

Biographical History

John Preston is the Director of the Technology Licensing Office at the Massachusetts Institute of Technology. As Director, he manages the patenting and licensing of M.I.T., Lincoln Laboratory and Whitehead Institute inventions and software. He is a member of the Board of Directors of Molten Metal Technology, Environmental Bioscience and Ergo Computing, Inc. and is Chairman of the Technology Transfer Advisory Panel for the Strategic Defense Initiative of the United States Department of Defense.

Mr. Preston received his B.S. in Physics from the University of Wisconsin, and his M.B.A. from Northwestern University. His professional activities have been directed toward technology transfer, and specifically toward issues related to starting new high technology companies. He has founded, or assisted in, founding companies that are currently worth several hundred millions of dollars. In addition, about 40 companies, mostly spin-offs of M.I.T., have been started, in part, through the efforts of the Technology Licensing Office during his tenure.

THE ROLE OF THE UNIVERSITY LICENSING OFFICE IN TRANSFERRING INTELLECTUAL PROPERTY TO INDUSTRY

By: John T. Preston

INTRODUCTION

Universities in the United States have a significant impact on business through the transfer of technology. This transfer of technology takes various forms, including faculty communications (such as lecturing and the publication of research results), faculty consulting activities, and the direct transfer of technology through the licensing of patents, copyrights and other intellectual property to industry.

Well-trained students and professional staff who leave the university to work in industry probably represent the universities' greatest contribution to industry. These persons stimulate creativity and bring new ideas and perspectives to industry.

Perhaps the most dramatic form of technology transfer from the university setting is the creation of new businesses. A recent study of MIT spin-off companies revealed that its personnel and technology were involved in six hundred and thirty six companies located in Massachusetts. In 1988, these companies employed over 200,000 Massachusetts residents, with annual revenues of \$39.7 billion. Had all of these revenues been within Massachusetts, it would have amounted to about one-third of the Commonwealth's entire economy. These data do not include the jobs or companies created when MIT license agreements result in the transfer of inventions, an additional benefit to the Commonwealth.

In a regional economy, it is interesting to note that for every high technology job created, four or five low tech jobs are also created, magnifying the benefit of these companies.

MIT spin-off companies include Digital Equipment, Raytheon, Analog Devices, Lotus Development and various other large businesses. Many of these companies achieve tremendous growth rates. Such companies are often characterized by the following: a large financial investment was secured from a well known source of capital; the company management consisted of a team of talented entrepreneurs with diverse and complementary backgrounds; and the companies owned a core technology with broad applicability, numerous products, and

considerable growth potential. These companies seem to play an enormous role in stimulating the economy and creating jobs.

Background

MIT is a large research university with about 1000 professors, 3000 research scientists, 4500 graduate students and 4000 undergraduate students. The annual research budget for the MIT campus is about \$300 million; in addition, the research budget at the MIT Lincoln Laboratory is about \$400 million, and another \$20 million at the Whitehead Institute, an affiliated biotechnology research organization. Approximately 80% of the on-campus research is government-sponsored.

The Technology Licensing Office ("TLO") at MIT is responsible for maintaining and licensing the intellectual property that arises from the \$700 million expended on research at MIT.

The TLO operations are managed by professionals from various complementary business and technical backgrounds, and several are experienced in building businesses from embryonic technologies. I have some familiarity with this process, having founded or assisted in the creation of nine companies (plus forty MIT spin-offs through the TLO). As an aside, four of these nine businesses have failed--the remaining five companies are doing well, with a cumulative net worth greater than \$100 million.

The TLO has a staff of fourteen people including seven professional staff, referred to as Technology Licensing Officers. Each has a technology background and several years of business experience. In fact, two of the seven professionals are former presidents of companies and entrepreneurs. These licensing officers have considerable latitude in negotiating licenses.

The TLO receives one or two inventions (or new software packages) daily. These are analyzed by TLO staff to identify inventions with strong commercial potential--these inventions are protected through the patent or copyright process. The TLO business analysis for commercially viable inventions results in about three patent applications filed each week.

The primary function of the licensing officers is to license these patented inventions--at present, the TLO licenses about two inventions per week. It has been in existence since 1932--the record number of license agreements prior to its present format, between 1932 and 1985, was 15 agreements in one year. MIT, Stanford and the University of California will each conclude more than 70 licenses this year. I estimate that these three schools, and the University of Wisconsin, will account for more than half of all US university license agreements and royalty income during the next year.

Based on 1988 data, Stanford and Wisconsin lead all US universities in royalty income, at \$9 million each. MIT royalties were \$6.2 million, including new equity (valued at the time of last trade); the University of California was approximately \$5.4 million. The top seven universities are listed below:

1988 Licensing Activity

University	# of Lic.	Royalty in \$Millions
Stanford	75	9.2
Univ. Wisc.	<20	9.0
MIT	92	6.2*

Univ. Calif. System	65	5.4
Mich. State	<5	3.3
Univ. Fla.	8	3.0
Columbia	<10	2.2
All Govt Labs	?	4.4

* Includes equity

These numbers are somewhat misleading because of single large winning inventions, and a change in the ranking will probably occur as these big patents expire. For example, at Stanford University, \$3.6 million of its \$9.2 million came from the Cohen/Boyer gene splicing patent which is shared with the University of California. At the University of California (all campuses), \$3 million of its \$5.4 million in license revenues came from the licensing of genetically engineered strawberries developed at UC Davis. At Michigan State University, all of its \$3.3 million came from the licensing of cis-Platin, a highly effective and valuable anti-cancer agent. At the University of Florida, its \$3 million came from the Gatoraid Trademark license. At the University of Wisconsin, most of the \$9 million came from Vitamin D licenses.

An overall perspective of the licensing business is that all US Universities entered into about four hundred licensing agreements in 1988, resulting in about \$45 million in royalty income. This yield, on a research base of thirteen to fourteen billion dollars, reflects a rather dismal performance. These results confirm that universities do not use licensing agreements as a primary mechanism to transfer technology. U.S. government laboratories are generating less royalty (\$4.4 million in 1988) from a larger research base. Furthermore, \$3.7 million of this amount came from inventions licensed by the National Institutes of Health, leaving all other government labs at just \$700,000.

This is changing, as reflected in the considerable growth in licensing over the last ten years by both universities and government labs. In 1981, for example, US government laboratories signed only ten license agreements. In 1990, the laboratories signed ninety-five agreements, a considerable increase. MIT's performance (70 - 100 agreements/year) indicates enormous potential for growth in government labs and other universities.

Goals of MIT Technology Licensing Office

There are 4 major goals of MIT's Technology Licensing Office. The first goal is to bring about the efficient transfer of technology as a way of making the technology available to the public. To accomplish this end, MIT is willing to give away technology when it is in society's best interest. As mentioned above, MIT receives \$700 million annually in research funds from the US government--MIT thus views the public trust and its obligations to society as very important. With some technologies, the public is better served if it is released to the public domain, especially so if the technology has a very low cost threshold to reach the market. Software is sometimes a good example of a low threshold technology and, in fact, one of the leading software packages, X-Windows, is licensed for free by MIT.

By way of contrast, if biomedical products are placed into the public domain, they may never reach the marketplace--the cost and regulatory hurdles to bring a new pharmaceutical to market are simply too high. For example, if someone invented aspirin today and patent protection was not sought, a company could not recover its costs of developing the technology. The cost of proceeding through the FDA may approach as much as \$150 million--no company would spend this money if a competitor could subsequently follow the initial company and make the product without having to incur the research and regulatory expense.

The second goal is to manage conflicts of interests that are inherent in faculty-industry interactions. MIT has created a set of policies to manage and prevent conflict. This goal has equal priority to the first goal. In other words, technology transfer should not occur unless potential conflict is managed.

The third goal for MIT's licensing office is to make money for the institution and the scientist. In addition to providing motivation royalty sharing gives positive feedback.

The fourth goal is to generate good will both internally with MIT staff and externally with the licensees

MIT's Technology Transfer Philosophy

The TLO has undergone a radical philosophical transition over the last 5 years, resulting in a number improvements in the technology transfer process.

The first change was to move the marketing of inventions away from attorneys and instead hire technology-trained business people. These professionals are now MIT's catalyst for technology transfer. By contrast the lawyers concentrated on the protection of the intellectual property more than the transfer process.

The second philosophical change is that MIT is working with a greater number of small or start-up companies. When dealing with an embryonic technology, Fortune 500 companies are often not particularly well suited to license and develop the technology--rather, small start-up companies can be better suited to commercialize new and early stage technologies. This can be partially explained by examining the allocation and effectiveness of technology development funds within large and small companies. Large companies often have considerable funds available to scale-up a technology for manufacturing from the prototype stage--prior to the prototype stage, though, very little money is available to develop and prove the product concept, particularly when the product concept was not generated within the company. Small companies are more willing to "import" ideas and to use equity or venture capital to develop and prove the product concept, bridging the funding gap between concept and prototype. After bridging the gap small companies often develop partnerships with large companies to accelerate market penetration and obtain funds for scale-up. It should also be noted that a dollar spent by a small company for technology development usually accomplishes more than it would in a large company. This is explained below by the differences in passion.

About fifty percent of MIT's license agreements are with small companies, with fewer than 100 employees. Ten percent of the license agreements are with new companies, created around the technology and the remaining forty percent goes to large companies (typically Fortune 1000).

To provide further perspective of MIT's entrepreneurial tendencies I will share some data published by Venture Economics. Only twenty-three investments were made by major venture capital funds in 1988 for the purpose of beginning high tech and biotech companies in the twelve Northeast Atlantic States. Interestingly, eight of these twenty-three companies (and one-half of the funds invested) were MIT spin-offs through the Technology Licensing Office. This percentage suggests that other universities have not yet started to catalyze new company formation. The TLO helped create 40 companies in the last 4 years, cumulatively raising about \$70 million for these companies. We estimate that eight hundred to nine hundred new jobs have been created in Massachusetts by these spin-offs, one of the few bright spots in an otherwise dismal economy.

Recent MIT start-up companies include some of the largest new ventures in the Boston area, when measured by the amount of first-round financing. These companies include American

Superconductor Corp, funded at \$4.5 million, Immulogic Pharmaceutical Corp, funded at \$3.25 million, and Oculon Pharmaceutical, funded at \$5 million. MIT does not invest its funds--its role in the process is to evaluate the technology at MIT, translate the technology into a product concept, and then to locate private sector funds and management to support and develop the new companies.

To facilitate this new enterprise formation process (and licensing to existing companies), MIT shares the development risk with its licensees. If MIT charged a company acquiring the early stage technology a large up-front payment, the risk of failure is transferred completely to the new company. If a cash fee is deferred, if no fee is charged, or if the fee is taken as equity, without an initial license fee, the development risk is shared with the licensee. MIT typically requires an initial payment--technology is not licensed only for equity and/or royalties--but its up-front license fees are usually lower than it was when the office was managed by lawyers, and as compared with other licensing offices.

An additional reason for limiting the amount of the initial license fee (thus sharing in the risk and success of the start up company) is that by doing so, the probability that the company will succeed may be enhanced. For example, if a new company has \$2 million in venture funding, and pays \$1 million as an initial license payment, the likelihood that it will be able to develop the technology properly, and achieve its business goals has been reduced tremendously as it now only has a million dollars left to build the business. Success factors for new companies are important to consider because the licensor's reward is greatly impacted by the likelihood of success of the company. My view is that a licensor is better advised to devote time and effort increasing the probability of success of the licensee, rather than increasing the royalty rate. Stated differently, it is much more valuable to create a business with an eighty percent likelihood of success, and a two percent royalty rate, than to create a business with a twenty percent probability of success and an eight percent royalty rate.

IMPORTANT FACTORS FOR SUCCESS IN NEW COMPANY FORMATION

There are several important variables that impact the probability of success for any new start-up company. These variables include the quality of the technology (Q_t), the quality of the management team developing the technology (Q_m), and quality of the source of money or investors (Q_{inv}).

When starting a new company, the probability of success (P_s), is proportional to the product of the variables, and although I do not want this to be taken too seriously, could be expressed by the following formula:

$$P_s = Q_t \times Q_m \times Q_{inv}$$

The variables are ranked from zero to one, with one being the best score.

Quality of Technology (Q_t)

Technology receives a high rating if the invention has the potential to create a number of new products ("product pipeline"; has a strong patent or copyright position; and has considerable market potential.

An invention that has the capacity to create many products greatly diffuses the risk of technology failure in a new start-up company, and offers more opportunities for success. Genentech, Inc. is a good example of having a viable product pipeline--its gene splicing technology can be used to generate many different products, e.g., TPA and Insulin. There are exceptions to this rule, of

course. Lotus Development Company, for example, had only a single product, yet was extremely successful. I would argue, though, that Genentech has a higher probability of success in the long term. Perhaps the problems that Lotus Development Company experienced with Jazz and Symphony (subsequent products) stems from the fact that its a core technology did not provide a big advantage to designing these products

Another critical factor for success relates to the need for a strong patent position, which provides a wider window of opportunity for a company to develop and commercialize its products without direct competition. A strong patent position provides a monopoly to the patent holder, keeping other companies at bay from the protected technology. The Japanese sometimes address a patent that they wish to have access to by filing "picket fence" patents. In effect, the Japanese company will file patents that represent small incremental innovations around the core technology they wish to acquire. If the incremental innovations represent the preferred way in which the base technology may be used commercially, a barrier to the effective use of the technology is created. They are then in a position to force cross-licensing of patents to acquire the core technology. This can be prevented by careful planning and a broad patent estate--if you have 20 patents, with 20 claims each, it would be difficult for someone to work around the patent estate, or to patent all the incremental improvements. This greatly enhances leverage of the owner of the core technology in attracting partners rather than competitors.

The market potential of the technology is obviously important. A technology with a billion dollar business potential will have a higher probability of success than one with a million dollar market.

Quality of the Management (Qm)

The quality of the receiving management is crucial to the success of the venture. Management gets high quality ratings if it maintains a healthy balance sheet; has a clearly focused strategy; and is realistic about marketing. A healthy balance sheet is the best way to assure that the financial community will be interested in making additional investments at later stages in the company's development. Almost every rapidly growing company will require additional funds as it prepares to produce products, or in biotechnology or pharmaceutical products, begins clinical trials of its products.

A clear strategy is essential because of the fluid nature of a start-up company--numerous paths that appear interesting will be presented, and must be filtered through a well-conceived strategic plan. Management that fails to do this will expend enormous energies on suboptimal efforts.

Good managers must be realistic about the market for their products. Much effort should go into the analysis of the market with a clear understanding of why products will or will not be purchased, and a clear understanding of how competitive products will respond.

For example, when the transistor was invented, the vacuum tube manufacturers redoubled their R&D and marketing efforts. As a result, vacuum tubes shrunk to half their size, half the power consumption and half the price within 5 years from the invention of the transistor. In fact, they were doing a great job of protecting their market until Texas Instruments developed an application for the transistor where vacuum tubes could not be easily used, i.e., hearing aids. The hearing aid sales enabled transistor manufacturers to reduce the price/performance ratio of the transistor sufficiently to compete with the vacuum tube in other businesses. A good counter example is the thirty year-old competition between silicon and gallium arsenide. GaAs is much faster than Si and from a fundamental viewpoint should displace Si. However, innovation in Si has been just fast enough to keep a better price/performance ratio than GaAs in the broad markets, leading to the joke that GaAs was, is, and always will be the material of the future. By anticipating the reaction of the

competition, and positioning the new technology properly in the market place, good managers can successfully commercialize new technologies to the marketplace.

Quality of the Investor (Qv)

There are a number of factors that influence the quality of the investor: first, the track record in building successful businesses; second, the network of connections with potential partners or customers; third, the level of personal involvement the investor is willing to devote to the business; and fourth, their access to money and long-term vision.

There are several examples of venture capitalists who have funded dozens of new companies over the last ten to twenty years, with only two or three failures, where failure is defined as a company in which the original investor failed to break even or is unlikely to break even. Clearly, the involvement of an investor with such a strong track record raises the probability of success.

Similarly, the investor's network of connections and ability to influence strategic partners impacts the probability of success. A venture capitalist with high-level contacts in industry can make a substantial difference in developing partnerships where such association could reasonably enhance the likelihood of success of the new technology development process. For example, Kleiner Perkins has assisted numerous such partnerships for companies it funded. One such example is the partnership between Genentech and Eli Lilly to make human insulin which helped establish Genentech in the early 1980s as the premiere biotech start-up.

Access to additional funds can determine whether a start-up company fails or succeeds. Federal Express, for example, went through five rounds of venture investment before finally achieving stability and outgrowing the need for venture funding. A large number of rounds of venture capital is usually "painful" for the start-up and indicates that the long term fundamentals look good, but the short term results are disappointing. In the case of Federal Express, Rothschild Ventures took the lead in all five rounds--the fact that Rothschild had access to large amounts of money was therefore a major determinant of success. Otherwise Federal Express might have failed for the wrong reason -- lack of cash.

Passion for Success (Pa)

The passion of the various players is a key determinant of success. Worded differently, any new business will encounter hundreds of barriers before it succeeds. People with no passion will use the first barrier as an excuse for failure, while people with high passion will do whatever it takes to overcome the barriers.

The formula is now modified as follows:

$$P_s = P_{at} \times P_{am} \times P_{ainv}$$

where P_{at} is the passion of the technologists, P_{am} is the passion of the managers and P_{ainv} the passion of the investors. Note that in this overly harsh formula, any zeros guarantee failure while all one are read to guarantee success.

Should any of the three groups be indifferent about success, the future of the company will be greatly impacted. Some companies succeed despite low marks in one or more areas, but as competitive pressures increase, it becomes more important that the start-up company have dedicated personnel. People with high passion will achieve spectacular results, and do whatever is necessary to reach the goals. As a result, it is important to evaluate and modify, if possible, the

strength, determination and commitment (or "passion") of the technologists, the managers, and the investors.

There are many ways to kill passion, but greed takes first place. Greed in the form of equity distribution is probably the single largest barrier to creating companies. All players in a new company are trying to maximize their ownership. Often inventors feel they should own 100% of the company. These people push very hard for a stock price when they raise venture capital. This behavior typically drives them to raise money from secondary sources, (relatives, wealthy friends or unsophisticated investors). This lowers the quality of the investor (Qinv). Second, they are very stingy in incentive stock plans for their employees, which again attracts second rate players. Worse yet, in addition to getting second rate employees and investors, the passion of the employees and investors fades rapidly as they come to realize that the probability is small that they will make significant money from the overvalued stock they acquired. This means the employees will be unwilling to work long hard hours and the investors will not be willing to come forward when (not if) the company needs more money.

Greed can take many other forms. Within a large company there is no equity to be distributed, only credit for good performance. Managers that claim all the credit when anything good happens and dodge blame when problems arise are killing the passion of the employees under them.

Other killers of passion are destructive criticism. We have many groups dedicated to criticizing plans to prevent us from making mistakes. For example, the Food and Drug Administration is designed more to prevent a drug which does not perform to standards from reaching the general public than to facilitate getting new helpful drugs to market. Within companies committees and lawyers serve the watchdog function. These people serve an important function much like the brakes on your car, but often can have devastating effects on the early stages of any new business development. The psychology of these individuals is that they can only take credit for "preventing a negative event" rather than "facilitating a positive." Worded differently, they cannot get credit for the original idea, only finding its problems. A large dose of such criticism kills passion.

The Image of the Company (I)

The final complication to the formula is to add the image or credibility of the new business as a whole. Thus the formula is now:

$$Ps = PatQt \times PamQm \times PainvQinv \times I,$$

where I is the image. The image factor is the way the company is perceived by potential strategic partners, investors, customers, employees.... For example, a biotech company with a Nobel Laureate on its Board of Directors will have more credibility in presenting a joint venture plan to a large pharmaceutical company than a company with unknown scientists. Similarly, a computer company in partnership with IBM will have an easier time selling its next products than a company without such an endorsement. Also, a company deriving its technology from Stanford, Harvard, or MIT will have a higher image rating than technology from a lesser known university.

There are many examples of image influencing outcome. If a company has a high image, people will expect success and therefore want to invest, partner or work with the company, creating a success induced success syndrome. If a company or person has an adverse image, failure is expected (failure induced failure). Within one year of the introduction of Lotus 1-2-3, for example, other companies had developed competitive products, which based on their price/performance ratio should have eroded Lotus' lock on the business use of spreadsheets. Lotus, though, had built a superb image through its marketing campaign. This marketing effort was enormous compared to other software companies, and focused solely on business users.

Lotus' competitors were not able to overcome the momentum created by Lotus' marketing program. In fact, the image created by Lotus' marketing program was so strong that 1-2-3 became synonymous with spreadsheets. One venture capitalist, in 1985, defined the worst possible investment as a "1-2-3 clone."

Level of Investment

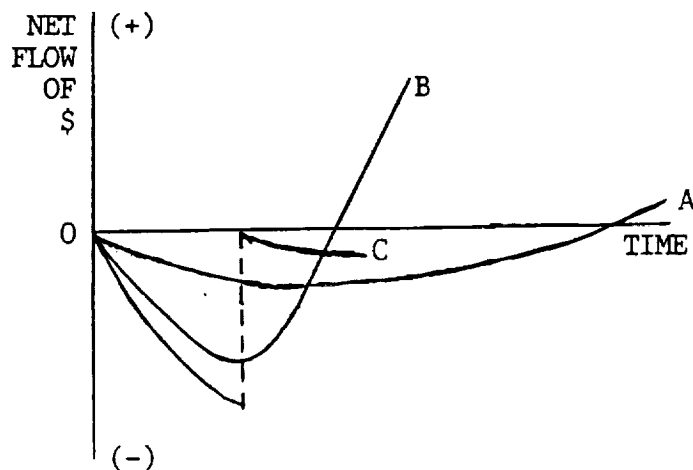
There are many different strategies for investing money in a new company. One end of the spectrum is typified by companies that adopt the minimalist approach. Namely, companies raise the minimum amount of money required to move the technology forward. Such companies may even try to "bootstrap" a start-up without raising capital. One benefit to this approach is that founders retain control and almost all ownership. Such companies are often attracted to and take advantage of the services, space and equipment made available by science parks and incubator facilities.

If money is raised, the investment is often too small to generate significant passion on the part of the investors. These minimalist companies are often not able to compete effectively, because technical and business developments move forward at a slow pace. Many of these companies also spend an inordinate amount of senior management time and effort in raising small amounts of capital needed to keep the company alive. This effort could have been devoted to developing the business had more funds been raised initially.

The other end of the spectrum (e.g., excessive initial capital) is often worse than the minimalist approach. The managers of these companies often lose the value of money typically pay high salaries and build lavish offices, and spend their weekends on their boats even when critical deadlines are imminent. I refer to this behavior as the "Taj Mahal syndrome." After spending large sums of money, these companies often frustrate investors by failing to show significant results. This frustration often leads the investors to cut off future investments and thus kill the company.

Somewhere between these two strategies is the optimal approach. Namely, sufficient resources are available for the company to develop its technology rapidly, but not so much that the managers lose the value of money.

The following chart demonstrates these three scenarios. It is interesting to note that passion in the optimal curve increases over time, while the minimalist companies tend to lose passion. The reason is that the employees and investors see the company moving toward a public offering while the employees in the minimalist companies see little hope for sale of their stock. Venture capitalists call such companies the "living dead."



Licensing to Larger Companies

Many factors discussed above relate directly to the creation of new businesses or product lines within existing companies. Using the formula from above, Q_t and Q_m have the same meaning. The Q_{inv} term, though, refers to the Quality of the Sponsor within the company. Most internal operations within a large organization generally require someone at a high level, a sponsor or champion, to provide funds and guidance for the new venture.

The sponsor's role is analogous to the venture investor's role. Similar to the venture investor, the sponsor must have experience building businesses, and a strong network of connections, especially within the company. These connections are important to avoid political pressures within an organization that would discourage innovation and entrepreneurial behavior. Also, large companies often have internal markets or access to external markets that are valuable to the new business unit. The sponsor plays a key role in arranging for access to these internal opportunities. Unlike the venture investor, a sponsor must also be skilled at the internal politics of the organization.

Large companies have numerous advantages over start-up companies in developing new businesses. The advantages include access to markets, both internal and external, and greater access to resources than a start-up. The disadvantages include a reward structure that is not as conducive to the creation of passion, and a greater need for communication--this tends to make decisions more deliberate and cumbersome.

The requirement for passion is greatest when the idea is extremely embryonic and opens new markets. In these cases a new start-up might have a greater probability of success over an existing company. If the technology is closer to an end product (eg. within 2 years), and if the product(s) are readily marketed by existing companies, the licensor might do better by licensing the technology to an existing company. In these later cases, the challenge is to generate passion within the large company and overcome company inertia that resists change and externally generated ideas.

Many large companies focus on short term performance (eg next quarter's earnings). This strategy is encouraged by the stock market which weighs quarterly results as more important than long term potential. It also drives management to behave along the minimalist curve (curve "A" in figure 1). In other words, a manager is not rewarded for investing in long term profit potential ("B" curve in figure 1); instead, if costs are reduced to the minimalist curve ("A"), the company's profit improves in the short term. I refer to such behavior as the "MBA Syndrome." Such managers can during a short period show increased profits and often get promoted or hired away before the long term disaster occurs. The irony is that if promoted, the manager has the opportunity and incentive to destroy a bigger piece of the company. The MBA Syndrome occurs in large U.S. companies for two reasons: 1) average U.S. job tenure is short (e.g. 3 years); and 2) the investors are speculators who care only about short term performance.

There are, fortunately, large companies that avoid this syndrome. Companies with large blocks of shares owned by one family are willing to invest for the long term. Family owned companies invest along the "B" curve because the family has no intention of selling its stock, instead, they plan to pass their shares on to their heirs. A number of publicly traded companies, such as Motorola, Corning and Ethyl have large blocks of shares held by a single family. Companies with family ownership of 10 percent or more of the outstanding shares which were also publically traded nearly doubled the performance of the Standard&Poors 500 companies over a four year

period (1984 - 1988), according to a study by Mark Cunningham of Alliance Capital . These somewhat incredible results are explained by the long term investment strategy of the owners. However, Cunningham's study becomes even more fantastic when the selection criteria includes active involvement of the family in managing the company. Cunningham has found that such selected family companies outperformed the S&P 500 by three and a half times during 1984-1988 and tenfold during the period 1968 to 1988.

Rewards to the Licensor

If the technology develops as expected, the university or licensor should expect a return equal to the royalty rate times the technology's realistic market potential times the probability of success.

However, there are several complications that will impact the licensor's rewards. For example, a poorly written license agreement could eliminate the licensor's rewards. One advantage in this regard is that universities can trade heavily on "good will." Companies will hesitate before alienating the university because the possibility of obtaining rights to future inventions may be jeopardized.

A significant factor limiting rewards to the university licensor is the level of hostility generated in negotiations. If the licensing company has grown to dislike the licensor because negotiations were one-sided, the licensee will view the royalty payments as a tax that should be avoided in any way possible. Energies will be expended, often subconsciously, to design around the patent or the agreement.

It is thus critical that the parties structure a well balanced agreement. The agreement is best written to provide for similarities between the winning scenarios for the licensee and licensor. In the case of a start-up, this creates strong incentive for the licensor to take equity in partial payment of the license. If the up-front payment has an equity component, the equity payment is not resented by the licensee as it does not remove resources from the technology and business. Also, subsequent design changes which may work around the patents do not impact the value of the equity, allowing the licensor a win in even the worst case.

Other Success Factors

Success factors for licenses are influenced by many factors other than those expressed above. For example, the quality of an invention is influenced by the industry which will use the invention. One could almost envision a parameter called "industry", ranked from zero to one, which describes the "adoptability" of patents in that industry. Certain industries, such as utilities or the automotive industry, are often not as receptive to externally generated technologies as other industries. If the technology has not been proven and established for many years, few people in these industries wish to take the risk of developing the invention. Other industries, such as the computer industry, have reduced the importance of inventions by extensive cross-licensing of patents. For many computer companies, the freedom to pursue a business strategy is a more dominant concern than using a patent to protect a monopoly. Also, the computer industry can more readily design around patents than most other industries.

Other industries, such as biotechnology and pharmaceuticals, where patents are more highly valued, are more difficult to design around.

The formula above could also be modified to reflect cultural differences. For example, both Japanese and European cultures tend to be more accepting of importing new technologies into large

firms, whereas in the US it is the small companies that are most supportive of importing new technologies.

Lastly, the role and significance of timing is crucial. For example, X-ray lithography has finally emerged as a commercially viable technology, just as MIT's fundamental patents are beginning to expire. The importance of timing is difficult to assess. It plays a key role in the development of markets for new technologies, and therefore a factor in assessing the quality of the invention.

SUMMARY

Start-up companies and technology transfer to existing companies will continue to play a major role in economic development. The positive impact from new business creation can be increased by targeting appropriate technologies; finding strong managers and quality investors or sponsors; enhancing the image or credibility of the business; and finally, encouraging passionate behavior by the key players toward the success of the new business. These qualities, coupled with a well written, balanced agreement and good will on the part of both the licensee and licensor will greatly enhance the likelihood for success of the venture and rewards to the licensor.