

Disruptive technology critical essay

Technology



**ASSIGN
BUSTER**

One of the most consistent patterns in business is the failure of leading companies to stay at the top of their industries when technologies or markets change. Goodyear and Firestone entered the radial-tire market quite late. Xerox let Canon create the small-copier market. Bucyrus-Erie allowed Caterpillar and Deere to take over the mechanical excavator market. Sears gave way to Wal-Mart. The pattern of failure has been especially striking in the computer industry. IBM dominated the mainframe market but missed by years the emergence of minicomputers, which were technologically much simpler than mainframes.

Digital Equipment dominated the minicomputer market with innovations like its VAX architecture but missed the personal-computer market almost completely. Apple Computer led the world of personal computing and established the standard for user-friendly computing but lagged five years behind the leaders in bringing its portable computer to market. Why is it that companies like these invest aggressively and successfully in the technologies necessary to retain their current customers but then fail to make certain other technological investments that customers of the future will demand?

Undoubtedly, bureaucracy, arrogance, tired executive blood, poor planning, and short-term investment horizons have all played a role. But a more fundamental reason lies at the heart of the paradox: leading companies succumb to one of the most popular, and valuable, management dogmas. They stay close to their customers. Although most managers like to think they are in control, customers wield extraordinary power in directing a company's investments. Before managers decide to launch a technology,

<https://assignbuster.com/disruptive-technology-critical-essay/>

develop a product, build a plant, or establish new channels of distribution, they must look to their customers first: Do their customers want it?

How big will the market be? Will the investment be profitable? The more astutely managers ask and answer these questions, the more completely their investments will be aligned with the needs of their Customers. This is the way a well-managed company should operate. Right? But what happens when customers reject a new technology, product concept, or way of doing business because it does not address their needs as effectively as a company's current approach? The large photocopying centers that represented the core of Xerox's customer base at first had no use for small, slow tabletop copiers. The excavation contractors that had relied on Bucyrus-Erie's big-bucket steam- and diesel-powered cable shovels didn't want hydraulic excavators because, initially they were small and weak. IBM's large commercial, government, and industrial customers saw no immediate use for minicomputers. In each instance, companies listened to their customers, gave them the product performance they were looking for, and, in the end, were hurt by the very technologies their customers led them to ignore.

We have seen this pattern repeatedly in an ongoing study of leading companies in a variety of industries that have confronted technological change. The research shows that most well-managed, established companies are consistently ahead of their industries in developing and commercializing new technologies- from incremental improvements to radically new approaches- as long as those technologies address the next-generation performance needs of their customers.

However, these same companies are rarely in the forefront of commercializing new technologies that don't initially meet the needs of mainstream customers and appeal only to small or emerging markets. Using the rational, analytical investment processes that most well-managed companies have developed, it is nearly impossible to build a cogent case for diverting resources from known customer needs in established markets to markets and customers that seem insignificant or do not yet exist.

After all, meeting the needs of established customers and fending off competitors takes all the resources a company has, and then some. In well-managed companies, the processes used to identify customers' needs, forecast technological trends, assess profitability, allocate resources across competing proposals for investment, and take new products to market are focused-for all the right reasons-on current customers and markets. These processes are designed to weed out proposed products and technologies that do not address customers' needs.

In fact, the processes and incentives that companies use to keep focused on their main customers work so well that they blind those 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, although personal computers did not meet the requirements of mainstream minicomputer users in the early 1980s, the computing power of the desktop machines improved at a much faster rate than minicomputer users' demands for computing power did. As a result, personal computers caught up with the computing needs of many of the customers of Wang, Prime, Nixdorf, Data

<https://assignbuster.com/disruptive-technology-critical-essay/>

General, and Digital Equipment. Today they are performance-competitive with minicomputers in many applications. For the minicomputer makers, keeping close to mainstream customers and ignoring what were initially low-performance desktop technologies used by seemingly insignificant customers in emerging markets was a rational decision-but one that proved disastrous.

The technological changes that damage established companies are usually not radically new or difficult from a technological point of view. They do, however, have two important characteristics: First, they typically present a different package of performance attributes- ones that, at least at me outset, are not valued by existing customers. Second, the performance attributes that existing customers do value improve at such a rapid rate that the new technology can later invade those established markets. Only at this point will mainstream customers want the technology.

Unfortunately for the established suppliers, by then it is often too late: the pioneers of the new technology dominate the market. It follows, then, that senior executives must first be able to spot the technologies that seem to fall into this category. Next, to commercialize and develop the new technologies, managers must protect them from the processes and incentives that are geared to serving established customers. And the only way to protect them is to create organizations that are completely independent from the mainstream business.

No industry of staying too close to customers more dramatically than the hard-disk-drive industry. Between 1976 and 1992, disk-drive performance

improved at a stunning rate: the physical size of a 100-megabyte (MB) system shrank from 5, 400 to 8 cubic inches, and the cost per MB fell from \$560 to \$5. Technological change, of course, drove these breathtaking achievements. About half of the improvement came from a host of radical advances that were critical to continued improvements in disk-drive performance; the other half came from incremental advances.

The pattern in the disk-drive industry has been repeated in many other industries: the leading, established companies have consistently led the industry in developing and adopting new technologies that their customers demanded- even when those technologies required completely different technological competencies and manufacturing capabilities from the ones the companies had. In spite of this aggressive technological posture, no single disk-drive manufacturer has been able to dominate the industry for more than a few years.

A series of companies have entered the business and risen to prominence, only to be toppled by newcomers who pursued technologies that at first did not meet the needs of mainstream customers. As a result, not one of the independent disk-drive companies that existed in 1976 survives today. To explain the differences in the impact of certain kinds of technological innovations on a given industry, the concept of performance trajectories - the rate at which the performance of a product has improved, and is expected to improve, over time - can be helpful. Almost every industry has a critical performance trajectory.

In mechanical excavators, the critical trajectory is the annual improvement in cubic yards of earth moved per minute. In photocopiers, an important performance trajectory is improvement in number of copies per minute. In disk drives, one crucial measure of performance is storage capacity, which has advanced 50% each year on average for a given size of drive. Different types of technological innovations affect performance trajectories in different ways. On the one hand, sustaining technologies tend to maintain a rate of improvement; that is, they give customers something more or better in the attributes they already value.

For example, thin-film components in disk drives, which replaced conventional ferrite heads and oxide disks between 1982 and 1990, enabled information to be recorded more densely on disks. Engineers had been pushing the limits of the performance they could wring from ferrite heads and oxide disks, but the drives employing these technologies seemed to have reached the natural limits of an S curve. At that point, new thin-film technologies emerged that restored- or sustained-the historical trajectory of performance improvement.

On the other hand, disruptive technologies introduce a very different package of attributes from the one mainstream customers historically value, and they often perform far worse along one or two dimensions that are particularly important to those customers. As a rule, mainstream customers are unwilling to use a disruptive product in applications they know and understand. At first, then, disruptive technologies tend to be used and valued only in new markets or new applications; in fact, they generally make possible the emergence of new markets. For example, Sony's early transistor

<https://assignbuster.com/disruptive-technology-critical-essay/>

adios 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. In the history of the hard-disk-drive industry, the leaders stumbled at each point of disruptive technological change: when the diameter of disk drives shrank from the original 14 inches to 8 inches, then to 5.25 inches, and finally to 3.5 inches. Each of these new architectures, initially offered the market substantially less storage capacity than the typical user in the established market required.

For example, the 8-inch drive offered 20 MB when it was introduced, while the primary market for disk drives at that time-mainframes-required 200 MB on average. Not surprisingly, the leading computer manufacturers rejected the 8-inch architecture at first. As a result, their suppliers, whose mainstream products consisted of 14-inch drives with more than 200 MB of capacity, did not pursue the disruptive products aggressively. The pattern was repeated when the 5.25-inch and 3.5-inch drives emerged: established computer makers rejected the drives as inadequate, and, in turn, their disk-drive suppliers ignored them as well.

But while they offered less storage capacity, the disruptive architectures created other important attributes- internal power supplies and smaller size (8-inch drives); still smaller size and low-cost stepper motors (5.25-inch drives); and ruggedness, light weight, and low-power consumption (3.5-inch drives). From the late 1970s to the mid-1980s, the availability of the three drives made possible the development of new markets for minicomputers, desktop PCs, and portable computers, respectively. Although the smaller

drives represented disruptive technological change, each was technologically straightforward.

In fact, there were engineers at many leading companies who championed the new technologies and built working prototypes with bootlegged resources before management gave a formal go-ahead. Still, the leading companies could not move the products through their organizations and into the market in a timely way. Each time a disruptive technology emerged, between one-half and two-thirds of the established manufacturers failed to introduce models employing the new architecture-in stark contrast to their timely launches of critical sustaining technologies.

Those companies that finally did launch new models typically lagged behind entrant companies by two years-eons in an industry whose products' life cycles are often two y. ears. Three waves of entrant companies led these revolutions; they first captured the new markets and then dethroned the leading companies in the mainstream markets. How could technologies that were initially inferior and useful only to new markets eventually threaten leading companies in established markets?

Once the disruptive architectures became established in their new markets, sustaining innovations raised each architecture's performance along steep trajectories- so steep that the performance available from each architecture soon satisfied the needs of customers in the established markets. For example, the 5. 25-inch drive, whose initial 5 MB of capacity in 1980 was only a fraction of the capacity that the minicomputer market needed, became fully performance-competitive in the minicomputer market by 1986

and in the mainframe market by 1991. (See the graph " How Disk-Drive Performance Met Market Needs.)

A company's revenue and cost structures play a critical role in the way it evaluates proposed technological innovations. Generally, disruptive technologies look financially unattractive to established companies. The potential revenues from the discernible markets are small, and it is often difficult to project how big the markets for the technology will be over the long term. As a result, managers typically conclude that the technology cannot make a meaningful contribution to corporate growth and, therefore, that it is not worth the management effort required to develop it.

In addition, established companies have often installed higher cost structures to serve sustaining technologies than those required by disruptive technologies. As a result, managers typically see themselves as having two choices when deciding whether to pursue disruptive technologies. One is to go downmarket and accept the lower profit margins of the emerging markets that the disruptive technologies will initially serve. The other is to go upmarket with sustaining technologies and enter market segments whose profit margins are alluringly high. For example, the margins of IBM's mainframes are still higher than those of PCs).

Any rational resource-allocation process in companies serving established markets will choose going upmarket rather than going down. Managers of companies that have championed disruptive technologies in emerging markets look at the world quite differently. Without the high cost structures

of their established counterparts, these companies find the emerging markets appealing.

Once the companies have secured a foothold in the markets and improved the performance of their technologies, the established markets above them, served by high-cost suppliers, look appetizing. When they do attack, the entrant companies find the established players to be easy and unprepared opponents because the opponents have been looking upmarket themselves, discounting the threat from below. It is tempting to stop at this point and conclude that a valuable lesson has been learned: managers can avoid missing the next wave by paying careful attention to potentially disruptive technologies that do not meet current customers' needs.

But recognizing the pattern and figuring out how to break it are two different things. Although entrants invaded established markets with new technologies three times in succession, none of the established leaders in the disk-drive industry seemed to learn from the experiences of those that fell before them. Management myopia or lack of foresight cannot explain these failures. The problem is that managers keep doing what has worked in the past: serving the rapidly growing needs of their current customers.

The processes that successful, well-managed companies have developed to allocate resources among proposed investments are incapable of funneling resources into programs that current customers explicitly don't want and whose profit margins seem unattractive. Managing the development of new technology is tightly linked to a company's investment processes. Most strategic proposals—to add capacity or to develop new products or processes—

take shape at the lower levels of organizations in engineering groups or project teams. Companies then use analytical planning and budgeting systems to select from among the candidates competing for funds.

Proposals to create new businesses in emerging markets are particularly challenging to assess because they depend on notoriously unreliable estimates of market size. Because managers are evaluated on their ability to place the right bets, it is not surprising that in well-managed companies, mid- and top-level managers back projects in which the market seems assured. By staying close to lead customers, as they have been trained to do, managers focus resources on fulfilling the requirements of those reliable customers that can be served profitably.

Risk is reduced-and careers are safeguarded-by giving known customers what they want. Seagate Technology's experience illustrates the consequences of relying on such resource-allocation processes to evaluate disruptive technologies. By almost any measure, Seagate, based in Scotts Valley, California, was one of the most successful and aggressively' managed companies in the history of the microelectronics industry: from its inception in 1980, Seagate's revenues had grown to more than \$700 million by 1986.

It had pioneered 5. 5-inch hard-disk drives and was the main supplier of them to IBM and IBM-compatible personal-computer manufacturers. The company was the leading manufacturer of 5. 25-inch drives at the time the disruptive 3. 5-inch drives emerged in the mid-1980s. Engineers at Seagate were the second in the industry to develop working prototypes of 3. 5-inch drives. By early 1985, they had made more than 80 such models with a low

level of company funding. The engineers forwarded the new models to key marketing executives, and the trade press reported that Seagate was actively developing 3.5-inch drives. But Seagate's principal customers- IBM and other manufacturers of AT-class personal computers- showed no interest in the new drives.

They wanted to incorporate 40-MB and 60-MB drives in their next-generation models, and Seagate's early 3.5-inch prototypes packed only 10 MB. In response, Seagate's marketing executives lowered their sales forecasts for the new disk drives. Manufacturing and financial executives at the company pointed out another drawback to the 3.5-inch drives. According to their analysis, the new drives would never be competitive with the 5.25-inch architecture on a cost-per-megabyte basis-an important metric that Seagate's customers used to evaluate disk drives. Given Seagate's cost structure, margins on the higher-capacity 5.25-inch models therefore promised to be much higher than those on the smaller products.

Senior managers quite rationally decided that the 3.5-inch drive would not provide the sales volume and profit margins that Seagate needed from a new product. A former Seagate marketing executive recalled, " We needed a new model that could become the next ST412 [a 5.25-inch drive generating more than \$300 million in annual sales, which was nearing the end of its life cycle]. At the time, the entire market for 3.5-inch drives was less than \$50 million. The 3.5-inch drive just didn't fit the bill- for sales or profits. " The shelving of the 3.5-inch drive was not a signal that Seagate was complacent about innovation. Seagate subsequently introduced new models of 5.25-inch drives at an accelerated rate and, in so doing, introduced an impressive

<https://assignbuster.com/disruptive-technology-critical-essay/>

array of sustaining technological improvements, even though introducing them rendered a significant portion of its manufacturing capacity obsolete.