

### **Theoretical Foundations**

## **Disruptive Technologies: A Credible Threat to Leading Programs in Continuing Medical Education?**

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**Abstract:** *Recent research into the history of some of the most prominent and successful firms in the for-profit sector has shown that industry leadership is extraordinarily fragile. Over and over, in industries as diverse as microelectronics, steel, motorcycles, and software, leading firms whose management practices at one point were widely admired and imitated have stumbled badly and even failed. The factor that consistently has triggered these failures has not been complacent, arrogant, or bureaucratic management. It has been the emergence in their markets of disruptive technology—simple, convenient-to-use innovations that initially are used only by unsophisticated customers at the low end of markets. Ironically, two of the fundamental paradigms of good management—the importance of listening closely to customers and the necessity of bringing to market a regular flow of improved products that can be sold at higher profit margins—are the reasons why well-managed companies have consistently failed when confronted by disruptive technologies in their markets. This paper asserts that in a very analogous way, disruptive innovations in continuing education for managers and for health care professionals pose a significant threat to the impact and profitability of the continuing education programs of the leading schools of medicine and business. Through their focus on the leading edges of technology, therapy, and practice, many of these programs have lost sight of a very different set of educational needs among the fastest growing health care institutions in our environment. The paper suggests that unless leading providers of continuing medical education at medical schools aggressively begin offering courses that are customized to the needs of specific health care providers, in formats and venues that are conveniently accessible, they will increasingly be displaced by new providers of these services.*

**Key Words:** Custom programs, disruptive technology, distance learning, educational technology, in-house training, professional education

Of the organizations that existed in the western world in the year 1530, only 66 have survived to the present in recognizable forms: the parliaments of Iceland and the Isle of Mann, two churches, and 62 universities.<sup>1</sup> More than most other forms of organization in our world, educational institutions

have evidenced an extraordinary ability to adapt and survive. Recent studies of how some of the most respected and powerful institutions in the for-profit sector have failed, however, suggest that even the most prominent educational institutions of our time also might be threatened by disruptive technologies. Analogous disruptive innovations in the delivery of knowledge have already captured a significant share of the dollars spent in certain fields within continuing education—including management and medicine. Unless they innovate appro-

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propriately, leading providers of continuing education stand to lose significant portions of their clientele to "disruptive" innovators in education.

To describe the nature of this threat, this article is structured in three sections. The first explains what disruptive technologies are and describes how some of the most admired private sector institutions in our history were crippled as disruptive technologies emerged in their environments and changed the axes around which competition occurred. The second shows how disruptive approaches to management education of the sort that toppled many leading companies are already beginning to threaten the viability of some leading business schools' programs in continuing management education. This section suggests that similar "disruptive" innovations now threaten the profitability and long-term viability of the continuing medical education (CME) programs of many leading schools of medicine. The final section discusses how those managing continuing medical and management education programs might respond to these threats.

### **Disruptive Technologies and the Failure of Leading Firms**

In the study of management, it has long been understood that bureaucracy, arrogance, poor planning, failure to understand customers' needs, and short-term investment horizons are reasons why many companies fail. One of the most troubling insights of recent research, however, is that even many of the best, most admired companies in the history of business have enjoyed relatively short tenures at the pinnacle of corporate performance.<sup>2</sup> The executives who ran companies like Sears, Dupont, IBM, Digital Equipment, and General Motors were at one time regarded among the deities of management, and the techniques they employed were widely copied by other managers who aspired to guide their companies to similar success.

Why did these companies subsequently stumble so badly? Was it because their executives lost

their touch and became complacent, pedestrian, or even bad managers? Or might it be that these firms were never well managed—and that possibly they rose to prominence because they were lucky? Maybe. But recent research suggests that in the cases of these companies, it was good management, not bad management, that led these companies to stumble so badly. It was precisely because they listened too exclusively to what their best customers wanted, developed streams of new products and services that met these customers' needs, and invested in new products, processes, and services that promised the greatest profitability that these companies lost their positions of industry leadership.

The processes and incentives that companies use to keep focused on their main customers work so well that they often blind great companies to important new technologies in emerging markets. Many companies have learned the hard way the perils of ignoring new technologies that do not initially meet the needs of mainstream customers. For example, early personal computers did not meet the requirements of mainstream minicomputer users in the early 1980s. Because they listened so attentively to the needs of their best customers, leading minicomputer companies such as Wang, Prime, Nixdorf, Data General, and Digital Equipment did not aggressively develop and market personal computers. Their management wanted to introduce new products that earned better profit margins, and their customers wanted better, faster computers. Personal computers did neither of these things, and, as a result, the minicomputer makers quite rationally discounted desktop computers as a threat to their business—until it was too late.

### **Disruptive Technologies and Performance Trajectories**

To explain how technologies that seem trivial or unimportant today can mount a fatal attack on a strong company tomorrow, the concept of performance trajectories—the rate at which the performance of a product is improving over time—can

be helpful. Almost every industry has a critical performance trajectory. In the insulin business, for example, the critical performance trajectory for decades was improvement in impure parts per million. In photocopiers, important performance trajectories were the improvement in gray-scale replication and in the number of copies per minute. In microprocessors, the trajectory has been the annual increase in millions of instructions per second.

Two classes of technological innovations affect performance trajectories. Sustaining technologies tend to maintain a rate of performance improvement, that is, they give customers more and better in the attributes they already value. For example, a series of improvements in technologies to make conductor lines of ever finer width on the surface of microprocessors, to help them process more information at higher speeds, would be called sustaining technologies. Some of these have been radically new technologies, while some have been incremental engineering refinements. But, together, these innovations have combined to give the microprocessor industry the remarkable, steady rate of performance improvement that we have all come to expect.

On the other hand, disruptive technologies introduce a very different package of attributes to a marketplace than the ones that mainstream customers historically have valued, and they often perform initially far worse along one or two dimensions of performance that are particularly important to those customers. As a result, mainstream customers are unwilling—indeed, unable—to use disruptive products in applications they know and understand. At first, therefore, disruptive technologies tend to be used and valued only in new markets or applications; in fact, they generally make possible the emergence of new markets. For example, Sony's early portable radios that used transistors—a disruptive technology relative to the high-fidelity, tabletop radios that used vacuum tubes—sacrificed sound fidelity but created a market for portable radios by offering a new and different package of attributes: small size, light weight, and portability.

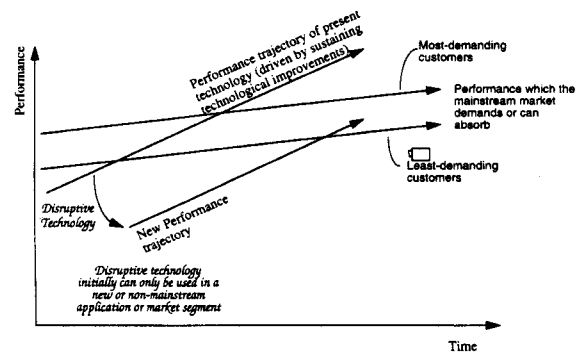


Figure 1 Differences in the character of disruptive vs. sustaining innovations.

In our studies of why great companies fail, we have found that only with a few exceptions, the leading companies in most industries generally have been ahead of their rivals in developing and adopting sustaining technologies of every sort—from incremental to radical. It seems that as long as the technology is crucial to helping them serve their most important customers more profitably with better products, good companies typically have figured out a way to develop and implement these new technologies. In contrast, we have found that these same leading companies have generally stumbled when confronted with disruptive technologies, even though, from a technological point of view, the disruptive technologies are far simpler products than the sustaining innovations at which they excel. It is disruptive, rather than sustaining, technologies that lie at the root of the failure of the leading companies mentioned above to stay at the top of their industries.

The mechanism by which disruptive technologies can dethrone leading companies is depicted in Figure 1. The key to this mechanism is a third trajectory: the performance improvement that a market demands, or can absorb, which is depicted by the dotted lines in Figure 1. This trajectory of market need typically slopes upward over time as customers' needs and expectations evolve. For example, the performance most of us demand in a personal computer today is greater

than what we needed 15 years ago. The attributes that surgeons demand from endoscopic tissue staplers is greater now than it was two decades ago. The rate of improvement in the performance of a product that markets demand or can absorb is affected by many factors. In the case of computers, this would include the amount of time we have to learn new software applications and how rapidly our work styles can change to use those applications. The improvement demanded in endosurgical equipment is gated, among other things, by the rate at which new procedures in endoscopic surgery emerge and can win regulatory approval, and by the time that surgeons can make available to be trained.

Our studies show that, most generally, the rate of improvement that technological innovators are able to provide to an industry is much steeper than the rate of improvement that customers in that industry are able to absorb. As Figure 1 shows, this means that a technology that squarely meets what customers need today may actually overshoot what those customers need tomorrow. It also means that technologies that so badly underperform what key customers demand today that they do not appear to be serious threats may squarely address what they demand tomorrow—and quite possibly at a much lower price.

This mechanism of action—disruptive technologies appearing and being used initially in new or unimportant low-end markets, and then improving at such a rapid pace that they attack and penetrate mainstream applications from the underside—is the reason that many of the most admired companies of the past have lost their positions of prominence. Small, cheap, low-performance personal computers and disk drives destroyed IBM's hegemony over the markets for computers and data storage equipment. General Motors, which made fast, large, stylish, and smooth-riding cars, was unseated by the likes of Toyota, which attacked the underside of the automobile market with small, cheap, standard cars, the quality of which was initially marginal. Sears lost its leadership in retailing to the likes of Wal-mart, which attacked the

underbelly of the retailing market, selling standard hardgoods with minimal in-store service at very low gross margins. Ricoh and Canon put Xerox under siege not by bringing faster, higher resolution copiers to market in an effort to leap ahead of Xerox's most sophisticated machines but by creating a new, low-end application—tabletop copiers—with products that were uncompetitive in the attributes valued by the customers from whom Xerox made most of its profits.

Once they structured themselves to be profitable in selling simple products at the low end of their respective markets, these disruptive innovators found that they could improve their profits dramatically with aggressive, persistent sustaining technological innovations of their own<sup>3</sup>—aggressively moving up-market, reaching for the mainstream customers of the industry leaders. Hence, Toyota introduced the Corolla, then the Camry, and, most recently, the Lexus into the world markets. Canon's cheap tabletop copiers evolved into sophisticated, reliable, highly featured machines. Many customers who formerly had to buy mainframe or minicomputers now find that their computing needs can be handled by desktop or server computers made by the likes of Compaq, Dell, and Gateway, rather than IBM, Control Data, and DEC.

In each of the cases above, when the disruptive technologists' products had become good enough to begin competing for mainstream customers, each of the prior industry leaders introduced disruptive products of their own to defend their core, traditional customers. But, for most, it was too late. The disruptive innovators had such strong market presence, were producing at low costs in such large volumes, and were innovating so rapidly that the established leaders could not keep up. Each has subsequently struggled to make money, and most have been forced to exit from product lines that, at one time, had constituted the core of their business.

In some industries such as computers, supermarket retailing, and automobiles, repeated waves of disruptive technologies have dethroned a series of companies that had been the leader of the prior

generation. Management myopia or lack of foresight cannot explain these failures. The problem is that managers kept doing what worked in the past: serving the needs of current customers. The very processes that successful, well-managed companies have used to become successful—processes that define the needs of their customers and weed out products that do not meet customers' needs, and processes that allocate resources to proposed investments that promise the greatest profitability—are incapable of funneling resources into programs that current customers explicitly do not want, and with profit margins that seem unattractive.

### **How Overshooting the Market Changes the Basis of Competition**

In many of the industries in which disruptive technologies have dethroned the industry's leader, the performance of the disruptive product has never surpassed the performance of the original technology; it simply became "good enough" for large segments of the market. Once it was good enough, mainstream customers switched to the "lower performance" alternative because it offered additional attributes that those customers valued. For example, networked desktop computers are still not nearly as powerful as mainframes. But they are good enough for what most computer users need and, in addition, they are far simpler, less expensive to buy, and more convenient to use.

Indeed, the mechanism described in Figure 1 in which the trajectory of performance improvement in a product or service overshoots what customers in a mainstream market demand seems to be the causal mechanism underlying the product life cycle. In the microprocessor industry, for example, the speed of the chip has been a key metric of performance for two decades. Speed has been the basis of competition—the metric along which manufacturers have striven to become better and better. Marketers have been able to predict that new products offering greater speed would meet robust demand and command higher prices. But will this

always be the case? Might there come a point when a new, faster chip proves incapable of capturing for its innovators premium prices and substantial sales—a point at which the mainstream market simply does not need all of the speed that the chipmakers provide? If this happens, will customers in this market change the metrics by which they compare and choose products—change the ways in which they define what is new and improved?

History has shown that when the performance of available products overshoots what customers in a particular tier of the market need, the basis of competition—the primary attribute that customers value when they choose one product over another—does indeed change. This basis of competition seems to evolve in a consistent fashion.<sup>4</sup> In the earliest phases of an industry's history, product performance is the basis of competition because initial products do not perform well enough to completely satisfy mainstream customers. Consequently, as competitors develop higher performance products, the market rewards the best of these with attractive prices, profits, and growth.

However, when the performance of available products approaches the right-most regions in Figure 1—when multiple products offer performance that is good enough, or even better, than what is needed in the mainstream market—customers redefine what "best" product means. Generally, they pass through a stage where "best" is defined by reliability and reputation; they will choose the products that are the most reliable in use, sourced from vendors with the best reputations for reliability in quality and supply. When the basis of competition centers around reliability, the aggressive use of branding becomes very important in leading firms' marketing strategies. The pervasive use of phrases such as "Intel Inside" is often a symptom that the fundamental performance of the product has become good enough for the mainstream market.<sup>5</sup> In this example, customers essentially are urged to continue using Intel's microprocessor products not because their

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speed is better than the microprocessors offered by competitors, although they indeed might be faster. Rather, the reason to buy Intel products is because they come from a dependable, trustworthy source.

Improvements in reliability can also be plotted on the vertical axis of trajectory charts such as Figure 1. However, the same "overshooting" phe-

axis of the trajectory charts. Typically, to the industry leaders, these are the least important and least sophisticated of the customers they have served. "Serious" customers are not initially distracted by disruptive technologies. These innovations take root at the lowest tiers of the market first, and then move inexorably up-market. This is why disruptive technologies so often prove fatal

### **Customized, On-Site Management Education**

Continuing management education was pioneered at the Harvard Business School in 1946 with its Advanced Management Program (AMP)—an intensive, 11-week program for executives who had risen to the top of their functional organizations and who needed further training prior to accepting their first assignment as a general manager responsible for an entire business unit or company. The AMP program has always been expensive (nearly \$40,000 per participant in 1997, plus the cost to the company of not having a capable executive's services). But participants give the AMP superb ratings. There is strong, consistent evidence that the educational experience is well worth its cost.<sup>9</sup>

Attracted by Harvard's success,<sup>10</sup> many other leading business schools, including MIT, Stanford, Northwestern, Duke, and Virginia, launched similar programs, creating a substantial executive education industry. Competition among these schools for the business of the most promising executives has forced their faculties to hone the quality of these programs to a remarkable degree. They have invested aggressively in sustaining innovations. The courses are taught only by the best and most experienced faculty, in classrooms outfitted with the latest multimedia technologies for teaching and presentation, often using interactive case materials provided on compact disks. For each of these schools, continuing management education has become a very significant source of income.

In the mid-1980s, however, a disruptive innovation emerged in the executive education industry. A group of Harvard Business School faculty members, who were outstanding teachers but were denied tenure because they did not enjoy the research and writing that is required to achieve that status, set up the Center for Executive Development (CED)—an independent provider of executive education programs with a very different value proposition. They would use Harvard's case

study materials, as did most other business schools. But rather than requiring executives to come to their campus and learn what the faculty decided was important to be learned, CED created customized educational programs for each corporate client. It offered these programs whenever, wherever, and for whatever duration their customers wanted.<sup>11</sup>

There are now several thousand firms of varying sizes selling these convenient, customized educational and training services. One needs only to read down the list of events held in the conference rooms at the local Holiday Inn on a typical weekday to see how pervasive the services of these independent providers of continuing management education have become. Some companies have even taken management training in house. McDonald's University, Motorola University, and Arthur Andersen's massive training operation near Chicago represent serious efforts by these companies to offer their employees the training they need to do their jobs more productively. Combined, these nonbusiness school institutions for management education generate over \$4 billion in revenues, and are growing at over 25% per year.

Despite the growth of these alternative programs, however, most business schools have not regarded these programs as serious competitors, let alone threats to the viability of their own programs. Why? They are disruptive innovations relative to established business school programs. They simply are not as good (as "good" historically has been defined by business school faculties). Topics in such short courses simply cannot be covered in the requisite depth. By focusing only on single subjects, these programs tend not to allow managers to examine how activities occurring in different parts of the company need to be integrated.

Objectively, this view of customized, in-house management education is absolutely correct. It is not as good. The experience of sitting in a Holiday Inn conference room for a few days with people from your own company simply cannot be as profound as immersing yourself for 11 weeks in

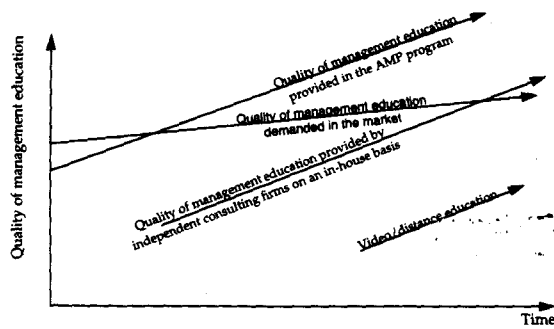


Figure 2 Impact of disruptive approaches in executive education on the mainstream continuing education programs of major graduate schools of management.

an academic classroom filled with capable executives from outstanding companies throughout the world. Predictably, therefore, the leading innovators in customized, management education have been entrants to the management education industry. The business schools have been reluctant followers.

Do these providers of customized and in-house continuing management education pose a credible threat to the business schools, or are they simply in a "different market" serving different customers, for different purposes? The answer to this question depends upon the relative slopes of the trajectories described above. Although the "quality" of management education is impossible to quantify robustly, most people in the management education world would agree that the quality of these customized or in-house programs may never be as good as the quality of the continuing management education offered on the business school campuses. As depicted in Figure 2, they are on a lower, possibly parallel, trajectory of improvement versus that of the business school programs.

The studies of how disruptive technologies ultimately proved fatal to leading institutions in the for-profit sector, however, suggest that this is the right answer to the wrong question. The issue is not whether these new modes of continuing management education will become better than the pro-

grams of the leading business schools. Rather, it is whether they will or have already become good enough for what the mainstream market needs.

Evidence suggests that the situation depicted in Figure 2 accurately summarizes the state of the world of continuing management education in 1998: in many areas of management, the trajectory of performance improvement blazed by the independent providers of management education and by in-house "universities" has intersected with the trajectory of quality demanded in the mainstream market. The size of the highest tier of the market, which the mainstream programs of the leading business schools target, is small and shrinking. Today, over 85% of those enrolling in Harvard's Advanced Management Program are from outside North America. While some of this shift is attributable to the globalization of business, much of it is because Harvard and its competitors can no longer attract large numbers of North American managers; there are too many other alternatives that are "good enough," programs that are much more convenient, with curricula more closely tailored to their immediate concerns. MIT has been forced to close its flagship program, which had been a direct competitor of the Harvard AMP. Other business schools, in order to keep their classes full, are having to admit larger percentages of those who apply for admission.

Many large companies that traditionally have sent hundreds of their managers to the mainstream continuing education programs of leading business schools have stopped doing so, opting for customized, in-house alternatives. Most alarming of all, few of the fast-growing technology companies that will dominate the business world in the next century have ever supported any of their managers through conventional programs such as the AMP. They are too busy and too pressured to afford such luxuries.

As happens in the for-profit world of products, these intersecting trajectories have precipitated a change in the basis of competition among management education programs. Faced with a variety of alternative programs that are good enough,



competition in this market has increasingly revolved around convenience. The firms offering more convenient programs have made executive education accessible to many more people. The leading business schools are being squeezed into a shrinking high-end market niche where the reliability (reputation) of the provider of education continues to give them an edge. One reason their mix of enrollees has shifted so pronouncedly to regions outside North America is that elsewhere, names such as "Harvard" and "Stanford" continue to command extraordinary clout.

Figure 2 also indicates that at the very lowest, least demanding tiers of the management education market, videotape and distance education technologies are beginning to be used. Consistent with the patterns we have observed in the for-profit sector, most business schools are attempting to use these technologies to enhance the quality of the programs they deliver, but not to supplant them. But few of them are alarmed yet that these truly disruptive technologies represent yet another wave of credible threats to the management education paradigms within which they have become so convincingly ensconced.

### **Disruptive Approaches to Continuing Medical Education**

With a growing proportion of physicians employed by managed care organizations or large group practices (from 28% of all physicians in 1988 to 43% in 1996),<sup>12</sup> time away from the office becomes more costly from the perspective of the organization, the individual, and his or her partners. Physicians and other professionals in these organizations are so strapped for time and energy that some have begun to opt for programs that are "good enough" from a quality or brand name point of view, because convenience, quick access, and the immediate relevance of the subject matter are such important considerations. The needs of this newer and rapidly growing market tier of health care professionals reflect a more constrained work environment in which the definition of what

constitutes a high-quality CME course—indeed, the very topics of interest—differs substantially from the interests of those in the tier of the market targeted by the mainstream CME programs of leading medical schools. Historically, most of these have focused primarily on MDs in independent practice.

A variety of independent consultants—generally not members of medical school faculties—have emerged to offer training courses better tailored to the needs of these professionals. As in industry, many managed care organizations have also established their own in-house training and CME programs to provide customized education for their professionals. Harvard Pilgrim Healthcare and Kaiser are among a growing number of HMOs that sponsor their own CME courses for internal and external consumers. The pressing training needs of these organizations and group practices relate to innovations that can increase efficiency and improve quality, both of which can be aided by CME delivered to their health care providers. The fact that those providers are less able to break away for large blocks of CME instruction opens the market to disruptive technologies.

In addition, some disruptive approaches to CME have enjoyed the flexibility to employ new teaching strategies that reflect the latest research from the cognitive sciences, suggesting more interactive or learner-centered methods that are more likely to support learning. Constrained by their infrastructures of classrooms and research-oriented faculty lecturers, many mainstream CME courses are stuck in instructional paradigms that stress transmission of factual information, creating additional room for disruptive technologies.

There are already Internet service providers for physicians that deliver content that they package. This delivery of information on pharmaceuticals and treatment protocols is setting the stage for expanding use of this Internet-based medium for delivery of CME options in the future.

Those responsible for the leading medical schools' CME programs do not yet view these disruptive alternatives as credible competitors.

For that matter, most of higher education lacks an appreciation for a new market tier looking for education at lower costs, with easier access, and greater relevance to job market preparation.

### **Responding to Disruptive Threats to Continuing Medical Education**

It should come as no surprise that few companies, business schools, or medical schools have been able to overcome the handicaps of size or success when confronted with disruptive technologies. But there are methods that directors of CME can use to assess whether new approaches to CME constitute credible threats to established programs.

The first step is to ask the right people the right questions about the importance of disruptive approaches to CME. Proposals to invest in disruptive technologies tend to stall early in management planning processes because managers ask questions of the wrong people. For example, established companies regularly ask mainstream customers—especially important ones where new ideas are usually tested—to assess the value of innovative products. Generally, these “lead” customers are selected because they are the ones striving the hardest to stay ahead of their competitors in pushing the performance of their products. They are the equivalent of “opinion leaders” in the world of health care, who are at the cutting edge of practice—those who are most likely to demand the highest performance from their suppliers. Lead customers such as these are reliably accurate when it comes to assessing the potential of sustaining technologies. But they are reliably inaccurate in assessing the potential of disruptive technologies. They are the wrong people to ask. The customers at the lower, least demanding tiers of the market are the ones who will lead in identifying and accepting disruptive technologies that are good enough, are more directly relevant to the basic problems they face day to day, and are convenient to buy and to use.

Second, it is important to draw a trajectories map of the sort depicted in Figures 1 and 2.

Although crisp quantification will be impossible, it will be possible to assess judgmentally how the quality and content of disruptive programs in CME of the sort described above have improved over recent years. By asking customers at multiple tiers of the market whether they have used and are planning to use such programs, you can get a sense for the pace at which these disruptive approaches are moving up-market. Of particular concern are the patterns in the CME programs being used by the institutions in health care—analogue to the high-technology companies described above—that are likely to dominate the health care industry in the next century. What sorts of CME programs are these institutions using? Do the professionals who continue to enroll in conventional, mainstream programs represent institutions that are losing market share?

Finally, and most importantly, directors of CME need to confront an extraordinarily difficult question that has vexed some of the best managers in industry: if disruptive technology is, in fact, beginning to penetrate the mainstream market, would we rather “kill” our existing programs with disruptive programs of our own, or should we let others kill our programs? Some companies that have launched their own disruptive programs—continuing to serve high-end customers with the traditional products as long as they could profitably do so, but simultaneously attacking the underside of the market with disruptive products—have survived the transition. Nearly all of these who opted, *de facto*, to let others kill them have suffered exactly that fate.

For example, in the personal computer printer business, Hewlett Packard’s laserjet printer division in Boise, Idaho was threatened with a disruptive technology: inkjet printers. Inkjet printers initially were slow, offered worse resolution, and could be sold for significantly less profit per unit than laserjet printers. But they have improved markedly over the past decade, so that, today, their speed and clarity is just about good enough for what many customers need—not as good as laserjet printers, but good enough for the market.

Had Hewlett Packard attempted to develop, produce, and sell inkjet printers from within its Boise laserjet operation, the inkjet would have languished. Instead, the company established a completely independent organization in Vancouver to make and sell inkjet printers. Employees in this division have had powerful incentives to improve the quality and reduce the costs of their inkjet products, in order to move up-market toward more attractive customers. They have been extraordinarily successful. At the same time, this competition has forced Hewlett Packard's laserjet business in Boise to become much more competitive as well. Similarly, IBM's decision to develop, produce, and sell its personal computers from within a completely autonomous division located in Florida was a key to its initial success in personal computers.

Companies that have not established independent organizations that have a charter to target the mainstream customers of the parent have inevitably failed when challenged by disruptive technology. This has been Digital Equipment's fate in personal computers. Five times in the last 12 years, Digital introduced personal computers to the market, and five times it has withdrawn from that market because it could not make money. Why? Because Digital attempted to manage these efforts from within its mainstream organization. Because the most valuable customers of Digital's mainstream company cannot use personal computers to solve their computing problems, and because the overhead costs required to develop and produce high-end computers are so high that they place large cost burdens on the simpler personal computers, it is not at all surprising that Digital has failed in personal computers, and that the market for minicomputers has all but evaporated as other makers of desktop computers have aggressively improved their products. Digital is being driven rapidly from the computer market because it has been unwilling to set up an autonomous organization that was chartered to target and steal the customers of its parent.

Disruptive technologies prove fatal to leading organizations because their threat is so counter-intuitive, and because the very culture and processes that have made these organizations so capable and effective will autonomously dismiss or weed out initiatives to launch disruptive innovations, such as those we have described above. We are convinced, however, that the patterns of disruptive technology—where trajectories of performance provided intersect with and ultimately overshoot the quality needed in the market—are as applicable in the world of CME as they are in for-profit marketplaces for products and services.

The threats of disruptive approaches to management education, CME, and probably to higher education as a whole are real. But so are the opportunities. Disruptive innovations—such as personal computers, photocopiers, helical scan video recorders, and microwave ovens—generally have brought useful technologies to much larger groups of people than previously had enjoyed access to them. Disruptive approaches to continuing education are likely to have a similar impact. Based on new models for learning, they are likely to be increasingly effective in delivering relevant knowledge to larger audiences than are reached by current programs. The lessons learned by private sector companies that have succeeded and failed in the face of disruptive technologies can provide useful models for directors of CME as they formulate strategies for the future.

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3. Readers interested in how disruptive technologies emerged to dethrone the leading institutions in a variety of industries can find more detailed accounts in Christensen CM. *The innovator's dilemma: when new technologies cause great firms to fail*. Boston: Harvard Business School Press, 1997.
4. For a fuller discussion of this phenomenon, see Christensen CM. Patterns in the evolution of product competition. *European Management Journal* 1997; 15:117-127.
5. The term "Intel Inside" is a registered trademark of Intel Corporation.
6. This argument is explained in a cogent manner in Moore G. *Crossing the chasm*. New York: Harper Business, 1991. Although Moore does not use the same terminology employed in this paper, he essentially argues that the advent of improved reliability opens up the "early majority" in the market. The advent of convenient products opens up the "late majority" market.
7. It is important to note that severe price competition can break out in an industry when competitors' products have overshot market needs on any of these dimensions, if no firm has yet introduced a more reliable or convenient product. In personal computers, for example, price-based competition among manufacturers of DOS-based computers was severe because products from multiple vendors were equally reliable and equally inconvenient. When Apple introduced its Macintosh computer with a graphical user interface (GUI), it was able to sustain very large price premiums, even while price wars prevailed in the DOS-based machine market. When Microsoft's Windows operating system then began to offer GUI, the convenience of personal computing became "good enough" for many customers, and price-based competition became more severe, again, across the board.
8. An implication of this framework is that in industries where the slope of the technology trajectory is parallel to, or slopes more gently than, the rate of improvement that the market can absorb, products will not mature. In the pharmaceutical industry, for example, markets for oral agents to treat Type II diabetes are fundamentally unsatisfied by the performance of available products. Hence, whenever an improved product is approved for the market, it commands very attractive prices and builds significant demand. This will occur as long as the market's need for performance is fundamentally underserved.
9. This assertion is based upon my personal conversations with scores of current and former participants in the Harvard AMP program.
10. For business schools in general, executive education is extraordinarily profitable, accounting for a larger share of profits, relative to the proportion of revenue that it generates. This is because the executive education programs can be created at relatively low cost by leveraging the base of largely fixed costs incurred for their mainstream MBA programs—and yet executive education can be sold for premium prices.
11. Accurate data on the size of this diffused executive education industry are hard to come by. This estimate was synthesized from a number of sources, including Fulmer RM, Vicere AA. *Executive education and leadership development: the state of the practice*. University Park, PA: The Penn State Institute for the Study of Organizational Effectiveness, 1995; Vicere A, Taylor MW, Freeman VT. *Executive development in major corporations: a ten-year study*. *Journal of Management Development* 1994; 13:4-22; and the entire collection of articles in "Executive development: new roles, new models," a special edition of *American Journal of Management Development* 1995;1(2).
12. Emmons DW, Kletke PR. *An examination of practice size. Socioeconomic characteristics of medical practice in 1997*. Chicago: Center for Health Policy Research, 1997:22.