieved by selling off business units in old markets and by creating new business units to pursue the new opportunities. But the individ-

ual business units themselves within those transformed corporations were almost inert to change.

It's like in biological evolution: The population will evolve, even though individuals can't. The same thing happens in the corporate world: The population of business units within corporations evolves, even though individual business units can't. That's because the capabilities of business units reside in their processes and their values, and by their very nature, processes and values are inflexible and meant not to change.

At Hewlett-Packard, Dick Hackborn just seemed to have an intuition that you couldn't do disruptive and sustaining things in the same organization. He was responsible for many of HP's moves into printers, workstations, scanners, and so on.

I fear that Carly Fiorina's intuition is exactly opposite: To cut costs, she's combining all of HP's computer businesses within one organization — all the printer businesses in one, and so on. This might make short-term financial sense, but in the long run it undoes the architecture that enabled HP to dodge so many disruptive bullets.

S+B: Hackborn saw the bullets coming, time after time, but most managers don't. Why is that?

CHRISTENSEN: That gets back to your previous question. How could Digital's collapse be so precipitous? It's because, in many ways, financial performance data is misleading. As you move up to the top of the market, you're getting rid of the less profitable products at the low end and adding business with more attractive margins at the high end. The rate of unit volume growth might be tapering off as you pursue these smaller markets, but your margins actually look better. So Wall Street rewards your stock price until you hit the ceiling.

You can invest to create the new growth business while the core business is still growing, because new business units don't need to get big fast. But when the core business stops growing, investing to create new growth businesses becomes impossible. To prop up the stock price, managers have to turn down the screws on everybody. That forces them to cancel all the projects that would lead to future growth in order to drop money to the bottom line. This is HP's dilemma today. Once a company's growth has

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stopped, the game as we have known it is over. It's a scary thing.

S+B: So would you say managers fail to see the disruptive bullet coming because they are misled by data that shows their current business enjoying healthy growth?

CHRISTENSEN: Right. When management waits until the data is clear, the game is over. But that means management has to take action on a *theory* rather than evidence. Unfortunately, the word *theory* gets a bum rap at the Harvard Business School and in business in general because it's associated with the term *theoretical*, which connotes *impractical*.

But actually theory is very practical. Gravity is a theory, for example. It allows you to predict that if you step off a cliff you will fall; you don't have to collect data on that.

Disruptive technology is a theory. It says this will happen and this is why; it's a statement of cause and effect. In our teaching we have so exalted the virtues of data-driven decision making that in many ways we condemn managers only to be able to take action after the data is clear and the game is over. In many ways a good theory is more accurate

than data. It allows you to see into the future more clearly.

S+B: Can you identify companies that are doing well today, but that the theory suggests are vulnerable to this kind of disruption?

CHRISTENSEN: Look at Merrill Lynch and Charles Schwab. In the boom of 1999, Schwab's market cap exceeded that of all the full-service brokerages. Each of the full-service brokerages, such as Merrill Lynch, has established an online capability, but has implemented it in a fashion that *sustains* its current business model. In other words, they use the Internet to get better information faster to their full-service brokers to do a better job serving their high-net-worth clients.

With their cost structures, this is exactly the right thing to do. These firms have billions of dollars of profit more to make before all their high-net-worth clients die. So it is only the theory, and not the data, that would predict that 10 or 15 years down the line, as Schwab moves up market with its lower-cost business model, in pursuit of high-net-worth clients, the full-service brokerages will be disrupted just like Digital was by personal computers.

If you just look at the data, you are led to believe that things are getting better, rather than worse. That's why the fall is really precipitous, once you hit the ceiling.

S+B: During the late 1990s, a lot of dubious business models were funded on the basis of “this is a disruptive technology.” Now the telecommunications companies that are doing the best are the old regional Bell operating companies, not the Internet-based startups. Some of these startups walked and talked like disruptive innovators, and yet have failed. Are we still too close to the midst of things to get a real read on what is happening?

CHRISTENSEN: When the functionality of a product or service overshoots what customers can use, it changes the way companies have to compete. When the product isn't yet good enough, the way you compete is by making better products. In order to make better products, the architecture of the product has to be interdependent and proprietary in character.

In the early years of the mainframe computer, for example, you could not have existed as an independent contract manufacturer of

mainframe computers, because the way they were made depended upon the art that was employed in the design. The way you designed them depended upon the art that you would employ in manufacturing. There were no rules of design for manufacturing.

Similarly, you could not have existed as an independent maker of logic circuitry or operating systems or core memory because the design of those subsystems was interdependent. The reason for the interdependence was that the product wasn't good enough. In every product generation, the engineers were compelled by competition to fit the pieces of the system together in a more efficient way to wring the maximum performance possible out of the technology that was available at the time. This meant that you had to do everything in order to do anything. When the way you compete is to make better products, there is a big competitive advantage to being integrated.

S+B: So you're suggesting that today, when broadband performance is still not good enough, the old integrated telecom companies are at an advantage?

CHRISTENSEN: Right. The strategy of CLECs [Competitive Local Exchange Carriers] like Northpoint was to provide only DSL service, and just plug into the infrastructure of the telephone companies.

But there were too many unpredictable technological interdependencies between what CLECs did and what the telephone companies had to do in response — interdependencies that existed because the technology is not yet good enough. When there are unpredictable interdependencies, the integrated player is going to win.

Regulatory fiat cannot create a market at a technologically interdependent interface. And by the same token, regulation and so-called monopoly power rarely prevail at *modular* interfaces between stages of value-added technology.

S+B: So is there really only an opening for a dis-integrated play when the interdependencies are well defined, like the programming interfaces to a software program?

CHRISTENSEN: If I know what to spec, and I can measure it, and there are no unpredictable interdependencies between what you do and what I must do in response, then an

economist would say that is sufficient information for a market to emerge between you and me.

Capitalism has taught us that markets are always more efficient than hierarchical managerial coordination. But in a situation where those three conditions aren't met, I can't outsource or partner with you because markets don't function in the absence of sufficient information. Management has to provide the coordinating mechanism between what the supplier provides and what the user needs in not-good-enough situations where product architecture is consequently interdependent. Management always beats markets when there is not sufficient information.

S+B: As the performance of the products improves, to the point where it's good enough or more than good enough for most customers, when the knowledge of how to achieve that performance is commonly available, then does a market emerge that supports the dis-integrated model?

CHRISTENSEN: Yes. When this happens, the way you compete has to change. Now speed-to-market begins to matter, and the ability to

“The Internet is a technological infrastructure that can be deployed to facilitate either a disruptive or a sustaining business model.”

conveniently customize the features and functions to the needs of smaller and smaller niches is critical.

In order to compete in that way, to be fast and flexible and responsive, the architecture of the product has to evolve toward modularity. Then, because the functionality is more than good enough, you can afford to have standard interfaces; you can trade off performance to get the advantages of speed and flexibility. These standard interfaces then enable independent providers of pieces of the system to thrive, and the industry comes to be dominated by a population of specialized firms rather than integrated companies.

S+B: Companies themselves seem to be in a transition from integrated structures to modular structures, and the rallying cry has become, “Focus on what you do best, outsource the rest” — outsource HR, outsource manufacturing, and so forth. Why is that?

CHRISTENSEN: The outsourcing gurus have been driving the theory, and they are saying everybody ought always to do this. But it is really contingent on where you are on the spectrum from “not good enough” to “more than good enough,” rela-

tive to each tier of the market.

It is when the product is not good enough that proprietary integration gives you a competitive edge. You *cannot* outsource and be competitively successful in this situation. But at the other end, where standard components assembled in standard ways can yield acceptable performance, you *must* outsource.

S+B: Are we at a place in corporate development where dis-integrating firms makes sense on a generic basis?

CHRISTENSEN: Absolutely not. As I mentioned, when product performance outstrips the ability of customers to use that performance in an industry, the competitive game changes. Under those circumstances you have to decouple components businesses from assembly businesses.

But I'd rather decouple than divest because the money shifts to the place where nonstandard integration next needs to occur. Compaq, even though its computers are more than good enough for what the mainstream needs, still has to offer the very best microprocessor inside its machines. So the money shifts to where Intel has been. It's

like when Wayne Gretzky said, “You should skate to where the puck is going to be.”

GM had to spin off Delphi, and Ford had to spin off Visteon, because the basis of competition in autos is changing. They need to flexibly source the best subsystems from the best Tier 1 suppliers. But in divesting these businesses, they did just what IBM did when it put Intel and Microsoft into business. They stayed where the money used to be and put into business the companies that are going to play where the money will be in the future.

S+B: So is the real message of “Intel Inside” that value inevitably migrates to the component suppliers and contract manufacturers? What's astonishing in this process is you hollow out the OEM until almost nothing is left but brand.

CHRISTENSEN: That's *often*, but not always, right. Because of the disruption phenomenon — technological progress outstripping the ability of customers to utilize it — the general tendency is for the money to migrate toward the subsystems.

But if there's a change in the performance demanded by customers, then products that once

were more than good enough are no longer adequate. Then the process flips, conferring advantage upon integrated manufacturers of the end-use product.

S+B: Some would say we've witnessed the weakness of this practice in Cisco's recent comeuppance. They spun off everything, and they didn't have good enough visibility into the market, and they wind up with this immense inventory to write down.

CHRISTENSEN: You have to examine the interface at each stage of value-added. Cisco's router is a disruptive technology to Lucent's and Nortel's circuit-switched equipment, and Cisco is now getting disrupted itself by soft switches and other things.

But the nonintegrated business model is a good way to compete here — what has happened to Cisco is not necessarily an indictment of the nonintegrated model. You can have a nonintegrated business model and not try to automate the interactions in the supply chain that hide the data. I think that when companies try to delegate solutions to complex problems to an automated system, they still find that judgment of managers causes them

to either pay attention to or ignore data. I'd bet that this is at the root of Cisco's huge write-offs. Automated decision making separated managers from data, and they weren't aware that they needed to intervene with judgmental overrides until it was too late.

S+B: Well, the same people blasting them for it now are the ones who lauded them for it last year.

CHRISTENSEN: For doctoral students or young faculty members, some of the lowest-hanging, richest fruit that they can pick is to take a management fad and ask categorization questions about it. Like, When does process reengineering not make sense? Or, Under what circumstances will outsourcing and the use of automated supply chain management software get you into trouble and under what circumstances is it the right way to manage things?

You can discover the root causes of problems only if you go through this cycle and pay attention to the categories. Corporate venturing is big now. So should everybody always do corporate venturing?

S+B: The returns on most corporate venturing historically have not been too good.

CHRISTENSEN: It's a fad, and people will walk away from it, but that's because no researcher has yet developed and articulated a sense of what the relevant circumstances or categories are. Under what circumstances is this kind of corporate venturing effective and under what circumstances should it be done differently? Without that kind of theory-building, most corporate-venture activities will fail because there are enough different circumstances out there that most companies *aren't* in

the circumstance where what they are doing will work.

I keep coming back to the value of management researchers building theories that are contingent upon specific circumstances. It's because we're not all ensconced within a single monolithic circumstance. For example, you can see the business press already coming down on the people who run Cisco, saying, "Their model has failed." So they search for some other Holy Grail, as opposed to saying, "Wow, because we didn't quite understand the categories, we didn't know when Cisco's model would and would not work."

A lot has been written about the Internet bust. From my point of view, it's quite clear the Internet isn't a category; the Internet is a technological infrastructure that can be deployed to facilitate a disruptive business model or a sustaining business model.

S+B: I think it was generally assumed when biotechnology came on the scene that it would be a tremendously disruptive technology to the pharmaceuticals business, and yet, 25 years later, the established pharmaceutical companies are still doing just fine. Why hasn't biotech disrupted pharmaceuticals?

CHRISTENSEN: I'm not sure I understand this issue either, but let me sharpen the question a bit. Remember the distinction between sustaining and disruptive technologies, and why it's important. When a technology, regardless of how different and difficult it is, *sustains* the trajectory of performance improvement, my research asserts that the leaders in the prior generation of technology are likely to end up on top of their industry at the end of the transition.

If you remember from *The Innovator's Dilemma*, quite often startups were first out of the gate with a sustaining technology. But somehow the leaders got the technology and stayed atop their industries. Sometimes they acquired the startup; sometimes they just developed the technology as a follower and used their muscle and mass to win. But they always won. If the technology is *disruptive*, on the other hand, the odds are that at the end of the transition, the leaders will have been toppled and new companies will be on top.

In most instances, biotechnology, though a radically different approach, is a *sustaining* technology: It's a dramatically improved way of targeting problems that we hadn't been able to solve with the conventional approach of mainstream pharmaceutical companies.

So our work would actually predict that although the startups may be the first out of the gate, in the end the mainstream pharma companies will end up on top. When an entrant is first to market with a sustaining technology, it occupies a piece of territory that the better-endowed leaders want to seize. So they'll just go get it, either

by designing around the entrant's patent or by acquiring it.

S+B: Well, the big pharma companies have done a lot of both, either outgunning the biotechs in patent litigation or acquiring them, and most of the revenues in biotechnology are still flowing to the large established companies. But is there another way in which biotech can disrupt health care?

CHRISTENSEN: There are other dimensions of biotechnology. If you think of biotechnology like the Internet, it's not a category — it's an infrastructure that can be deployed to sustain or disrupt. In health care, the most complex problems at the high end have to be dealt with in a problem-solving mode by the best, most experienced physicians you can find. In the middle tiers of the market you've got a set of problems that can be dealt with in a pattern-recognition mode — Type 1 diabetes, for example. If you're always thirsty, you're losing weight, you urinate frequently, and your eyesight is blurry, you have diabetes. It doesn't take nearly as much skill and intuition to deal with and treat problems in a pattern-recognition mode as it does in a problem-solving mode. Finally, down at the bottom of the market, you've got stuff in a rules-based mode — things such as, "If it turns blue, you're pregnant." These things take even less skill to diagnose and treat.

The important thing is that over time, scientific progress transforms things that used to have to be dealt with in a problem-solving mode down to the pattern-recognition space; and from pattern recognition into the rules-based mode. This is the mechanism by which less-trained people are enabled to do

more sophisticated things. This is always the way disruption happens. It enables a larger population of less-experienced people to do more sophisticated things.

S+B: You see biotechnology pushing more diseases down from the specialists?

CHRISTENSEN: Well, it can, and it often does. This is what I mean by biotechnology being an infrastructure that can be deployed to sustain or disrupt.

Sustaining applications won't transform health care. But disruptive applications will. For example, some senior scientists at Millennium Pharmaceuticals recently published a paper showing that leukemia isn't a disease; it's actually an umbrella symptomatic description of six distinct diseases. It used to be that when we thought it was a disease, you'd go to the oncologist and she'd run a bunch of tests; analyze the data; come up with a hypothesis; and then embark upon a course of treatment. If it worked, then it meant she had diagnosed the problem right. If it didn't work, she'd conclude that there must be something else going on, and she would try another therapy.

But Millennium has shown that you can identify which of those six diseases you have by looking at a pattern in about 50 genes. So, when Millennium develops a test using this discovery, and this gets FDA approval, if you think you have leukemia, you could go to a technician. He'd draw a sample, look at the pattern in your genes, and compare it against the template, and say, "You've got Number 5." Knowing that you have Number 5, a specific therapy can be defined for Number 5 that would be different from the

others. Then a nurse could administer that therapy.

Previously, only oncologists could administer the therapy because what worked for one patient wouldn't work for the next — the problem-solving mode required the oncologist's judgment. The reason, of course, was not that Tuesday's batch of chemo drugs was off-spec. The patients had different diseases. Millennium's discovery, which is truly disruptive, means that in the future, a technician could give a more accurate diagnosis and a nurse could give more effective therapy than could the oncologist.

Things like this facilitate the disruption of the high-end established institutions (in this case, a class of professionals), because they bring the diagnosis down to a pattern-recognition mode. This kind of biotechnology could enable massive disruptions in the health-care world, and these are the kind that will actually transform health care as you and I experience it. As it happens, we'll have less expensive, more convenient, higher-quality health care — and we'll consume more of it.

S+B: A book called *The Innovator's Dilemma* raises the question, What's

the innovator's solution? You make the case in the book for spin-outs, but I'm not sure that history shows big companies are all that good at spin-outs either. Could you share your thoughts on what is the innovator's solution, and what your new book is going to be about.

CHRISTENSEN: I *think* I'll call it *The Innovator's Solution*. It's going to have three pieces. One is the problem of how to manage the spin-outs. A lot of people who read *The Innovator's Dilemma* for answers rather than understanding kind of got this one-size-fits-all sense that, "Anything that is different I need to spin out." So, for example, Bank One spun out WingspanBank.com. But if you think about it, online banking is a sustaining technology. It helps banks serve a segment of their existing customers more conveniently, and at much lower cost. There's never a need to spin out sustaining technologies.

Another thing I've observed is how critical the role of the CEO is when a technology truly is disruptive. In looking back on companies that have successfully launched independent disruptive business units, the CEO always had a foot in both camps. Never have they suc-

ceeded when they spin something off in order to get it off the CEO's agenda. The CEOs that did this had extraordinary personal self-confidence, and almost always they were the founders of the companies. Because it runs so counter to the logic of the current business model to do this stuff, it takes a lot of personal confidence. A lot of professional managers aren't that secure.

S+B: How can they possibly know that the disruptive enterprise is worth the risk?

CHRISTENSEN: You're right. In a large successful company where your power base as CEO isn't all that secure, it's hard for a CEO to pursue a truly disruptive strategy.

The last section of my new book focuses on the question, How do I know a high-potential growth market before it emerges? I think I've really got some good insight into this. It will be fun to get these ideas out, so people can use and react to them — surfacing new anomalies that these theories can't yet explain. It's the only way we can all keep learning. +

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