

# Steps to High-Tech Success

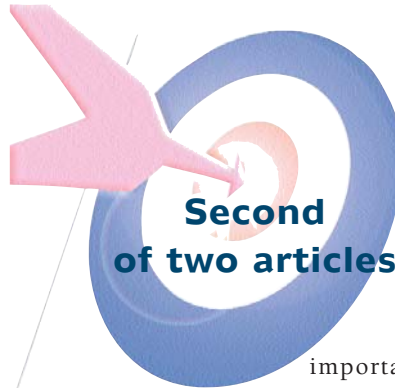
Of the new technology companies created each year, most will never make a profit. Success demands more than a good product; it requires the right combination of partners, employees, and investors, all with a passion for pursuing the company's goals (see *The Industrial Physicist*, June/July 2003, pp. 16–18). Once a company is organized and financed, it must also pursue a course of action that many high-tech innovators never think about as they invent and develop their technology. Yet these factors, including protection of intellectual property and getting the product to market quickly, can prove more influential than the technology itself in determining the company's ultimate success.

## Intellectual property

In several industries, patents play an essential role in creating a sustainable advantage for technology-based businesses. In many respects, Japanese companies have filed patents more aggressively in recent decades than their U.S. competitors. However, the Japanese patents are more likely to be incremental improvements. The radical breakthrough patents that we see mainly come out of laboratories in the United States.

As an example of how patents could play a key role in building a business, suppose you approach a large company and propose a partnership based on your technology, which would solve some of your potential partner's problems and save it enormous amounts of money. The first thing that company will consider is whether it needs you (see *The Industrial Physicist*, August 2000, pp. 26–27). The company may find your solution appealing, but if you do not have a strong intellectual-property position, it may simply appropriate your technology and go ahead without you. We jokingly call this creating a 600-pound-gorilla competitor, meaning one with more capital, better access to markets, and the resources to move the technology forward. However, if you have a strong patent position, and the company's technologists decide you have a useful

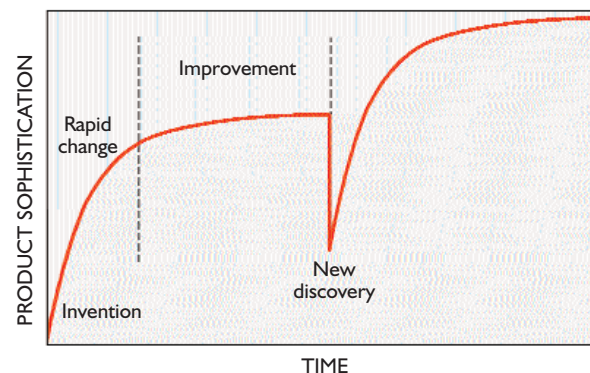
product, the company will likely partner with you before one of its competitors realizes what you have to offer.



It is important to consider intellectual property protection at the founding of a new company. Employees and advisors should sign agreements that assign intellectual property to the company, and they should be instructed in how to protect and generate value in intellectual property.

## Speed of innovation

We are witnessing a quickening in the speed of innovation that every high-tech start-up must recognize and address. D. Bruce Merrifield, professor emeritus at the University of Pennsylvania's Wharton business school and president and chief executive officer of Pridco Management Co., stresses the fast pace of change when he notes that "90% of all the engineers and scientists that have ever lived in the history of mankind are alive today."



**Figure 1. Innovations typically go through cycles of invention, rapid change, and incremental improvement when products reach maturity.**

Innovations go through cycles in which there is typically a period of rapid discovery followed by incremental improvement when products reach maturity (Figure 1). After the invention of the transistor in 1948 by William Shockley and others at Bell Laboratories, the device followed such a cycle, during which it changed dramatically. Although transistors were first made of germanium, researchers soon determined that silicon was a better material. Next, they figured out that photolithography provided a better manufacturing method. This period of rapid change was followed by one of slower, incremental changes, which I call improvement. During this stage, silicon linewidths went from 5  $\mu\text{m}$ , to 4, to 3, and finally to 2  $\mu\text{m}$ . Then, Robert Noyce and Jack Kilby invented the integrated circuit and dramatically changed the playing field—starting a new curve of invention, rapid innovation, and incremental improvement. This cyclical trend repeats itself over and over.

The United States has created one of the best environments for invention and discovery. We have wonderful fundamental research and we encourage individualistic behavior. There are many advantages to both those traits. Japan, on the other hand, has created an environment that fosters incremental improvement. Thus, industries dominated by creativity tend to do better in the United States, whereas industries dominated by improvement tend to do better in Japan. From 1988 to 1998 the U.S. semiconductor industry increased its global market share from 38% to 54%, while Japan's market share dropped from 51% to 28%. Many people believe that U.S. firms have finally learned how to build improvement into their manufacturing techniques to be competitive with Japan.

But this only tells a small piece of the story. I would argue for the importance of another factor: the dramatic decrease in the average life span of a product on the market. As product life becomes shorter, the relative importance of the chip-design soft-

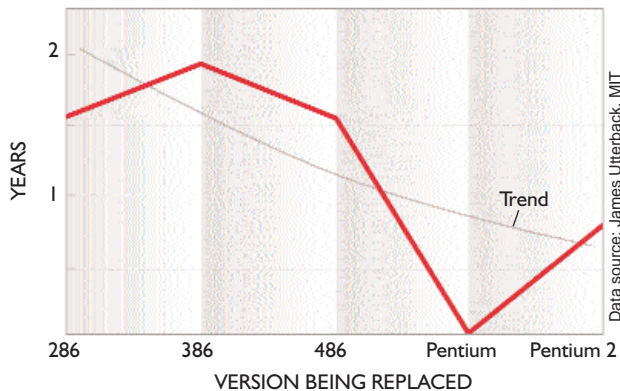
ware and mask layouts becomes more significant, and thus, the creative side becomes a more crucial part of the equation.

## Time to market

The time at which your product reaches the marketplace may determine its success or failure. Consider the number of years that Intel was in volume production of each of its microprocessors before it announced the next version, which made the current version obsolete (Figure 2). Intel produced the 286 for two years before it announced the 386, and it marketed the 386 for 2.5 years before it announced the 486. The company announced the second Pentium chip at the same time that it went into volume production on the first Pentium chip, and it announced the third version only one year after going into production on the second. You can see that this trend shows a halving, on average, of the product life span of Intel's microprocessors. We see such rapid product-development cycles repeated over again by successful American companies in electronic, software, computer, and semiconductor industries.

The chief technology officer of Hewlett-Packard (H-P) once highlighted the importance of speed-to-market. He noted that getting a product to the marketplace one month earlier was typically worth more to H-P than its entire engineering and development cost. Reaching the market either six months earlier or six months later increased or decreased, respectively, a product's lifetime profits by one-third. Clearly, speed-to-market is a major factor in determining product profitability and success.

For industries in which patents are of less importance, such as software, speed-to-market is truly the key to success. There is, however, a trade-off between speed and quality. For example, as I said earlier, Intel announced its second Pentium chip at the same time that it started volume production on the first. But the second had a math co-processor problem. Intel may have rushed



**Figure 2. The number of years between the start of volume production of an Intel microprocessor and the announcement of the next version trends down, illustrating the company's successful strategy of time-to-market.**

the chip to the market too fast, and the company had to spend \$450 million to recall the flawed product. It was an expensive mistake.

## Flexibility

One thing that inhibits large companies from developing innovative technologies is their lack of flexibility. Masao Yukawa, formerly at Mitsubishi and now at Toyota, studied this problem in Japan. In the mid-1990s, he compared the Japanese rate of adoption of multimedia technology with that in the United States, and found a huge difference between the two countries. (He used multimedia to describe Internet-related activities.) The United States had much higher use of personal computers, much higher network access, and much more business activity based on networked computers.

Yukawa, who was concerned that the Japanese lagged behind Americans in adopting the Internet, found numerous reasons for his findings. First, he analyzed the impact of regulations in Japan and found that many of them suppressed adoption of the innovative technology. For example, the Ministry of Health had rules in the mid-1990s that required doctors to meet face-to-face with patients to make a diagnosis and to charge for their services. By contrast, the Massachusetts General Hospital was already telelinked to dozens of hospitals worldwide, whose patients its specialists helped to diagnose. In Japan, doctors were denied compensation for using this innovation.

Yukawa also pointed out that the Ministry of Transport did not allow sales of tickets outside a registered travel office. Inter-

net users in the United States were already actively purchasing electronic tickets, and this trend has accelerated rapidly since then. The Japanese Ministry of Education did not allow academic credit for learning outside the traditional classroom. By contrast, Stanford University had about 2,000 students taking classes to earn master's degrees via cable TV at their company locations beginning at 5 p.m. each day.

Large companies can suffer from the same type of rigidity that suppressed innovation in Japan. Managers must create rules with caution because they might inhibit progress, and old rules should be reviewed periodically to make certain that they are still constructive. The Japanese rule prohibiting doctors from charging fees unless they met with the patient was clearly intended to protect patients. However, it had the unintended effect of suppressing the development of telemedicine in Japan. William Weld recognized the potential problems of old rules when he was governor of Massachusetts and created a task force to analyze existing regulations in the context of promoting job and wealth creation. The subsequent removal of obsolete regulations and the modification of other rules streamlined doing business in the state and enhanced its competitiveness. This helped stimulate one of the most dramatic economic growth spurts seen anywhere in the world.

## Clusters give an edge

Finally, recall the phrase "location, location, location." Michael E. Porter of the Harvard Business School observes that where you locate your company is a key determinant of success. He concludes that you should locate it close to your fiercest competitors and/or your most demanding customers. That way, you gain from the advantages created by the cluster of companies that have complementary or competitive skill sets. The advantages of locating among similar companies include a better labor pool, more competitive vendors, more receptive venture investors, and customers who regularly visit the region. In addition, if

you compete locally against the fiercest competitors, your products are globally competitive. Porter argues that the greatest economic development—job and wealth creation—comes from products that have a global market.

An example taken from Porter's work is the Dutch flower business. The Netherlands controls 75% of the cut-flower business in Western Europe. That may seem strange because to grow flowers, you need land, sun, and rain. Although Holland gets lots of rain, it has little land or sunshine. Nevertheless, its growers dominate the cut-flower business because they have a cluster of companies that specialize in all aspects of flowers: breeding, growing, cutting and preserving, packaging, and air shipping. This kind of dynamic, productive infrastructure has made Dutch companies much more competitive. In fact, Holland even ships flowers to Disney World in Florida.

In the United States, we have centers or clusters in Northern California and Massachusetts, where start-up companies have played an enormous role in rejuvenating the American economy by creating new industries such as computers, software, biotechnology, and the Internet. We have not seen as many radical innovations commercialized by Japanese or European companies in recent years. In Japan, this could be partly because so many major companies are at a later stage of maturity. Many of Japan's largest employers—Mitsubishi, Toshiba, Hitachi, and so on—were founded more than 50 years ago.

### Risk tolerance

In Japan, there is a great stigma for failure, and people are therefore extremely reluctant to risk their careers by taking a chance on a start-up company. Opportunities for the best and brightest appear more attractive in large companies. Most of Europe also has a stigma for failure, but surprisingly, many cultures have a stigma for success, causing entrepreneurs to hide their success. When success is concealed from the public eye, it fails to create role


models for young would-be entrepreneurs. The stigma for success surprises Americans, but it seems to stem from the belief that wealth is shifted rather than created. This leads to the view that when someone gets richer, someone else becomes poorer. The United States has a nearly ideal culture for innovation. It celebrates success and accepts failure. People want to take chances, and the stigma for failure is less than elsewhere. The result is that the best and brightest in the United States often gravitate toward start-ups because of the greater challenges and rewards.

We must never forget the importance of encouraging and rewarding creativity and individual behavior. In the United States, the president annually presents the National Medal of Technology to leading innovators, and the National Medal of Science to outstanding U.S. scientists. The Lemelson-MIT Prize honors a leading U.S. innovator with a \$500,000 award. This kind of positive reinforcement for people willing to take risks should be strongly encouraged. The only people who never experience failure are those who never push the envelope of what mankind is capable of doing. Nietzsche was right when he said: "Whatever doesn't kill you makes you stronger."

### Further reading

Porter, M. E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*; Free Press: New York, 1998; 432 pp.

Porter, M. E. *The Competitive Advantage of Nations*; Free Press: New York, 1998; 896 pp.

Yukawa, M. *Japan's Enemy is Japan*; self-published: 3-30-3 Denen-chofu, Ohta-ku, Toyko 145-0071, Japan, 1999; 171 pp. 

### B I O G R A P H Y

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