SUCCESS FACTORS IN TECHNOLOGY-BASED ENTREPRENEURSHIP

John T. Preston
Associate Director, MIT Entrepreneurship Center
Originally a Transcript of a Lecture Delivered in Tokyo in 1997
Updated August 2001

INTRODUCTION

MIT students and faculty create roughly two new inventions every day. I spent ten years of my life managing the commercialization of those inventions. MIT's Technology Licensing Office files four patents a week, licenses hundreds of inventions to industry each year, and creates ten to twenty new start-ups a year around these inventions. Between 1985 and today, the MIT licensing office has created over 200 companies. These companies currently employ thousands of people and have a market value of approximately $20 billion.

Despite these many important and highly visible successes, the role that MIT plays in stimulating entrepreneurial behavior is highly underestimated. Even the importance of entrepreneurial behavior on the US economy is not well appreciated. In Massachusetts alone there are 1,065 companies founded by MIT alumni; worldwide there are more than 4,500 companies created by MIT alumni. This entrepreneurial activity dates back to the 1880s when MIT was only a twenty-year old university. MIT spin-off companies founded in the 1880s include Stone and Webster, Charles T. Main, and Arthur D. Little. This entrepreneurial activity continued with the founding of Raytheon in the 1920s, EG&G (1940s), Digital Equipment (1950s), Lotus Development (1980s) and Akamai (1990s). MIT's entrepreneurial engine has been very powerful and has been running for many years -- long before I arrived at MIT. MIT alumni-founded companies on the West Coast have

also played a major role in creating new industries. The biotech industry was founded around Genentech started by Bob Swanson. The founding of Intel by Bob Noyce, Gordon Moore and Andy Grove built the integrated circuit business. These, along with Hewlett-Packard and 3Com, are but a few examples of other great companies started by MIT alumni.

MIT has recognized the importance of entrepreneurial activity and is fostering entrepreneurship education through the MIT Entrepreneurship Center, headed by my friend and colleague Ken Morse. This center is training students in the key success factors of entrepreneurship and is exposing MIT's students to real world startup company problems and opportunities.

SUCCESS FACTORS IN BUILDING NEW HIGH TECH COMPANIES

What are the key success factors in building new high-tech companies? This talk addresses some of the important factors that I have observed in starting nearly 100 companies (SLIDE 1).

First, I will address ***attitudes***, and particularly why small companies are so important in bringing new innovative ideas to market. Second, I will discuss the ***management talent*** needed to make a company succeed. I would much rather start a business around a first-rate management team with average technology, than to start it around a first-rate technology and a second-rate management team. First-rate managers have a much higher probability of success.

Patents play a major role in building a *sustainable advantage* for small, high-tech startup companies. I am also going to address how to stimulate ***passionate behavior*** among employees in startup companies. I will discuss the role of ***quality investors***, and how the rate of infusion of money is so important in building a business. I will talk about *getting* ***high quality products to the market quickly*** and the need for ***flexibility*** in small organizations. Finally, I'm going to talk about some of the work that Professor Michael Porter has been doing at the Harvard Business School on the importance of ***location*** -- where you locate your business -- and a concept that he refers to as "***Clusters of Excellence***."

ATTITUDES

Let me start by saying a few words about ***attitudes*** (SLIDE 2). Let us contrast the behavior of large companies vs. small companies. Large companies tend not to develop innovative technologies the way small companies do. There's a statement on this slide that says, "Radical innovation never originates with the market leader!" This statement came out of a book published by a friend of

mine, Jim Utterback, at MIT. [1] Jim spent several years of his life looking at radical innovation. He looked at innovations that have occurred over the last hundred years around the world. He found no case where the market leader pioneered radical innovation. That's a very powerful statement, because often the market leader was the inventor of the radical innovation, but refused to pioneer it, often fearing that it would cannibalize sales of their existing products.

Let me give you two examples. Back in 1981, I left MIT for the first time to start a business in the new emerging field of software for personal computers. I started the company with one of the world's leading experts in microcomputer technology, a professor at MIT by the name of Hoo-min Toong. By 1981, Hoo-min had written the front cover article in *Scientific American* on this new emerging technology -- personal computers. Hoo-min was also advising IBM on designing the architecture for what became the IBM PC AT. In 1980, one of Hoo-min's students, Mitch Kapor, wrote a software program called VisiPlot/VisiTrend and licensed that software to VisiCorp for $2.5 million. This is a fun thing to think about: a 27-year-old graduate student making $2.5 million from a license agreement. Mitch used that money to write a software program called "1-2-3." Hoo-min knew that"1-2-3" was going to be important to his friends at IBM, so he arranged to fly Mitch Kapor to IBM's PC headquarters in Florida three times to try to convince IBM to take an exclusive license to "1-2-3." Ultimately IBM refused, saying, "Hardware is a multi-billion dollar industry. The market for PC software is only a fifty million dollar industry, so go off and become successful and we'll talk to you." Three years later when Mitch had built a company where his stock was worth a quarter of a billion dollars, he was no longer interested in licensing this technology exclusively to IBM for three and a half million dollars.

The point I am trying to make is IBM missed a fundamental paradigm shift. They missed the fact that the value added was shifting from the hardware to the software. The relative value of the intellectual content in the software was going up while the hardware was becoming a commodity product with prices going down very rapidly. As evidence of this, you can look at the fact that today Microsoft is worth more than IBM. If the two were to merge, IBM would become a subsidiary of Microsoft (a twenty-year old software company based around the software for IBM's personal computers). IBM did, subsequently, take an exclusive license to "1-2-3" by purchasing Lotus Development Corporation for $3.5 BILLION, not three and a half million. Because they were locked in their old ways of thinking, a large company refused to take advantage of a radical innovation that was offered to them on a silver platter.

---

[1] James Utterback, *Mastering the Dynamics of Innovation* (Harvard Business School Press, 1994)

There's an interesting quote in one of the annual reports of Western Union from the late 1800s. The chairman said, "Many of our stockholders have asked me about this new invention by Alexander Graham Bell called the telephone. While we think it's an interesting curiosity, there's never going to be a market for that technology, and therefore we have declined the offer to take a license."

A quote attributed to Napoleon is, "What, sir, you mean to tell me that by lighting a bonfire under the deck of a ship, you can make it sail against the wind and the currents? I pray you, excuse me. I have no time for such nonsense." Then he kicked the inventor of the steamship, Robert Fulton, out of his office. There are numerous examples of this kind of attitudinal problem in large organizations.

I'm going to end with an example from Professor Utterback's book because it's a particularly fun example. It has Thomas Edison in the role of both the attacker of a new market and later, as the market leader. Let's start by talking about Thomas Edison when he was attacking a market. When Thomas Edison invented the electric light bulb, he held a press conference to give the first public demonstration of his new invention. At that time, the market leaders were the gas companies, selling gas to illuminate homes in the United States and around the world. The management of one of the gas companies felt so threatened by Edison's invention that they hired an electrician to sabotage the press conference. The electrician showed up with a wire tucked under his sleeve, around his back, and out the other sleeve. During the demonstration he shorted that wire across one of the light bulbs. You know what would happen if you short a wire across a light bulb in this room -- you would turn out the lights -- and of course that's what happened. But, fortunately for Thomas Edison, he had placed a fuse on every fourth light bulb so only four of the light bulbs went out and the others remained on. They had enough light to see what was going on. They caught the saboteur, threw him out, and then replaced the fuse, and the demonstration was a brilliant success.

Twenty-five years later, Thomas Edison had become the market leader. His behavior changed. A young entrepreneur by the name of Westinghouse working with the famous physicist Tesla spawned an innovation that threatened Edison. At this point in time, Edison was selling direct current (DC) generators and light bulbs to provide power and lighting up and down the East Coast of the United States. He was the market leader. Westinghouse determined that alternating current (AC) electricity is much more efficient. You have fewer losses, and therefore you get more power delivered to the home at a lower cost. Edison, rather than partnering with Westinghouse, did everything he could to sabotage Westinghouse's efforts to get to the market. He started a campaign to show that alternating current was unsafe. He even held public electrocutions of animals in Central Park, New York City, to show that AC was the best way to kill mammals and very dangerous so that no one would want it in their homes. He convinced the New York State Legislature to become the first customer for the Westinghouse generator to replace hanging of convicted felons with electrocution. That's how we got electrocution as a form of capital punishment in the United States. Again, this example shows how attitudes shift when you become the market leader. Edison is the

American who has the most patents of any person in the history of our country. He is recognized as the most innovative American. But when he became the market leader, his attitudes shifted and he resisted radical innovations rather than adopt them.

MANAGEMENT TEAMS

Let me now talk a little bit about ***management teams*** (SLIDE 3). As I mentioned before, I would much rather have a first-rate management team with average technology than have the reverse -- a first-rate technology with a second-rate management team. The strong management team is much more likely to succeed. One of the false impressions about entrepreneurship is that entrepreneurship is an individual behavior. What we've found is that entrepreneurial behavior is more successful when performed by teams. Professor Ed Roberts of the Sloan School did a study of startup companies and their probability of success. What he found was that the probability of success increased dramatically with team size until you got up to four or five entrepreneurs founding the company. Teams of people with complementary skill sets perform better. For example, if a technologist partners with someone who knows the capital markets and another person who knows how to sell technology-based products, the team of three will have a much higher probability of success than the solitary technologist trying to start a company on his or her own.

ARE CERTAIN CULTURES LESS INNOVATIVE?

In the United States we see *centers or clusters* in Northern California and in Massachusetts where startup companies have played an enormous role in rejuvenating American industry by creating entire new industries such as the computer industry, the software industry, the biotechnology industry and the Internet industry. Recently, we haven't seen as many radical innovations commercialized by Japanese or European companies. In Japan this could be tied in part to the fact that so many of the major companies are at a later stage of maturity. Many of the largest employers in Japan -- Mitsubishi, Toshiba, Hitachi and so on -- were founded more than fifty years ago. The engine for creating new companies is not the same in Japan today. One reason is that it's much more difficult in Japan to get the best and brightest people to agree to work in a small startup company. Clearly there's a *great stigma for failure* in Japan, and therefore, severe reluctance to risk a career by taking a chance on a startup company. In Japan, the opportunities for the best and brightest might appear to be more attractive in large companies. The situation in the United States tends to be reversed. People want to take the chance and the stigma for failure is not as great so they are willing to go into startup companies because the reward for success is so high. Also, there is a high precedence for such entrepreneurial behavior. We have many entrepreneurial role models in the United States. As we walk down the halls of MIT, every one of us sees people who have been highly successful; they have made millions of dollars by being an entrepreneur or by being

involved in starting a company. The common joke is, "I'm as smart as he or she is. Therefore, if he can make fifty million dollars in four years, I should be able to make a hundred million."

Many parts of the world, including the United Kingdom, suffer from both a stigma for failure and a stigma for success. The stigma for success is surprising for an American and seems to stem from the zero sum belief that wealth is shifted rather than created. This leads to the view that if someone got richer, then someone else must have gotten poorer. This causes the successful entrepreneurs to hide their wealth or move to the US. Sadly, this removes role models from the society. Prince Charles recognized this problem and decided in the early 1990s to give awards for innovation and entrepreneurship in the UK. The purpose for these awards is to create role models. Unfortunately, these awards were discontinued when Princess Diana died and Prince Charles assumed responsibility for some of her charitable activities.

The US has a nearly ideal culture for innovation. It celebrates success and accepts failure. I view that the greatest risk for the future is that the US becomes so litigious that it becomes intolerant of failure. We already see today that class action lawsuits are stifling management's ability to take certain calculated risks in public companies.

A STRONG INTELLECTUAL PROPERTY POSITION PROVIDES A SUSTAINABLE ADVANTAGE

Patents play a key role in creating a sustainable advantage for technology-based businesses. In many respects, Japanese firms have been more aggressive in filing patents than their counterparts in the United States. However, the Japanese patents have been relatively incremental patents. The radical breakthrough patents that we see are mainly coming out of laboratories in the United States.

Let me give you an example of how patents could play a key role in building a business. Suppose you approach a large company and propose a partnership with them. The basis for the partnership is that you have technology that will solve some of their problems and save an enormous amount of money. What is the first thing that's going to happen? The company is going to ask themselves, "Do we really need these people?" If you go in with a weak patent position, often you're going to create a competitor, because they're going to say, "This is a neat idea. It works. They don't have a good intellectual property position, so we can just go ahead and do it on our own." We jokingly refer to this as creating a Six-Hundred-Pound- Gorilla competitor because they have much more capital, they've got much better access to markets for that product, and they've got the resources to move the technology forward. If you have a weak intellectual property position, they're going to become your competitor. However, if you have a strong intellectual property position, their technologists will analyze the situation and say, "Yes, this a good technology. Yes, it solves our problem." Then their lawyers will say, "They've got a very strong intellectual property position.

We should partner with them before one of our competitors realizes what they've got." So the weak intellectual property position creates competitors whereas the strong intellectual property position creates partners.

For some of you who are in the electronics and software industry, the rules are a little bit different. I'm going to talk about this later when I get to the subject of *speed to market*.

PASSIONATE BEHAVIOR

Let me now say a few words about ***passionate behavior*** (SLIDE 4). I believe what we can achieve in life is a function of a number of things: how hard we work, how smart we work, how much leverage we have on the work we do, and how much courage we have. Of course, how hard we work is going to be tied to how passionate we are. One of the key differences I find between American and Japanese or European companies is that American companies are much more generous than Japanese or European companies in giving stock options to their employees. Why is this important? When you distribute ownership to the employees, the employees behave fundamentally differently. They no longer behave like employees; they behave like *owners*.

Let me give you an example to support my opinion. A Harvard Professor and I were on the West Coast giving a lecture on entrepreneurship and we flew back together to Boston on an airline called Southwest Airlines. Southwest Airlines has become one of the most successful regional airlines in the United States over the last twenty years. They were the only airline in the United States to make a profit in 1988, the worst year for US airlines. I believe it is no coincidence they also have the highest percentage of employee ownership of any airline in the United States.

Something surprising happened during a stopover: the pilot, co-pilot and flight attendants came back through the cabin of the airplane to clean up the trash and prepare the plane for the next flight out. I've been on many flights and many stopovers in my life; I've never seen the cabin crew clean up the airplane. I started chatting with one of the flight attendants about why they do it this way because normally you see a ground crew come aboard to clean the airplane. She explained to me that they didn't want to waste the money to hire a ground crew to clean the plane when they could do it themselves. Then she went on to explain how

one of her friends was retiring after being a flight attendant for twenty years and that her stock options in the company were now worth nearly five hundred thousand dollars. She further explained that her own stock options were a meaningful part of her retirement fund.

I've seen this same sort of shift in behavior in a number of companies. Let me give you an example

at Lotus Development Corporation. One of the things that Mitch Kapor did extremely well at Lotus was to give his employees incentives through stock options. His administrative assistant, who was the third employee in Lotus, made ten million dollars from her incentive stock options in Lotus. Now what happens to your behavior when you have the chance to make ten million dollars? You no longer care whether it's nine-to-five. You're willing to work whatever hours needed to make critical deadlines. At my company right now where we're working on a breakthrough understanding of science, I can show up at the office at ten o'clock at night or one o'clock in the morning, and chances are there are still people working in the company at those odd hours because they care so passionately about succeeding.

One of the key determinants for success in startup companies is the passionate behavior of the founders. People who lack passion will use the first barrier they come upon as an excuse for failure. People who have high passion will do whatever it takes to overcome those barriers. Wide shareholder ownership is one of the best ways to stimulate passionate behavior. Unfortunately, large companies can't really passionately motivate employees with stock options because you're not going to see a General Motors' stock go up a hundred fold from the day an employee arrives to the day that employee retires. However, small high-tech companies can see a hundred- or a thousand-fold increase in the value of their shares between when their early employees start and when they retire. There are, however, several interesting share ownership strategies that large companies can use to motivate employees. Thermo Electron, for example, spins off separately traded entrepreneurial companies and uses the stock in new businesses to motivate the team behind generating these new businesses.

INVESTORS MAKE A DIFFERENCE

Now, let me talk about ***investors*** (SLIDE 5). Many people think indifferently about sources of investment. They think what's important is how much money is raised for how many shares and they don't differentiate between the sources of that money. But the quality of the source of money, and the rate at which that money comes in, are key to determining the success of the company. Investors can provide significant *leverage*. I said before that success is not only a function of how hard and how smart we work, but also how much *leverage* we have on the work we do. In other words, can we convince others to work hard to help us succeed?

Let me give you an example, which occurred at a board meeting for a company that wanted to do business in a certain country. During the discussion about how to proceed, one of the board members (who is a world recognized figure) suggested that he should call the president of the country to ask how we should proceed. That five-minute phone conversation saved the company six months of hard work. This kind of leverage from an investor can be extremely valuable. I also

remember talking with Bob Swanson about what differentiated the success of Genentech from Cetus and other biotech companies in the early days. Clearly, one of the factors that helped Swanson immensely was the role Mayfield Ventures and Kleiner Perkins, two of his early lead investors, played in opening doors for them.

Another key determinant of success for startup companies is whether the venture capitalists have access to more money downstream. New companies typically need more money than the entrepreneurs originally think. Companies more often fail because they run out of money than because the technology has problems. Companies that have investors with "very deep pockets" will succeed more often. For example, Venrock -- which invests the Rockefeller family money -- is one of the most successful venture capital firms because it has incredibly deep pockets and has the staying power to help assure that its companies succeed.

As an aside, the venture capital industry in the United States was originally started by MIT and Harvard Business School. Back in the Great Depression, Karl Taylor Compton, the president of MIT, was lamenting the fact that MIT students could not find jobs. He was also annoyed by the fact that technology was being blamed for the loss of jobs. So he said, "Why don't we take some of the endowment of MIT and create new high-technology businesses to show that this is actually a powerful way to create jobs and at the same time create employment opportunities for MIT grads?" That dream was interrupted by World War II, but after the war, Karl Compton teamed up with the Dean of the Harvard Business School. The two of them put some of the endowment of MIT and Harvard into creating the first venture fund in the United States called American Research and Development (AR&D).

American Research and Development was started in the 1940s, but didn't really become famous until 1956 when it invested $70,000 to help create a company called Digital Equipment Corporation. Of course, that investment in Digital Equipment ultimately became worth many hundreds of millions of dollars and attracted an enormous amount of money to the venture community in the United States. This supports one of the things I was saying earlier: role models are one of the key determinants of behavior. So, walking around the MIT campus and seeing so many successful entrepreneurs makes others on the campus want to be entrepreneurs. Having successful venture capitalists has made others want to be venture capitalists. Right now in the United States we have more than twenty billion dollars worth of private and venture capital money being invested in new startup companies each year.

INVESTMENT TIMING

Finally, I want to make a point about the ***timing*** of how investments are infused into a company (SLIDE 6). This graph shows you two different scenarios for how to invest in a startup company. It shows the net flow of money as a function of time. When you're negative, you're investing money; when you're positive, you're making a return on the investment. This first curve, this "A" curve, says, "Let's put a small amount of money in this company over a long period of time, in the hope of going positive." That curve actually has a number of problems associated with it. First, the management often spends too much time raising money in small chunks instead of building the business, and second, it creates a wide window of opportunity for a competitor to come in more aggressively on the "B" curve and kill them. What really surprises me is that most large US companies tend to behave on the "A" curve, rather than the "B" curve, as it relates to radical innovation. However, for incremental innovation, they behave on the "B" curve. Why is that? If you look at the time horizon of going cash flow positive -- the "break-even point" -- if the time horizon is very short (less than two years) the company is more inclined to invest on the "B" curve. The reason is that public companies are judged by their shareholders on a relatively short-term time horizon. If you ask who owns our largest companies in the United States, they are really owned by speculators in the stock market. They are owned by pension funds, and other stock market gamblers. You ask, "What's the time horizon of those gamblers?" It's very short - typically less than 6-18 months.

I believe it's different in Japan: banks have a much larger role in ownership of the largest Japanese companies. The banks have time horizons that are a little bit longer, which enables the management of the largest Japanese companies to behave a little bit better long term than their counterparts in the United States. If a management team that is driven by short-term behavior has a radical innovation that might take five years to hit the payback, they will cut any investment from this optimum curve (the "B" curve) down to the "A" curve. Management can become a hero by cutting back to the "A" curve because all of the area between the A and B curves prior to breakeven will go to short-term profits. All of the area between these curves after breakeven is long-term lost opportunity, but because the management is being judged in the short term, they will make more money in the short term using fewer assets. I call such short-term behavior the "MBA Syndrome." I joke that these managers will be promoted to destroy a bigger piece of the company.

I made a presentation on the problem of this short-term investment behavior at a White House conference several years ago. D. Mark Cunningham was also making a presentation about the most successful public companies as a function of their ownership. He said that his data matched beautifully with my points. What he found was that companies with large blocks of shares held by an individual or family -- for example Microsoft, where Bill Gates holds a large block of shares -- have a longer time horizon than the average public company. He built one of the top performing

money management funds around the concept of ownership of the business. His data showed that companies that have large blocks of shares held by families or individuals, out performed the broadly traded public companies. So, when you have family ownership, the time horizon is very long term, which means they tend to choose the "B" curve investments more frequently than the "A" curve investments. The longer the time horizon, the more the shift to the "B" curve.

If you extrapolate back to what I was saying before, we see that a long-term orientation is key to determining success. These startup companies tend to have a higher percentage of active managers. In other words, they're entrepreneurs like Bill Gates who own more than 10% of the outstanding shares and are actively involved in running the company. Often, by the time the company gets to be the size and age of General Motors, family ownership has been diluted below the 10% level and is no longer a key factor in determining their behavior. Also, the original entrepreneurs are probably no longer alive and their heirs are no longer actively involved in managing the company. I could almost plot the performance of IBM as a function of the Watson family's ownership and involvement in IBM. When they owned more than 10%, and were actively involved, the company grew steadily. When they dropped below 10% and Tom Watson, Jr. left the Board of Directors, the company started to decline.

SPEED OF INNOVATION

Innovations go through cycles (SLIDE 7). In the early stages following a discovery, there is typically a period of rapid discovery followed by incremental improvement when products reach maturity. For example, in 1948 when Shockley and others invented the transistor at Bell Laboratories, the transistor followed such a cycle. Shortly after the first one was made, the transistor went through a period of *rapid invention* and discovery during which it changed dramatically. First, it was made of germanium; then it was determined that silicon is a better material. Next, we figure out that photolithography was a better manufacturing method. There was rapid change initially and then there was a period of slower, incremental changes, which I call *improvement*. During the improvement stage, silicon line widths went from five microns to four to three to two to one. Then, Noyce invented the integrated circuit and dramatically changed the playing field – starting a new curve of rapid innovation followed by incremental improvement for the integrated circuit. I would argue that this cyclical trend of innovation -- rapid invention, followed by a phase of gradual incremental improvements -- repeats itself over and over and over again.

I would also argue that culturally the Japanese have created a wonderful environment for improvement. Japanese firms also have one of the best environments for stimulating team behavior anywhere in the world. I would argue that the United States has created one of the best environments for invention and discovery. The US has a huge percentage of the Nobel Prize Laureates granted each year. We have wonderful fundamental research. We encourage

individualistic behavior much more than the Japanese culture encourages individualistic behavior. Japanese culture tends to favor group behavior. There are many advantages to that. We find that industries, which are dominated by creativity, tend to do better in the United States, while industries dominated by improvement tend to do better in Japan. For example, the movie industry is driven by creativity; hence, the US has a very dominant position in that industry. Software is also dominated by creativity and the US is again very successful. On the other hand, Japan is very strong in consumer electronics, which is dominated by the need to improve manufacturing techniques.

Recently, we've seen the US semiconductor industry doing extremely well worldwide. Many people believe the US semiconductor industry has finally learned how to build improvement into its manufacturing techniques to be competitive with Japan, Korea and other places that have done a wonderful job in that area. I would argue that there's actually another factor: the average life span of a product on the market has dramatically decreased. As the product life becomes shorter, the relative importance of the microcode that goes into designing that product becomes more important -- the creative side becomes more important.

SHORTEN TIME TO MARKET

I will now address the importance of speed to market and start with data from Intel (SLIDE 8). This slide shows the number of years that Intel was in volume production of each of its microprocessors before it announced the next version of that microprocessor which makes the current version obsolete. Intel was in production for two years on the 286 before they announced the 386, two and a half years on the 386 before they announced the 486 and so on. They announced the second Pentium chip at the same time they went into volume production of the first Pentium chip. On the second major version of the Pentium chip, they announced the third version only one year after going into production. You can see that this trend line cuts in half, on average, the product life span of their microprocessors. We see these rapid product development cycles repeated over and over again in very successful American companies in the electronics, software, computer and semiconductor industries.

For example, I was on Singapore's National Science and Technology Board (NSTB) with the Chief Technology Officer of Hewlett-Packard. He highlighted the importance of speed to market. For example, he said that the value of being one month earlier to market for a typical Hewlett-Packard product is worth more than the entire engineering and development cost of that product. He also said that being either six months earlier to market, or six months later, impacted the profitability of that product by one third over its entire life. In other words, if you get to market six months earlier, you will increase the lifetime profitability of that product by one third; if you are six months late, you will decrease the lifetime profitability by 30-35%. This is a very, very powerful statement: speed to market is a major factor in determining product profitability and success.

For those industries which are not dominated by intellectual property -- where patents are not as important -- speed to market is key to success. Of course, there is a trade-off between speed and quality. If you look at the Intel graph again, you will see that Intel announced the "686 equivalent" at the same time that they started volume production of the 586 (the first Pentium chip). You may recall that this second Pentium chip (the "686 equivalent") had a math co-processor problem. Intel may have tried to rush it too fast to the market and the math co-processor problem cost Intel $450 million to recall the flawed production. In this case, Intel compromised quality by going too fast. It was an expensive mistake. I think Intel now has reached a very healthy balance between emphasis on speed to market and on quality of the products that they are releasing. They should avoid this problem in the future.

FLEXIBILITY

Going back to the main themes I wanted to cover, the next one is ***flexibility*** (SLIDE 9). One of the things that inhibits large companies from developing innovative technologies is their lack of flexibility. Dr. Yukawa at Mitsubishi has studied this problem as it relates to Japan with very interesting findings. In 1993 and 1994, he wrote several papers about Japanese flexibility in the multimedia technology field. Dr. Yukawa compared the Japanese rate of adoption of multimedia technology with the rate of adoption of multimedia technology in the United States. "Multimedia" was the name used to describe Internet-related activities (although it has a broader context). What Dr. Yukawa found was that there was a huge difference between the adoption of multimedia technology in the United States relative to Japan. There are more PCs in the United States, and a much higher number of them were networked. Today, the number of networked PCs is close to 100%; almost everyone who uses a PC in an office is networked and is on the Internet. In 1996, Professor Dertouzos who managed the MIT Lab for Computer Science -- which hosts the World Wide Web Consortium -- told me that 95% of all queries on the Internet during 1996 originated in the United States. That's a staggering figure when you consider that the Web is available internationally.

JAPANESE REGULATIONS SUPPRESS INNOVATION

Dr. Yukawa was concerned that the Japanese were lagging behind the US in the adoption of this innovative technology (SLIDE 10). In looking under the surface he found that there were actually many reasons why the Japanese were lagging. He analyzed the impact of a number of the regulations in Japan which suppressed adoption of this technology. For example, the Ministry of Health had rules in 1993 -- and I imagine they still have them today -- requiring doctors to be face-to-face with patients in order to make a diagnosis and to charge for their services. The

Massachusetts General Hospital is currently tele-linked to dozens of hospitals around the world. Experts at the Massachusetts General Hospital help diagnose patients around the world with the same caliber of diagnosis as if the patient actually came to the Massachusetts General Hospital. In Japan, this innovation would be illegal because the doctors could not charge for their service. If they can't charge, they won't perform the work.

Dr. Yukawa also pointed out that the Ministry of Transport did not allow sales of tickets outside a registered travel office. In 1993, Internet users in the United States were already actively purchasing electronic tickets. This trend has accelerated rapidly over the past eight years.

The Ministry of Education in Japan does not allow academic credit for learning outside the traditional classroom. By contrast, Stanford University has about 2000 students taking classes to earn Masters Degrees via cable TV at their company location beginning at five o'clock in the evening. In Japan, this convenience would be illegal.

The Ministry of Finance won't allow banks to conduct business outside of banking hours and outside of banks' locations. I understand this law is starting to relax where automatic teller machines are finally, for the first time, being allowed to stay open past five o'clock at night. In the United States, the whole purpose behind the creation of automatic teller machines was to enable 24-hour service almost anywhere. In Dr. Yukawa's opinion -- and I share his opinion -- the list of regulations in Japan and the degree of rigidity suppresses the development of this innovative new technology. By the way, the bankcards in my wallet can be used today in ATMs in almost every country in the world, *except* Japan. The Japanese banking system generally does not service anyone whose bank account is not in Japan.

CLUSTERS BREED COMPETITIVE ADVANTAGE

Finally, I will address the importance of ***location*** of the business (SLIDE 11). Michael 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 your company close to your fiercest competitors and/or close to your most demanding customers. What he's saying is that you can gain regional advantages by clustering companies that have complementary or competitive skill sets. If you want to build a semi-conductor business, you would be much better off building it in Silicon Valley than in Cleveland or New Orleans. The reason is that you can more easily find employees and the infrastructure needed to support building a semiconductor company in Northern California than in Ohio or Louisiana.

One of the fun examples from Porter's work is the Dutch flower business. The Netherlands controls 75% of the cut flower business in Western Europe. That seems somewhat crazy when you think

about it because to grow flowers you need sun, rain and land. Holland has very little land (which it repossesses from the ocean) and very little sunshine. But they get lots of rain -- so they have one out of three. Yet, they still dominate this business because they have a cluster of companies that specialize in all aspects of growing flowers: breeding, growing, cutting and preserving, packaging, and air shipping. In fact, Holland even ships flowers to Disney World in Florida every morning on KLM flights. This kind of dynamic, productive infrastructure has made their companies much more competitive.

Silicon Valley semiconductors, Japanese consumer electronics, and the Singapore hard disk drive industries are other examples where company clusters create regional excellence. Japan, unfortunately, has utilized barriers for foreign competitors. Japanese bureaucrats have had the mistaken belief that barriers support local clusters, but Japan is actually becoming less globally competitive because of these barriers. Companies start to lose their global competitiveness when they do not need to change as much as foreign competitors. We have seen a trend over the last five or ten years where some of the largest, most competitive Japanese companies like Toyota, Sony and Toshiba are increasing their production outside of Japan, because the domestic regional clusters are no longer as competitive. The Japanese auto supply companies are losing their competitiveness relative to other clusters around the world. One of my recommendations is that Japan lower these so-called "protective" barriers to make these clusters more globally competitive, not just regionally competitive.

CONCLUSIONS

Let me summarize (SLIDE 12). First, I believe that trade barriers actually reduce the value of Japanese clusters over the long term. They may increase the value somewhat over the short term, but, over the long term, they will make it worse.

Second, creativity and individual behavior should be encouraged. In Japan, over the last twenty or thirty years, individual behavior has actually been discouraged. If you think back to what really made Japanese industry great, it was a few individuals who showed enormous courage to start businesses against all kinds of adversity and the risk of failure.

Third, I recommend that success be rewarded. In the United States, we have national awards given by the President to leading innovators each year. One is called the National Technology Award. There is also the Lemelson-MIT Prize which gives a half million dollars to a leading US innovator. We also have another award for scientists called the National Science Award. This kind of positive reinforcement for those few people who are willing to take risks should be strongly encouraged. Japan is not alone in the need to provide positive reinforcement for success; the UK and much of Europe also need to address this issue.

Fourth, we must find ways to lessen the stigma for failure. In Japan and Europe, if you try something and fail, it can ruin your career. In the United States, you will get another chance. If a culture can find ways to be more accommodating for failure, it would be advantageous. In my opinion, ***the only people who never experience failure are those who are not pushing the envelope of what mankind is capable of doing***. Nitsche was correct when he said: "Whatever doesn't kill you makes you stronger." My greatest advances have followed my greatest failures.

Finally, I believe we need to find a way to get the best and brightest people to look at entrepreneurial activities as a good and noble thing to do. Right now, I suspect that in Japan and much of Europe, the best and brightest are attracted either to large companies or the government.

I want to thank you for the opportunity to make this presentation. I wish I could take questions, but I know that my colleague Ken Morse is extremely familiar with this field. We have had a wonderful time building the Entrepreneurship Center at MIT together. I'm sure that he'd be willing to answer any of your questions. Thank you very much.

For further information, please contact either:

Kenneth P. Morse, Managing Director
MIT Entrepreneurship Center
55 Hayward St., Rm. E39-115
Cambridge, MA 02142-1347 U.S.A.
Phone: +1-617-253-8653
Fax: +1-617-253-8633
Email: kenmorse@mit.edu

John T. Preston, Associate Director
MIT Entrepreneurship Center
55 Hayward St., Rm. E39-115
Cambridge, MA 02142-1347 U.S.A.
Phone: +1-508-324-6411
Fax: +1-508-324-6401
Email: preston@mit.edu

