

CORE CURRICULUM



Strategy

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READING + INTERACTIVE ILLUSTRATIONS

Technology Strategy

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This reading contains links to online interactive illustrations and video, denoted by the icons above. To access these exercises, you will need a broadband Internet connection. Verify that your browser meets the minimum technical requirements by visiting <http://hbsp.harvard.edu/list/tech-specs>.

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1 INTRODUCTION

Humans are distinguished from other species by our abilities to work miracles. We call these miracles technology.¹

—Peter Thiel, PayPal co-founder

New technology can change the world. Bone marrow transplantation technology enables people to survive cancers that would have been fatal only a few decades ago. *Innovations* in horizontal drilling have doubled oil production in the United States.² The invention of air conditioning in 1902 was critical to the population growth of regions such as Arizona and Florida.³ Various videoconferencing solutions, ranging from WebEx and Zoom to Skype and FaceTime, not only facilitate global business collaboration for teams across time zones but also allow families and friends to maintain rich relationships despite separation or distance.

Economists define **technology** as the way an organization produces outputs from inputs.⁴ The technology used by a bakery, for example, determines the maximum amount of bread of a specified quality that it can produce with a given set of inputs: labor, ingredients, and equipment. The word *technology* comes from the Greek word *tekhnē*, meaning “art” or “craft.”⁵ The bakery’s technology includes everything about the way it produces the bread, including the skills of its workers; how the workers are organized, trained, and motivated; how the bakery selects which equipment to use; where it places the machines; how it develops recipes. Technology does not have to be high-tech.

For businesses, selecting a technology is one element of choosing how to compete. An artisanal bakery and the maker of the mass-produced Wonder Bread use different technologies to suit their very different competitive positions. The artisanal bakery’s technology produces premium loaves with a limited shelf life at a relatively high cost. The makers of Wonder Bread use automated production to deliver pre-sliced loaves with added preservatives at a low per-unit cost.

Mass-produced bread is now common, but when it was introduced in the United States in 1921, Wonder Bread was the product of a new technology. Pre-sliced bread became so popular in the 1930s that it established a colloquial benchmark: “The greatest thing since sliced bread.”⁶

Because new technology can create a new way to compete—as the Wonder Bread example shows—it can represent an enormous opportunity and a potent threat. It can create competitive advantage, undermine existing competitive advantage, radically reshape an industry, and even threaten an industry's very existence. Portable music players, for example, have been rendered nearly extinct by music apps on smartphones. New technology can have a profound impact on how firms compete.

That is why a firm's competitive strategy must include a **technology strategy**: an integrated set of choices about how to use new technology to produce superior financial returns in the long run. Whether introducing a new technology or responding to one developed by someone else, *every* firm needs a technology strategy.

For the strategist, what matters is technology *change*. If all firms serving a market are using the same technology, technology ceases to have a strategic impact. But a new technology can redraw the playing field. Joseph A. Schumpeter was the first economist to emphasize this point. In *Capitalism, Socialism and Democracy*, published in 1942, he challenged economists' focus on firms using similar technologies:

It is still competition within a rigid pattern of invariant conditions, methods of production and forms of industrial organization in particular, that practically monopolizes attention. But in capitalist reality as distinguished from its textbook picture, it is not that kind of competition which counts but the competition from the new commodity, the new technology, the new source of supply, the new type of organization . . . competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.⁷

Schumpeter argued that the essence of capitalism is the creation and destruction of businesses through revolutions in technology, which he famously called the process of **creative destruction**.⁸ This competition between old technologies and new ones is seen as one of the most important drivers of economic growth and wealth creation. Economist William Baumol argues that the principal benefit of capitalism—which he calls “the free market innovation machine”—is speeding the spread of new technology.⁹

Every technology is born, grows, matures, and dies when a new technology supersedes it. Bulky cathode ray tube (CRT) display technology has been replaced by flat-screen liquid crystal displays (LCDs), light-emitting diodes (LEDs), and OLED (organic LED) technologies. Typewriters were superseded by

word-processing machines, which were then replaced by a combination of word-processing software and computer printers.

Although technology change is constant, it is usually characterized by long periods of incremental change (evolution) punctuated by radical performance improvements (discontinuities, or “revolutions”).¹⁰ The strategic impact of a new technology is generally influenced by the size of the functional improvement it creates. Incremental technology change, which usually yields small improvements, may have little or no strategic impact. In the automobile industry, for example, cars become a little safer, more reliable, and more fuel-efficient each year, without substantially affecting the competitive positions of the major manufacturers. Technology discontinuities, on the other hand, can dramatically affect a firm’s competitive position. Google’s search technology, for example, represented a performance improvement large enough to enable the firm to displace incumbents and dominate the market. The widespread adoption of digital photography destroyed Kodak’s film business and drove the company into bankruptcy.¹¹ But as we will see later, some firms can survive even major technology changes.

Although new technologies appear in every industry, technology strategy is most important where performance improvements due to new technology are larger or more frequent. Such industries include biotechnology, life sciences, optoelectronics, energy, information and communications, electronics, flexible manufacturing, advanced materials, aerospace, weapons, and nuclear technology. It is important to note that even apparently stable industries such as stockbroking, travel, and book retailing can be challenged by a new technology. In the late 1990s, many such businesses that thought they understood their competitive environments were shaken by new threats enabled by the Internet.

Firms that wish to create and exploit a new technology must also address a host of other questions: What process will help us innovate? How do we build an organization that is capable of creating and exploiting new technologies? How should we manage the financing of a technology startup? Such issues are beyond the scope of this reading. For some answers, we refer you to the literature on the innovation process and to the Core Curriculum series on entrepreneurship.¹²

In this reading, we focus on how to use new technology to compete successfully. We start by explaining why technology strategy is different from “conventional” competitive strategy. This overview, in section 2.1, introduces the distinctive features of technology and innovation that shape a technology strategy compared to traditional business sectors. We then describe how innovators (technology leaders) can develop strategies to manage technology risks, identify market needs, commercialize new technologies, and compete successfully in the product market.

We also explore the question of timing: When introducing a new technology to a market, is it better to be a leader or a follower? We describe strategies for two situations: where a new technology creates an entirely new offering for a new industry, and where a new technology affects an existing industry. We then discuss how to position a business to exploit the next new technology.

A Supplemental Reading explains the importance of platform technologies and the strategies to succeed in platform competition.

2 ESSENTIAL READING

2.1 What's Different About Technology Strategy?

A strategy of any sort is a series of choices. When developing a “conventional” competitive strategy—one based on a company’s use of existing technologies—strategists try to choose a competitive position that neutralizes the unattractive features of their industry and exploits its attractive features, and they attempt to develop a competitive advantage by doing something uniquely well for a particular market segment. (For more on these fundamental concepts, see *Core Reading: Competitive Advantage* [HBP No. 8105].) For example, in the book-retailing industry, some firms chose to establish small specialty bookstores in affluent and educated communities, while others set up large stores carrying a wide range of books in high-traffic locations. Recall that we define technology as the way a firm produces outputs from inputs. In both cases, the principal inputs are wholesale books, retail property, and retail staff, and the outputs are retail book sales. The firms in this example have chosen different competitive positions while using essentially the same technology.

However, competing using a new technology opens up a new set of choices—choices that may enable firms to create new value by targeting customer needs they could not meet before or to achieve lower costs than were previously possible, permitting a new range of competitive positions and new types of competitive advantage. Jeff Bezos, the founder of Amazon, realized that he could produce the same output—retail book sales—with a different set of inputs: wholesale books, a website, a warehouse, and a delivery service. This new book-retailing technology enabled Amazon to occupy a new competitive position as a purveyor of the widest range of books at the lowest prices, a position made possible by a competitive cost advantage due to the elimination of expensive retail store locations and retail staff. The new technology also gave Amazon a

competitive advantage in helping customers find books by generating recommendations based on a buyer's history and by providing a way for customers to both read and write reviews.

Technology strategy, then, differs from “conventional” competitive strategy because it requires strategists to understand the competitive implications of using a new technology. The technology strategist needs to recognize the potential for *new competitive positions* and *new sources of competitive advantage*, and to perceive the most profitable opportunities and the most potent threats. Because a new technology may allow a firm to target the customers of multiple industries, a technology strategy has to go beyond choosing a position in an industry to choosing an industry. Consequently, a technology strategy influences corporate strategy because it addresses the question: “What business should we be in?” Bezos, for example, considered music and software retailing and other industries before deciding to enter the book-retailing industry.¹³

Although we have focused so far on producing an existing offering in new ways, one of the most striking and important aspects of new technology is that it can create an entirely *new offering*. Facebook, for example, allowed advertisers to do something they couldn't do before: insert their messages into people's social communications.

Technologies that create an entirely new offering can lead to the formation of *new industries*. The advent of the smartphone led to the creation of a mobile apps industry. Genetic engineering technology led to the formation of the biotechnology industry. Instead of competing to capture a share of the value in an existing industry, a new technology can allow a firm to create and capture value in an entirely new industry. When competing in a new industry, however, the strategic challenges multiply. Initially, positioning may be impossible because there may be no suppliers, no customers, and no clearly identified competitors. It may not be apparent who the potential entrants are, or which products customers consider to be necessary complements and acceptable substitutes.

In a new industry, technology strategy is highly dynamic; it's about moving quickly to create value, adapting to others, dealing with uncertainty, influencing the evolution of the industry, and shaping the competitive landscape.

When strategizing using existing technologies, firms usually choose among well-understood customer segments and proven products and services. But technology strategy must deal with the risk and uncertainty that are inescapable aspects of new technology. There is always a risk that a new technology will not work. And there can be uncertainty about how to create value, or for whom. As Nathan Rosenberg observes, there has been “a remarkable inability to foresee

the uses to which new technologies would soon be put.” One of the problems, he suggests, is that “new technologies typically come into the world in a primitive condition.” When the first electronic digital computer “contained no fewer than 18,000 vacuum tubes, was notoriously unreliable, measured more than 100 feet long, and filled a huge room,” it was difficult to envisage a time when people would be carrying computers in their pockets.

New technologies can also require long gestation periods and complementary inventions. As Rosenberg puts it, “The impact of invention A will often depend on invention B—which may not yet exist.”¹⁴ The potential of laser technology for communications, for example, did not become apparent until optical fiber technology was developed. Yet technology strategists must attempt to forecast new technologies and choose how and when to respond to unpredictable developments. A technology strategy must be dynamic, capable of dealing with changing circumstances. Amazon’s technology strategy, for example, had to deal with imitators and other evolving threats and opportunities as online retailing technology became widely adopted. Harvard Business School professor Andy Wu argues that “defining the future” is an essential first step in crafting a technology strategy, one that requires articulating, even in simple terms, “a vision of the opportunity that will exist in the future” and looking ahead to “where technology, value opportunities, and market structure will be” to inform present-day strategy and planning.¹⁵

The choice about how to **commercialize**—make money from—a new technology is another important aspect of technology strategy. A new technology is essentially an idea. In some cases, a firm can sell the idea for close to its true value—for example, by licensing the technology or by being acquired. The firm must also understand the **ecosystem**—a set of mutually dependent suppliers, customers, and **complementors** that work together to create value. For innovators, a technology strategy must specify whether they will attempt to sell their technology idea to another firm or enter a market with it themselves. If they enter the market, should they engage with the ecosystem by “befriending” the most powerful firm? Or is it more beneficial to “battle” the competition, with the intent to dominate the market?¹⁶

While some of the most well-known examples of technology innovation battled to take over the market, many new technologies cannot reach their potential—or create value for customers—on their own. To do so, they require **complementary assets**. In 1979, Godfrey Hounsfield shared the Nobel Prize in Physiology or Medicine for developing the computer tomography (CT) scanner, yet his company, EMI, was overtaken in the market by General Electric (GE) and eventually exited the industry. GE had the complementary assets—the manufacturing, technical service, and sales infrastructure—that were needed to get hospitals to adopt the new technology.¹⁷ Mobile application developers are

part of an ecosystem that includes smartphone manufacturers, such as Apple and Samsung, as well as wireless carriers, and each of these players own complementary assets that are essential to delivering customer value. While complementary assets also influence strategy for firms competing using existing technologies, they are frequently a vital factor in technology strategy.

To gain access to valuable complementary assets, a firm with a new technology may create a new ecosystem or may cooperate with players in an existing ecosystem. Becoming part of an ecosystem presents a range of challenges for the technology strategist. How should developers of a new technology induce partners to work with them? Providing an incentive for customers to buy the product, or for partners to collaborate in producing it, will require surrendering value and sharing proprietary information. Suppliers, customers, and complementors may require additional compensation for the perceived risk of working with an innovator. How do innovators avoid surrendering too much value? Sharing information may even turn suppliers, complementors, or customers into competitors.

Another differentiator is the focus on *timing*. Because competitive strategy emphasizes performance over the long run, it rarely emphasizes timing, but it is a critical aspect of a technology strategy. Strategists must choose whether to attempt to innovate (lead) in the development and commercialization of a new technology or whether to follow and adopt a new technology developed by someone else.

The importance of timing choices in technology strategy is magnified by **increasing returns to scale**, which exist when a firm's profitability increases disproportionately with its customer base. For example, ride-sharing platforms such as Uber require significant initial fixed costs to get up and running. However, once the app is released, the returns increase significantly with each ride.¹⁸ **Economies of scale** and network effects are two sources of increasing returns to scale. **Network effects** mean that the value a customer can get from choosing a technology depends on how many others make the same choice. Both can create **first-mover advantages**.

Network effects and the competition for customers can also lead to dramatic steps to acquire new users, even if this effort reduces the company's profits. For new entrants, the **chicken-or-egg problem** occurs when a new product relies on network effects for success but does not yet have the critical mass of users needed to pull in and retain new customers. In sectors where investors enable firms to sustain high initial startup costs and firms plan to operate at a loss for the long-term, strategies for customer acquisition and achieving competitive advantage will differ considerably from those used in traditional competitive environments.

Early entrants may achieve advantage by locking in customers or by making moving from one product to another more challenging or costly.¹⁹ New products must address the possibility of low **switching costs**—the cost to switch from one product to another—or low **multihoming costs**—the cost and effort required for a user to use multiple competing products or platforms.²⁰ When strong network effects are combined with high switching costs, innovators may find that customers are reluctant to adopt a new technology until a standard product design emerges. These dynamics can lead to a **standards war**, in which firms with different product designs compete in a winner-takes-all battle to become the standard. In such situations, technology strategy involves choosing how to fight and win a standards war.

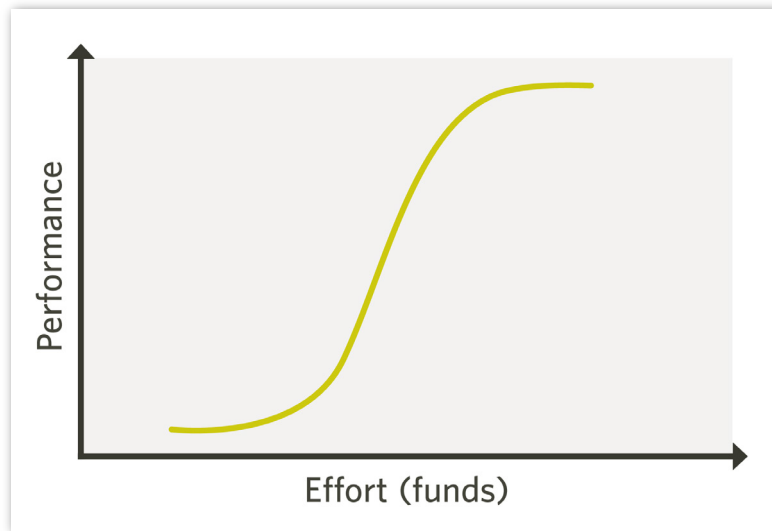
2.2 Technology Strategy for Innovators

An *innovator* is a firm that introduces a new technology into a market. An innovator may be an existing firm or a startup, and it may target an existing market or an entirely new one.

An innovator's technology strategy is influenced by two types of change: the evolution of the technology's performance and the development of the market for the new technology. Although the convention is confusing, both technology and market change are characterized by S-shaped curves.

Richard Foster describes the evolution of the performance of a technology using an **S-curve**, as shown in **Exhibit 1**. In the beginning, performance improves slowly. Then, as problems are solved, performance improves rapidly. Finally, the technology reaches its performance limit, and additional expenditure to improve it is unproductive.²¹

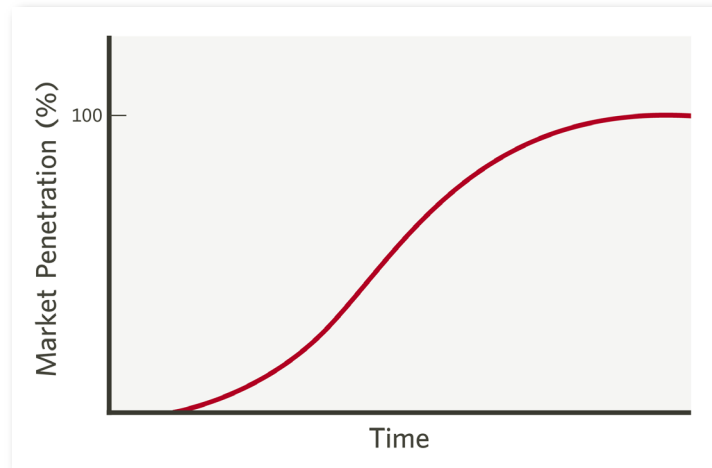
EXHIBIT 1 The Technology S-Curve



Source: Richard Foster, *Innovation: The Attacker's Advantage* (New York: Summit Books, 1986), p. 31. Reprinted by permission.

Rather than being adopted by everyone at once, an offering based on a new technology *diffuses* through a market.²² As shown in **Exhibit 2**, market penetration increases slowly at first and then tends to grow rapidly before leveling off as the market reaches saturation.

EXHIBIT 2 The S-Shaped Market Diffusion Curve



Source: *The Economics of Technological Diffusion* by Paul Stoneman. Reproduced with permission of Blackwell Publishers via Copyright Clearance Center.

The innovator's technology strategy varies with the stage in the technology's evolution and the stage in the market's development. At the birth of a new technology, the innovator's strategy must answer three questions:

- Does it work?
- Who will adopt it?
- How do I commercialize it (that is, make money from it)?

After the technology has been commercialized, the strategic questions focus on the product market:

- How will I grow the market?
- How will I capture a share of the value?

As the market matures and the performance of the technology plateaus, the question is one of sustaining value: How should I respond to the challenges from (and opportunities of) the next new technology? (See **Exhibit 3.**) Even before figuring out how to make money from a new technology, an innovator must address two key questions: Does the new technology work? and Who will adopt it?

EXHIBIT 3 Technology Strategy Issues for Innovators

Stage of Market Development	What the Innovator Has to Sell	Innovator's Technology Strategy Issues
Introduction	Technology idea	Does it work? Who will adopt it? How should I commercialize the idea?
Growth	Product	How should I grow the market? How will I capture a share of the value?
Maturity	Business	How should I respond to new technologies?

In established industries, in which all competitors use the same proven technology, there is little technology risk and the market is understood. Companies need a competitive strategy that positions them to meet the needs of a customer segment better or more cheaply than other players, but they already know how to produce a working product and who is likely to be interested in buying it.

New technologies are different. The technology strategy has to manage the risk that the technology may fail to live up to its promise. Making a technology work is a task for the technologists, but managing its risks is the job of the technology strategist.

Even if a technology works, its value may not be apparent to customers. Recall that, although the Apple Watch now leads the smart-watch market, it did not initially meet expectations for customer adoption and acceptance when it was launched. User skepticism about a need for such a product, along with concerns about the watch's usability, complexity, and price compared to simpler fitness trackers, required Apple to communicate more explicitly the product's value to both early adopters as well as a wider market.²³ Geoffrey Moore explains that a new technology needs to enable something that "has an intrinsic value and appeal to the non-technologist," such as a flagship application.²⁴ An innovator needs to develop the value proposition and identify the customers who will benefit most.

2.2.1 Managing Technology Risks

All technology innovators must manage risk. A failed technology may harm an existing firm's reputation and damage its customer relationships. For a startup, capturing value depends vitally on the ability to reduce or eliminate technical

risk cheaply. Otherwise, investors who bear most of the risk will demand most of the equity.

The biotechnology company Genentech provides an example of how to manage risks in introducing a new technology. Genentech was founded “to develop the new science of recombinant DNA into viable therapeutic products with mass market appeal, something that most scientists agreed was at least a decade away.”²⁵ That “at least a decade” forecast reflected a level of uncertainty that represented a significant risk for investors, yet investors were essential for developing the technology.

Genentech decided to manage the risk by conducting an experiment. Before attempting its real objective, which was to make insulin, researchers at the company would produce a simple human protein as a proof of concept. As Genentech co-founder Herbert Boyer explained, “What we needed to do was show that we could actually make a human protein in bacteria, and that was key to the next level of funding . . .”

But venture capital investor Tom Perkins saw risk in the experiment. He described his concerns to one of the company’s founders:

[W]e’ve got to figure out a way to take some of the risk out of it—something instead of me giving you all the money, then you renting the facility, buying the equipment and luring the people. With that approach you’ll have spent maybe a million dollars by the time you get to actually performing the experiment. Then if it doesn’t work it’s all over and all that money is lost.²⁶

Perkins argued for subcontracting the experimental work to institutions that already had some of the necessary capabilities instead of creating an entirely new experimental facility. As he said, “I’ll want to own most of the company if I’m going to take all of that conventional risk.”

Perkins’s proposal prevailed, and Genentech contracted with several research institutions. One contract allowed the institution to own any patents produced; Genentech would be an exclusive licensee and pay royalties on sales. Another allowed Genentech to own any patents and pay a 2% royalty on sales.

The experiment was a success, and Perkins told investors he was pleased that the first commercial demonstration of the new technology had cost only \$515,000. He commented that the experiment was able to “remove much of the risk from the entire venture . . . For next to nothing we had removed a world class question about risk.”²⁷

The takeaway here is that it is critical to identify the technology risks and to devise inexpensive ways to reduce them, such as developing prototypes and conducting small-scale experiments. Such approaches may lead to higher valuations from investors, but this collaboration may also require sharing some of the value created with partners, as Genentech did.

2.2.2 Identifying the Customer

While established industries already have customers, entirely new offerings may not. Innovators may need to define, target, and develop—in other words, *produce*—a customer.

Which customer should you target? As Carl Shapiro and Hal Varian explain in their book *Information Rules*, “A new technology had better offer significant value added.”²⁸ Target the prospective customers for whom the customer proposition is strongest and the competitive forces are weakest. Sometimes that means creating a new market. Targeting the right customers requires an analysis of the value the technology creates for them and of potential industry participants’ likely response to your market entry.

In choosing which customers to target, Amazon founder Jeff Bezos considered the capabilities of the then-new web technology, the potential value propositions for customers, and—where customer needs were already being met by another technology—the nature of the industry environment. He believed that online retailing represented a significant opportunity, but it was important to target the market where this new technology provided the greatest competitive advantage. Because online retailing necessitated shipping products to customers, items needed to be physically small and have a high ratio of value to weight to make shipping economical. And because customers could not inspect the goods, there had to be no doubt about their quality. The goods had to be something that the relatively affluent and well-educated early users of the web would want.

Bezos developed a list of over 20 categories of products that he thought could be sold successfully online, including software, music (sold at the time in compact disc form), and books.²⁹ As he explained, books were a particularly good match for online retailing:

At the time, I made the observation that books was [*sic*] one of the few—maybe the only—categories where computers have already been very helpful in selling the product. For a long time, bookstores have had information desks, where you walk up and somebody uses a computer to help you find what you’re looking for . . . You could see how with a large number of products, the

sorting and searching could help. But that wasn't the main thing. The main thing was that you could build a bookstore on the Web that simply couldn't exist any other way. The Web is an infant technology. If you want to be successful in the short-to-medium term, you can only do things that offer incredibly strong value propositions to customers relative to the value of doing things in more traditional ways. This basically means that, right now, you should do online only what you cannot do any other way. The largest physical bookstores only carry 170,000 titles. There are only three that big. We have 1.1 million titles in our catalogue. And if we printed our catalogue, it would be the size of seven New York City phone books.³⁰

In choosing which industry to enter, Bezos considered the size of the market and the power of suppliers. In the music industry, six major companies owned most of the big labels, which Bezos saw as a concentration of power that could easily freeze out an upstart. This was much less of a risk in the book industry, given that there were over 20,000 publishers in 1995 in the United States alone. The competition was fragmented, too: Barnes & Noble and Borders, the largest players in the United States at the time, accounted for less than 25% of sales, which meant that a new entrant would be unlikely to encounter a coordinated response from competitors. As Bezos said, "There aren't any 800-pound gorillas in bookselling."³¹ Traditional book retailers also faced a cost disadvantage because of the need for large investments in inventory, real estate, and staff members at each retail location. Bezos's analysis led him to enter the book-retailing industry, and the rest is history.

Some successful innovators use a stealth approach, entering underserved or nontraditional markets rather than challenging powerful incumbents directly. Clayton Christensen cited the example of 3.5-inch disk drive manufacturers in the 1980s, which targeted the new portable computer market rather than the large and well-established desktop computer market.³² Netscape, the producer of the first widely used web browser, chose instead to challenge Microsoft openly with a potential replacement for applications software (web apps), eliciting a powerful competitive response. Michael Cusumano and David Yoffie, arguing that this may not have been the wisest strategy, offer this memorable advice: "Don't moon the giant."³³

For innovators that are existing firms, markets where the firm can use its complementary assets represent attractive opportunities for the new technology. Apple, for example, leveraged its brand, software and hardware design capabilities, and product ecosystem to target the markets for wearables with the Apple Watch and the streaming industry with Apple TV.

2.2.3 Commercialization

A new technology is essentially an idea. All innovators face a fundamental strategic issue: How do I make money from this idea? The answer to that question is a *commercialization strategy*.

Joshua Gans and Scott Stern characterize the commercialization issue as a choice between cooperation and competition. Innovators can choose to cooperate with another firm—usually an industry incumbent, a firm currently serving the market targeted by the innovator—to commercialize the idea, or they can choose to compete with incumbents by entering the product market. The choice depends on two factors: the robustness of the “market for ideas” and the ownership of valuable or specialized complementary assets.³⁴

When the market for ideas works well—that is, when there are opportunities for licensing, a joint venture, a strategic alliance, or even an acquisition that allows the innovator to realize a fair price—an innovator can commercialize a new technology through cooperative efforts without having to enter a product market. For example, the inventor of a new drug can sell the idea to a large pharmaceutical company with the resources to gain clinical approval for it, manufacture it, and distribute it worldwide.

Several issues can interfere with the market for ideas, however. If a new technology is easy to copy, an innovator may be unwilling to approach potential buyers for fear of imitation.³⁵ Patents, copyrights, trademarks, and trade secrets offer some protection, but many can be invented around, and intellectual property protection is sometimes weak. To cooperate with a firm, the innovator must disclose information about the idea, but doing so reduces the incentive for the potential partner to pay for it. This is known as the paradox of disclosure.

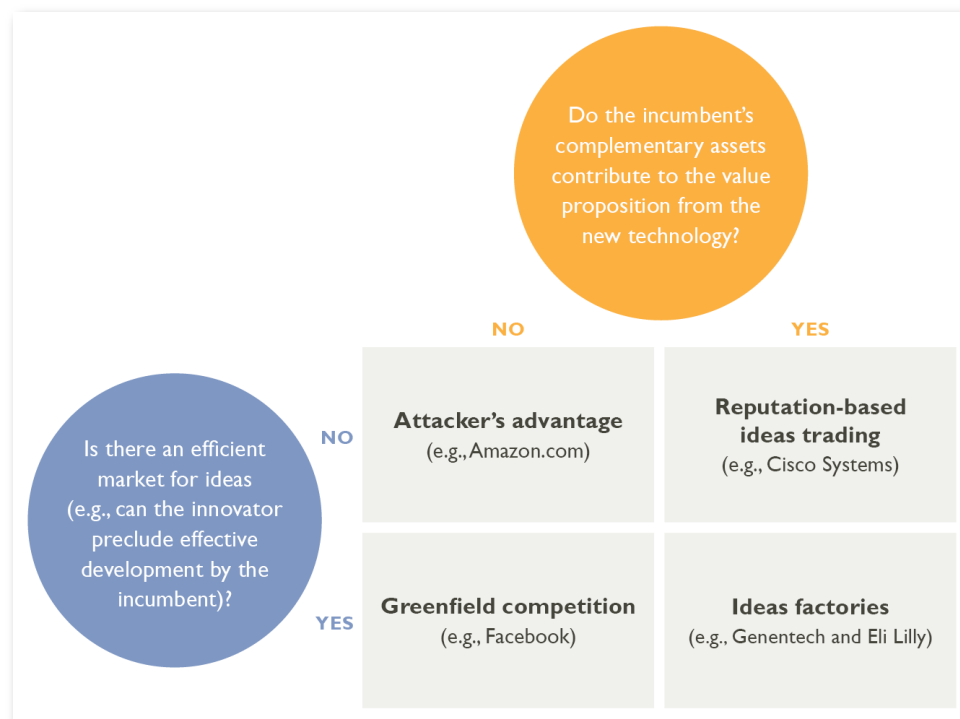
The innovator’s choice between either cooperation or competition is also informed by the ownership of valuable complementary assets. An innovator that does not own those assets—and wants to avoid costly and risky investments in them—has an incentive to cooperate with an incumbent that does. For the incumbent, cooperation preserves market power and avoids potential competition in the product market.

A subtle interaction exists between the effectiveness of the market for ideas and the ownership of complementary assets. Owners of valuable complementary assets are likely to have the market knowledge to appreciate the value of the idea and the technical expertise to imitate it. When intellectual property rights are not strong—that is, when the market for ideas is weak—owners of complementary assets (incumbents) are the most able to imitate the idea and the most likely to do so. Gans and Stern cite the case of the inventor of the

intermittent windshield wiper, who fought for decades to get compensation from automakers who copied his idea.

Gans and Stern use these two dimensions—the existence of an efficient market for ideas and ownership of valuable complementary assets—to create a useful framework for choosing a commercialization strategy. Their framework is shown in **Exhibit 4**. We will discuss the commercialization strategy for each environment in turn.³⁶

EXHIBIT 4 Commercialization Strategies



Source: Adapted from "The Product Market and the Market for 'Ideas': Commercialization Strategies for Technology Entrepreneurs," Joshua S. Gans and Scott Stern, *Research Policy* 32, no. 2 (February 2003). *Research Policy* by North-Holland. Reproduced with permission of North-Holland via Copyright Clearance Center.

Attacker's Advantage

Where the incumbent does not control valuable complementary assets, there is no incentive for the innovator to cooperate. If the incumbent can exploit the idea, the innovator has an incentive to enter the market and attack the incumbent before the incumbent can copy the idea. This situation is called the **attacker's advantage**. In entering the product market, the innovator is likely to have several advantages. It will have skills in the new technology that are not well developed in the incumbent. The incumbent may be so focused on protecting its own profitability that it overlooks the innovator. The innovator

can follow a stealth strategy—by targeting unserved markets—to avoid provoking a competitive response.

For example, when Amazon entered the US retail book market, incumbents Barnes & Noble and Borders had no assets that Jeff Bezos considered valuable for Amazon. In fact, he perceived their retail stores and retail staff members as liabilities. He had little incentive to try to sell the idea of online book retailing to them because there was no way to stop them from adopting the idea themselves. Amazon's best commercialization strategy was to enter the product market and attack the incumbents.³⁷ In doing so, Amazon had some advantages. It had developed skills in online retailing that the incumbents did not have. Barnes & Noble struggled between protecting the returns from its brick-and-mortar stores and responding to the attacker.

When innovators' ideas have little intellectual property protection, their technology advantages may be fleeting. Amazon's idea, for example, was easy for other startups to imitate. Like any other innovator that enters a product market with an idea that is easy to imitate, Amazon had to develop a strategy to deal with emerging competitors.

Ideas Factories

At the other extreme is the commercialization environment where an innovator has a technology that the incumbent cannot exploit on its own, and the incumbent has complementary assets that enhance the value of the technology. The two parties have every incentive to cooperate. Gans and Stern characterize this environment as suitable for what they call *ideas factories*: innovators that produce ideas for incumbents to buy.

Genentech was essentially an ideas factory. According to Tom Perkins, "after two or three years of work at Genentech we had some strategic questions to ask ourselves. Should we attempt to use our patents as a barrier to other companies? Or should we license our patents broadly?"³⁸ For Genentech, the relatively strong intellectual property rights of the pharmaceutical industry made licensing feasible. The company decided to license its technology to pharmaceutical firms, which had the resources to fund both clinical trials and production. A natural target as a licensee was Eli Lilly, holder of 80% of the US market for insulin, which it produced by deriving human insulin from the pancreases of animals. Both companies benefited from cooperation.

In this environment, the question is: When and how to cooperate? As Gans and Stern explain, "The key to an effective cooperation strategy is to initiate cooperation at a point where technological uncertainty is sufficiently low but sunk investment costs have not yet become substantial." Genentech could have

attempted to license the technology after it produced the simple human protein somatostatin. By waiting until it had successfully produced insulin, the company increased the perceived value of the technology and the importance to Lilly of acquiring it. Lilly was a major supplier of insulin, and this alternative source was a strategic threat.

In the case of Genentech, the market for ideas worked well. Four years after Tom Perkins agreed to buy 25% of the equity for \$100,000, an initial public offering (IPO) valued Genentech at \$300 million. In 2009, it was fully acquired by the Swiss health-care company Roche for \$47 billion. Reflecting on their choices years later, Perkins said, “I still think the strategy of the way we did it—subcontracting the experiments, then licensing to Lilly . . . I don’t think we could have done it better.”

Reputation-Based Ideas Trading

Why would Google, Apple, or IBM ever buy a software company? An idea for a new software product is relatively easy to imitate. All these firms have deep software expertise and valuable complementary assets. Once they hear of a new idea, any of them could apply considerable resources to develop their own version of it.

The problem with developing a reputation for imitating ideas is that doing so eliminates the incentive for ideas factories to develop new technologies that might benefit the imitating firm. In fact, it gives them an incentive to hide their ideas from such a firm and instead approach competitors that have a better reputation.

Incumbents who develop a reputation for being willing to participate in the market for ideas—for example, by paying licensing fees or acquiring companies at a fair price—provide an incentive for innovators to develop new technologies that enhance the value of the incumbent’s assets. In this situation, the incumbent’s good reputation allows for reputation-based ideas trading, which benefits both the innovator and the incumbent.

Trading in ideas requires innovators to get the attention of potential acquirers. This may not be a problem for in-house research and development staff developing a new technology for the company’s use, but innovators in technology startups may have difficulty getting access to decision makers. Venture capital firms can be useful intermediaries in those situations, adding credibility to the innovator’s idea.

Greenfield Competition

The last type of commercialization environment is one where the innovator has a technology idea that is difficult for an incumbent to develop, and the incumbent has no valuable complementary assets. In this case, there is no incentive for the innovator and the incumbent to cooperate. In such so-called greenfield opportunities, the competition is among the innovators, who may end up in a race for first-mover position. For example, when Mark Zuckerberg developed Facebook's technology, the main incumbent (Myspace) had no valuable complementary assets. Zuckerberg's best option was to be a fast follower in the greenfield online social networking market.

Google's developers, Larry Page and Sergey Brin, initially tried to sell their search technology to a leading web portal for \$1 million, reportedly because they felt it was taking too much time away from their PhD studies at Stanford University.³⁹ After that attempt failed, the two got some venture capital backing and chose to enter the market for online search services. Although there were other search engines and web portals, Google was the first *fast* search engine. The technology worked already, so the risk was low, and the rapid growth in the number of users was a clear demonstration of market need. The number of potential users was vast. With limited time before an imitator appeared, entering the online search market made sense. The next question for Page and Brin was how to get people to pay for the service.

Choosing an Offering and Selecting a Revenue Model

In new markets, the way firms get paid—the **revenue model**—may not be established. Innovators often experiment with revenue models, which may entail experimenting with offerings. In some cases, the customers of the revenue-producing commercial offering may be quite different from those of the initial offering.

Consider Facebook and Google, providers of **information goods**, which have a distinctive characteristic: near zero marginal cost. While either firm could have attempted to charge users a proportion of the value they received, the two companies would have faced competition from firms offering similar services for free. Both firms chose instead to develop an offering for advertisers, for whom users' attention was a valuable complementary asset. Facebook and Google had an incentive to work with advertisers, and advertisers had an incentive to work with them.

Advertising is not the only revenue model for information goods and services. Other options include subscriptions, freemium pricing models (in which a basic version is free but a version with extra features is not), and complement pricing

(in which a basic service is free but the firm charges for complementary goods or services). All those models have been employed in the new mobile apps industry, and complement pricing through in-app purchases was discovered to be profitable only as the industry evolved.^{40,41}

2.2.4 Growth

Once an innovator has chosen how to commercialize a new technology, the competition shifts from the market for ideas to the market for products or services. The strategic challenge is to grow the market while capturing the maximum possible share of the value created.

An offering based on a new technology may be a familiar offering—produced in a new way—for an existing market or an entirely new offering for which no market currently exists. Amazon’s initial offering, for example, was entirely familiar—a book—and the retail market for books was well established. Only the technology of producing retail book sales was different. The first personal computer, on the other hand, was an entirely new offering for a market that at the time did not exist.

Despite these very different situations, the strategic questions remain the same:

- How do we get mainstream customers to adopt the offering?
- How can we maintain competitive advantage and bargaining power to capture a share of the value as the market develops?
- How can we shape the competitive environment to sustain bargaining power in the long run?

The challenge of technology strategy is to address these three questions *concurrently* in an environment that is changing and evolving. The technology strategy needs to specify a series of choices over time that create value by getting mainstream customers to adopt the offering and that capture value by preserving and enhancing the innovator’s competitive advantage and bargaining power, both in the short and long term.

Growth Strategy: Achieve Adoption by Mainstream Customers

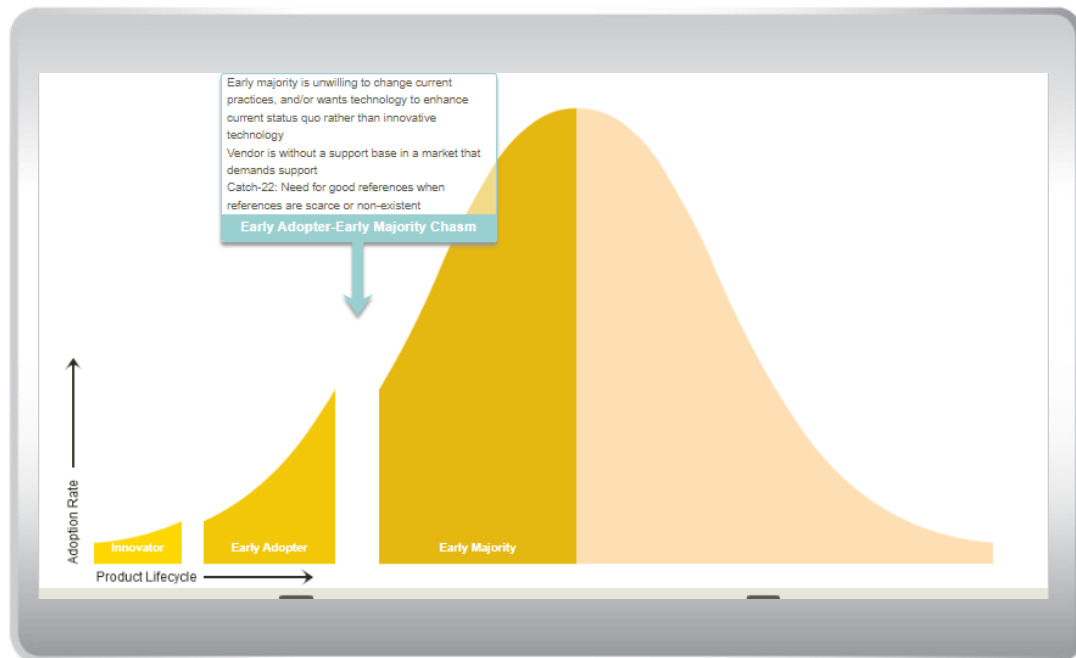
In *Crossing the Chasm*, Geoffrey Moore explains that different parts of the market adopt new technology at different rates. **Early adopters** are quick to see the potential benefits of a new technology. The *early majority*, by contrast, “are content to see how other people are making out before they buy in themselves.”⁴² The key, Moore says, is in “making the transition from an *early market* dominated by a few *visionary* customers to a *mainstream market*

dominated by a large block of customers who are predominantly *pragmatists* in orientation”⁴³ (italics in original). The product offering must evolve to meet the differing needs of those market segments. Moore refers to the gap between the needs of the early adopters and the needs of the majority as a chasm. “Crossing this chasm,” he writes, “must be the primary focus of any long-term high-tech marketing plan.”⁴⁴



INTERACTIVE ILLUSTRATION 1 The Chasm in the Technology Adoption Life Cycle

To access the interactive illustration, click on the image or use [this link](#).



Source: Figure: “Technology Adoption Life Cycle,” from *Crossing the Chasm* by Geoffrey A. Moore. Copyright © 1991 by Geoffrey A. Moore. Reprinted by permission of HarperCollins Publishers.

The chasm is wider for some technologies than it is for others. Its width depends on the cost to the customer of switching to a new product or service. Where *switching costs* are low, a small improvement in performance may be enough to get the early majority of the market to switch. Where switching costs are high, collaboration with complementors may be necessary to develop a value proposition that meets the early majority’s needs. For example, the manufacturer of a new video game console will collaborate with developers to make popular games available on the new console.

Click on **Interactive Illustration 1** and then click the play button to see the characteristics of each market segment, the reasons why a gap (or, in one case, a

chasm) exists between the needs of one segment and the needs of the next, and how to negotiate the gaps and cross the chasm.

The best way to cross the chasm is to seek to dominate a market niche. A tight focus allows the innovator to provide excellent support, develop targeted marketing messages, and promote word-of-mouth marketing. Moore likens that strategy to the D-Day invasion of Normandy during World War II:

Cross the chasm by targeting a very specific niche market where you can dominate from the outset, drive your competitors out of that market niche, and then use it as a base for broader operations. Concentrate an overwhelmingly superior force on a highly focused target. It worked in 1944 for the Allies, and it has worked since for any number of high-tech companies.⁴⁵

Amazon's initial focus on the US retail book market is an example of targeting a niche to cross the chasm. It was always plausible that tech-savvy early adopters would buy products online. The question was: Would mainstream (early majority) customers be willing to change the way they purchased books? By focusing tightly on delivering a powerful value proposition to book buyers, Amazon was able to attract millions of customers who had never before made an online purchase.

Growth Strategy: Retain Competitive Advantage and Bargaining Power

Whether a company is competing using a new technology or an existing one, the fundamental principles of competitive strategy are the same: The value captured depends on the value you create, your competitive advantage, and your bargaining power. With a new technology, the difference is that all of these conditions are continually changing as the market grows and the technology develops. If the new technology produces a competitive advantage, competitors will rush to exploit it. A large market will open up.

Having created value, the challenge for the technology innovator is to capture a share of that value in the face of the many other market participants—suppliers, powerful customers, competitors, potential entrants, suppliers of substitute products, and complementors—who would like to secure that value for themselves. A successful strategy for a technology innovator will include many of the following elements:

- Seek to dominate a market segment.
- Sustain competitive advantage by improving the value proposition.
- Be prepared to adjust your offering and cannibalize your business.
- Preempt competitors.