From:

Intellectual Property Rights

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Report of the APO Symposium on Intellectual Property Rights 11–14 November 2003, Bangkok, Thailand

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Contents

Foreword

Intellectual property rights (IPRs) are crucial from the perspectives of attaining productivity and competitiveness, which forms the core mission of the APO. Today it may not be an overstatement to argue that whether business corporations survive or perish depends on their intellectual property, or more broadly, knowledge assets. It is therefore important to promote the creation of new technologies and services, protect the rights of the original owners, and encourage people to utilize them fully. In many developing countries, however, the concept of IPRs is not well understood, and further the mechanisms of registration and marketing are still weak. Some of the problems involved in IPRs include the filing of patent applications on R&D results, negotiations for licensing agreements, treatment of exclusive or nonexclusive licensing, justification of the costs involved, and real contributions from both benefactors and beneficiaries for commercialization. R&D is a high-cost investment. The result of R&D is IPRs, which unless successfully exploited, will not achieve economic returns. It is important to establish the machinery for IPRs and educate researchers who are the sources of creativity and innovation. Furthermore, it is crucial to protect IPRs as this is indispensable to a country's competitiveness in global markets. The role of government is also important, since it should provide the infrastructure, platform, and environment for the creation, protection, and exploitation of intellectual property.

Keeping the above background in view, a symposium was organized in Bangkok, Thailand, from 11 to 14 November 2003. The current publication in the form of an e-book is a compilation of selected papers presented by distinguished speakers. It is our sincere hope that readers will gain new insights from this publication on how IPRs should be created, protected, and best utilized for higher productivity and competitiveness.

Takashi Tajima
Secretary-General

Tokyo
May 2004

Symposium Report

BACKGROUND

Intellectual property rights (IPRs) have now become a crucial issue from the perspective of achieving productivity and competitiveness, which forms the core mission of the APO. It may not be an overstatement to argue that whether business corporations can survive or perish depends on their intellectual property, or more broadly, knowledge assets. It is therefore important for all stakeholders including government and industry to make all-out efforts to create, protect, and utilize intellectual property. Among others, the rights of the original owners of intellectual property should be protected since their infringement has become very costly. In 1991, Kodak paid almost US$1 billion to Polaroid due to patent infringement. In 1996 and 1999, Texas Instruments settled patent disputes with Samsung Electronics and Hyundai Electronics with the payment of US$1 billion each by the latter two firms. There are a number of similar cases but these few suffice to emphasize the importance of IPRs in business.

Mr. Fujio Mitarai, President and CEO of Canon Inc., has recently referred to the importance of IPRs in a newspaper article. Canon is one of the leading business corporations in the global market in cameras and laser printers. As it deals with the most advanced technologies, the creation, protection, and utilization of intellectual property have a crucial bearing on corporate growth. Canon, together with Hitachi, Matsushita, and other electronic makers, has been aggressive in promoting and licensing its intellectual property not only from the viewpoint of protecting its R&D achievements but also to raise income from royalties. Canon earned 20 billion yen or US$180 million in patent royalty income during 2000. Mr. Mitarai noted that a huge investment was required from the stage of concept generation to the stage of product commercialization. In the case of Canon, R&D investment for a single product could exceed 100 billion yen, or US$900 million. That investment cannot be recovered if a copied product appears on the market. The firm registers the rights to original development to prevent the appearance of copycat products. To compete with China or Vietnam, which can offer lower-cost labor, Japanese business corporations have no choice but to manufacture high valued-added products. Such high value addition should be protected through IPRs. It is often said that Japanese university professors put considerable energy into writing theoretical papers on new technological developments, but pay hardly attention to acquiring patents based on them. They may argue that academic research is not meant to earn money, but business corporations are seeking basic R&D as this is an area they find it difficult to undertake but universities can deal with. The number of patents Canon acquired in the USA last year was second only to that of IBM. Most are applied patents leading directly to profit generation. To make the long, painful process in the "Valley of Death," sustainable, university involvement is desirable to generate new ideas for commercialization. As this is a risky process, government should support those toiling through the Valley of Death. Just before crossing the valley, i.e., before commercialization of R&D outputs, tripartite linkages should be formed among the government,

academia, and industry under the leadership of industry. This is the most ideal pattern for commercializing R&D outputs into new products.

The Japanese government has established an intellectual property strategic center and enacted a basic law on intellectual property. There are numerous issues involved. First, in Japan it takes a few years to screen patent applications. In light of the shortened product life cycle today, this should be cut to within one year. Second, it is necessary to work out a global rule on the acquisition and protection of IPRs. If a patent must be applied for in all countries, it would require huge funds. If a patent acquired in one country can be applied across national borders, the time and money thus saved can be diverted to R&D investments. Excessive protection may adversely affect free competition as it could give too much protection to a business corporation that acquired a specific patent. If a clash with the public interest is likely to occur in such fields as drugs for the treatment of AIDS, separate measures will be required for the benefit of developing countries. Japan should design an economic strategy at the national level to cope with megacompetition. The protection of IPRs is one of the answers to this challenge.

Mr. Mitarai's arguments on the importance of IPRs in business are convincing, as he believes that the protection of IPRs serves as an incentive for innovation, which in turn offers a dynamic stimulus to economic development. Either as users or as creators, a number of APO member countries have paid considerable attention to IPRs. In light of the emerging interest in IPRs in member countries, the APO organized a Symposium on Intellectual Property Rights in Bangkok, Thailand, from 11 to 14 November 2003. The findings as well as the conclusions and recommendations derived from presentations and discussions are given below.

FINDINGS

The awareness and perceived benefits of IPRs as a tool for business strategy are lacking in, among others, small and medium enterprises (SMEs) that feel that IPRs are not relevant to their business. It is therefore suggested that public agencies undertake promotional and advisory campaigns and seminars to spread the "intellectual property literacy" and nurture an "intellectual property culture" among them. Such activities should emphasize that legal IPRs can be protected in any field. Technology licensing offices (TLOs) located in local cities should initiate actions as they, in cooperation with local universities, often play an important role in helping SMEs to develop new technologies based upon IPRs possessed by TLOs. Stanford University in the USA offers an illuminating case explaining the linkages between a TLO and intellectual property. It earned as little as US$5,000 in patent fees during a 15-year period in the 1960s and 1970s. After it established its TLO in the 1980s, its patent revenue increased rapidly and reached US$44 million in 1996, when it was the top earner among US universities.

In Japan, the cluster concept has been promoted to form local networks of universities and local firms in an attempt to create new industries and businesses in leading-edge fields. TLOs already in operation are expected to play an important role in promoting this concept. Thirty-two national projects have been launched. For example,

the biomedical cluster has attracted a great deal of attention for its integration of biotech-oriented venture firms, where a national university is playing a leading role.

Several Japanese university professors have argued that R&D outcomes should be open to the public free of charge and they are not in favor of acquiring patent applications. Basically, however, it is recommended that university professors apply for patents so that firms cannot produce copycat products. This will also contribute to strengthening competitiveness in global markets. The "ubiquitous" concept was proposed by Prof. Ken Sakamura of the University of Tokyo. He made all computer programs he developed open to the public under this concept, including a number of leading firms. The high-efficiency engine system of automobiles produced by Toyota Motors was developed based upon the ubiquitous concept.

Little effort has been directed toward valuing intellectual property as a tangible asset of an enterprise. A survey showed that a majority of UK firms do not undertake a formal evaluation of their intellectual assets. Of 226 Fortune 500 companies surveyed in the USA, 76% had not assigned any value to their intellectual capital. Yet it was estimated that the intangible assets of publicly listed US firms (excluding financial institutions) totaled as much as 69% of their total value in 1998. While not all intellectual capital requires patent registration, it is difficult to sell, license, or transfer technology without IPR protection.

The assessment of the value of patents and therefore that of damages for patent infringement vary from one country to another. The fundamental differences point to the institutional philosophies of the corporate and legal systems. While in the USA the courts are prepared to allow the payment of huge amounts of compensation for patent infringement, in Japan many business corporations still think that they should earn profits by offering better goods and services to consumers but that they should not do so by licensing the results of R&D as this would mean a market monopoly. Which view is better or sounder depends on the socio-economic perspectives of stakeholders. Suffice it to add that many Japanese corporations are aggressive in commercializing their intellectual property such as Canon, Hitachi, NEC, and Matsushita.

IPR strategies adopted by SMEs are different from those of large firms. Patent applications are not only expensive to formulate and file but also costly to maintain, with the fee increasing over the years. In general, large firms are prepared to file patents on most inventions both as a preemptive means for product and market dominance as well as for potential cross-licensing with their competitors. However, many SMEs do not engage in intellectual property development due to a lack of awareness, financial and manpower resources, support from large or multinational corporations, and public infrastructure. The rising tide of globalization has forced SMEs to market abroad but this also means higher costs for patent protection in new markets.

A university has three missions: education, research, and creation of new industries. To create new industries, it is indispensable to create new technologies based upon new concepts and ideas. This mission is the most relevant for universities to undertake, as students take it for granted that they can develop new concepts and ideas based upon academic theories and principles. This is where linkages between industry and academy are called for. Put differently, it is necessary to link basic R&D undertaken by universities with corporate efforts to commercialize an R&D outcome. In Japan,

university performance in terms of the number of patents generated and license royalties received will also be taken into account when the government determines its R&D budget allocation. In this connection, a culture of creativity and innovation needs to be inculcated at an early age in schools and tertiary institutes. This can be achieved by infusing an adequate amount of original thinking and independence in the school curriculum.

It is not easy for university professors to manage a business concern while holding a university position. In light of the current shorter product life cycle, venture businesses will lose their competitive edge in markets if they cling to a single technology. They can receive financial support to launch new businesses but neither further support needed for growth is assured nor are rescue measures in the case of failure in place. Clearly there is a host of problems and issues that must be examined to determine how the unique advantages of universities can be harnessed to create new technologies and commercialize them.

The progressive mass customization of products and services and the sharp reduction in life cycles require business corporations to become more agile and responsive to the growing significance of intangible business assets such as intellectual property. Large corporations that possess abundant resources can relatively easily cope with these trends, but it is important to promote an intellectual property culture in SMEs based upon the "three Cs" of competence, capital, and connectivity. Competence should be developed not only by enhancing IPR awareness but also by providing practical knowledge on intellectual property. Capital is required for securing and maintaining IPRs, and further tax incentives should be given for IPR-related costs. Connectivity should be strengthened through advisory services by large firms, R&D institutes, and public IPR offices.

The auditing of IPRs is an important subject as a firm accumulates more patents. The purpose of auditing is to examine whether the patent portfolio covers the firm's core technology and best interests. This exercise may lead to streamlining its R&D focus. Another purpose is to evaluate whether licensing in, licensing out, or relinquishment would help the firm to pursue its strategic objectives. This exercise is helpful not only in increasing intellectual property-based earnings but also in savings on IPR-related maintenance costs.

The Young Report published in 1985 marked an important milestone in devising national strategies for the US economic recovery. One unique feature of this report was that it linked national competitiveness with IPRs. It referred to the importance of IPRs to the US economy and the need to protect US-owned IPRs in the domestic and international markets and recommended a number of action programs to strengthen IPRs in the technological age. The WTO agreement on the Trade-Related Aspects of Intellectual Property Rights (TRIPS), which went into effect in 1995, was a monumental result of the Young Report for the protection of intellectual property.

Following the IPR policy announced in July 2002 and the Basic Law on Intellectual Property enacted in March 2003, the Japanese government devised a strategic program for the creation, protection, and exploitation of intellectual property. In terms of protection, it referred to measures to prevent counterfeiting and piracy, which have been increasing over the years. In the area of business software piracy, the decreasing trend

seen until 1999 was reversed in 2002, while the countries and regions in which counterfeited Japanese products are manufactured and distributed have been expanding. IT allows quick, easy access to new technologies and information. It is necessary to protect patent rights both domestically and internationally through the establishment of a proactive enforcement network between the public and private sectors to make the fight against counterfeiting and piracy effective.

In the era of patent "explosion," the number of patent applications has increased at an accelerating pace worldwide. As a result, patent offices in the USA, Europe, Japan, and many Asian countries have faced acute problems in coping with the backlog. All countries have adopted measures to reduce the approval time, and the Japan Patent Office decided to increase the number of examiners radically in spite of the government's basic policy of decreasing the number of government officials.

CONCLUSIONS AND RECOMMENDATIONS

R&D expenditure for universities and research institutes is usually sizeable compared with the national expenditure on R&D. Every effort should be made to bring the investment to fruition with respect to the commercialization of R&D results. One measure is to ensure that the public research is "user inspired" to meet and satisfy the felt needs of customers. Attempts should also be made to spin off companies from public research organizations as high-tech start-ups. Entrepreneurship can be promoted through the use of successful role models and recognition through awards and rewards.

Intellectual property has a multifaceted, intricate nature that presents particular problems to SMEs that may lack the relevant training and education. One solution is to set up an intellectual property academy with its curriculum tailored to the needs of SMEs including abundant practical cases. The other is the training of patent agents who are well versed in SME-specific issues and problems in R&D. For example, the Intellectual Property Academy was set up in Singapore to develop professional experts on IPRs.

The lack of qualified promoters is also a challenging issue in Japan. It is not easy to identify persons who possess knowledge of and experience in technology, patent laws, and business management. The lack of promoters is a major hindering factor in the development of TLOs, industrial clusters, and venture businesses. In this context, it is timely that a number of Japanese universities have established a new curriculum dealing with the management of technology.

In light of the increasing number of legal disputes over IPRs, it is important to train and develop specialists who have knowledge of both intellectual property-related laws and technology. As it is not realistic to expect judges and lawyers to acquire knowledge of advanced and sophisticated technologies, it is best if such specialists could play a role by helping them make a proper assessment of the value of technologies.

A country's industrial competitiveness should be strengthened by the development of a knowledge creation cycle. It starts with the creation of new technologies and products by universities and industries. The outcome should be protected and commercialized. Profits thus generated are utilized for future creative activities. It is crucial to rotate this cycle as rapidly and dynamically as possible. In the past in Japan, for example, it took nine years to protect newly developed technologies. Obviously this

slow action discouraged entrepreneurs from generating new venture businesses. It is also necessary to provide funds for new R&D activities. To give momentum to the cycle of creation-protection-utilization, it is now required not only to develop human resources but also to promote content businesses. Overall, these five factors will play a central role in strengthening industrial competitiveness.

During the R&D process, extra attention should be paid to the laboratory logbooks that serve as the legal record of events leading to a patentable invention as they contain evidence related to the priority of patent claims. In writing up the logbooks very detailed formalities should be strictly observed on what to write and how to write it as a legal document.

The expertise of knowledge-based firms is to create new technologies, products, and services for which IPRs are registered as intangible assets. When they approach financial institutions for loans to expand their businesses, they usually face difficulties in light of the nature of those assets. As there is a lack of sophisticated techniques for assessing IPRs, financial institutions are not willing to accept lPRs as loan collateral. They argue that the valuation of IPRs, no matter how sophisticated the valuation models are, is after all subjective and does not guarantee future cash flows since the value of IPRs could fluctuate. This is where equity funding from venture capitalists comes into play. They spend more time in assessing IPRs and are more willing to follow a high-risk, high-return investment policy based upon the future potential of firms in which they invest.

Measures to Promote Technology Transfer through Tripartite Linkages

Dr. Kunio Yoshida
Professor Emeritus
University of Tokyo
Japan

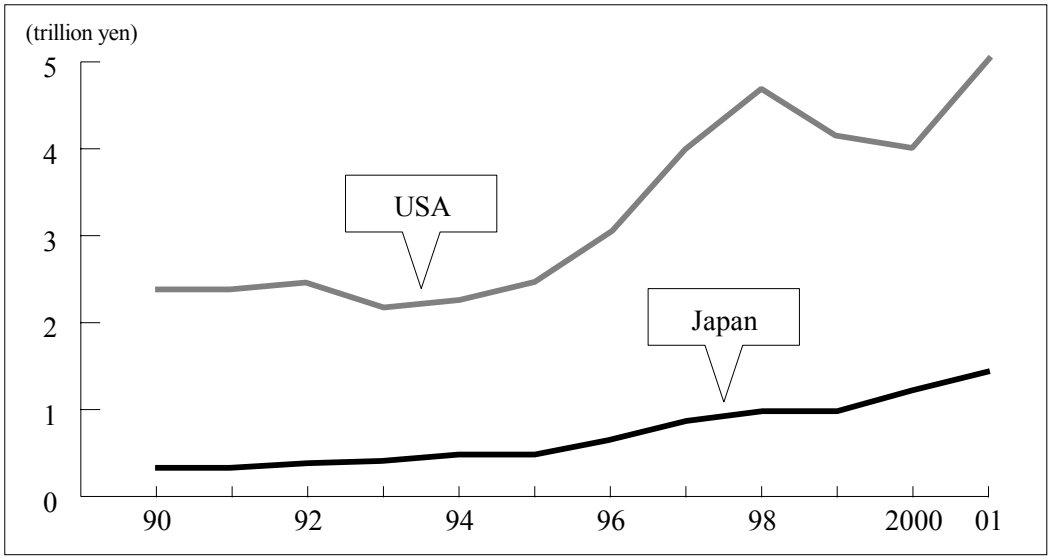
INTRODUCTION

Japan achieved a miraculous recovery and a high rate of economic growth after the Second World War in the area of producing goods such as electronic products, precision machinery and instruments, and automobiles. Yet the newly industrializing Asian economies, including China, the Republic of Korea, and the Republic of China, have accelerated their pace of development and caught up with Japan. Even in such high-tech products as DVD players, Japan's market share has been gradually encroached upon. Japan is a high-cost country epitomized by high labor costs that are allegedly as much as 20-fold, or even more, higher than those in China. It is therefore indispensable for Japan not only to develop creative technologies and products but also to generate innovative production technologies to regain its competitive edge. What is needed therefore is to make Japan a knowledge-driven engine of economic activity.

In the 1980s, the USA was suffering from the dramatic inroads made by Japanese automobiles and home appliances in its home market, but achieved great success thereafter with its powerful pro-patent policy. The Young Report in 1985 had considerable influence on that policy. It pointed out that "the role of government is not to help companies but to provide infrastructure for them to become competitive." In this spirit, the report laid emphasis on: 1) tax reform; 2) educational reform; 3) the promotion of basic research through government funding; and, more importantly, 4) the need to focus on intellectual property. The report made it clear that the US private sector had a lower R&D/GDP ratio than that in Japan and Germany and that the number of patents acquired by US inventors was decreasing.

The Young Report generated dramatic results. The number of patent applications in the USA, which was about 70,000 in 1985, rose sharply to double that number in 1994. Similarly, the surplus in US technology trading, which stood at US$5.5 billion in 1985, increased to a staggering US$16.8 billion in 1994.

Inspired by the US policy as a model, the Japanese government established the Strategic Council on Intellectual Property headed by the Prime Minister in March 2002. In July of the same year, the Intellectual Property Policy Outline was designed. In line with these actions, the ground was laid for the supporting legal systems and infrastructure. Since then, full-scale activities have been launched to achieve nation building based on intellectual property. Intellectual property covers patent rights, utility model rights, design rights, trademark rights, and copyrights. Figure 1 compares the royalty incomes from intellectual property received by the US and Japan across national borders.



Source: Ministry of Trade and Science.

Figure 1. Royalties received from intellectual property trade.

PRESENT STATUS OF JAPANESE UNIVERSITIES

Following the establishment of the Science and Technology Basic Plan in 1996, the budget allocated to science and technology has continued to increase on a dramatic scale. During the 10-year period up to 2005, this budget is expected to reach as much as 20 trillion yen (Figure 2.) Figure 3 shows how the budget was allocated to eight major science and technology areas in fiscal 2003. Roughly one-third of the entire science and technology-related budget was allocated to universities. By area, life sciences received roughly one-third, followed by energy, especially nuclear energy, and space and marine frontier research.

Figure 4 is an international comparison of R&D expenditures. The figures include not only natural sciences but also social sciences and humanities. Figure 5 illustrates R&D expenditure in relation to GDP for selected countries. Japan ranks first in the world in terms of its research fund/GDP ratio. Figure 6 is an international comparison of the numbers of researchers. In Japan, 27% of researchers are working in universities while 68% are in the private sector (Figure 7). In the USA, however, 11% are in universities and 85% in the private sector.

Japan's number of researchers and R&D expenditure are both very high, second only to those in the USA. Yet, the benefits derived are not as visible as desired in terms of GDP per capita. Although R&D activities in Japan have become more dynamic since the 1980s, they have not made sufficient contributions to national economic prosperity (Figure 8).

Japanese universities have traditionally focused on the publication of research papers and tended to pay less attention to patent acquisition. This is partly because the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has allocated

almost no budget to cover the cost of patent application. Figure 9 shows the number of patent applications by Japanese universities over a five-year period. While the number has increased, it still remains extremely low compared with the total number of patent applications in Japan. Table 1 compares the number of patent acquisitions between Japanese and US universities. Under the pro-patent policy, US university professors have made aggressive bids to acquire patents in such fields as biotechnology, and the number of US patents in Japan far outstrips the corresponding number of Japanese patents in the USA.

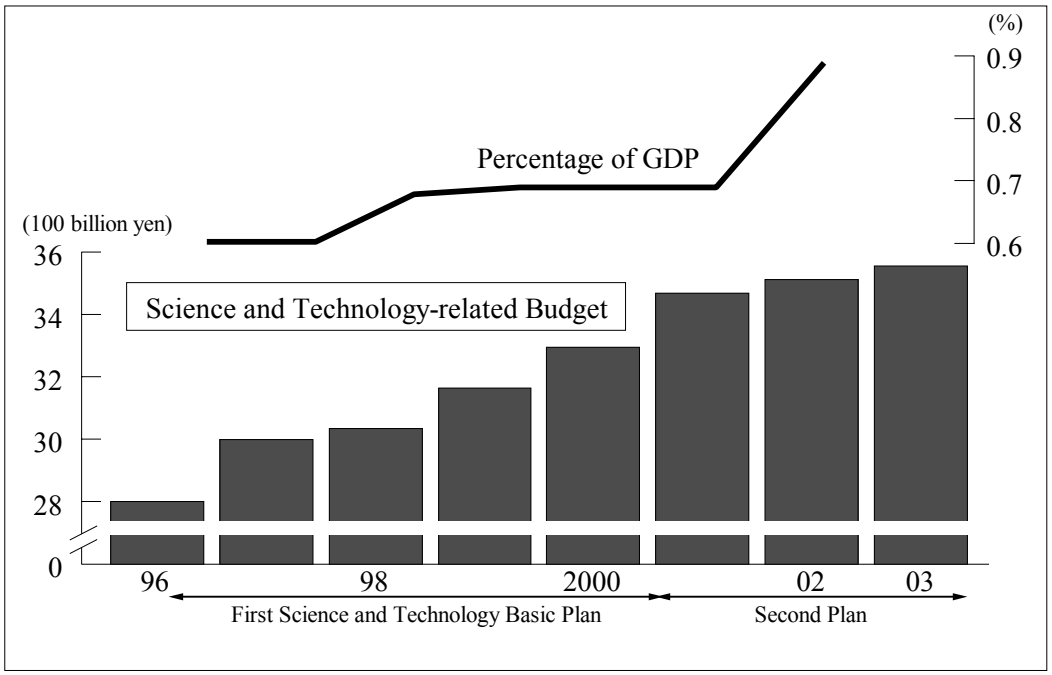


Figure 2. Japan's science and technology-related budget as a percentage of GDP.

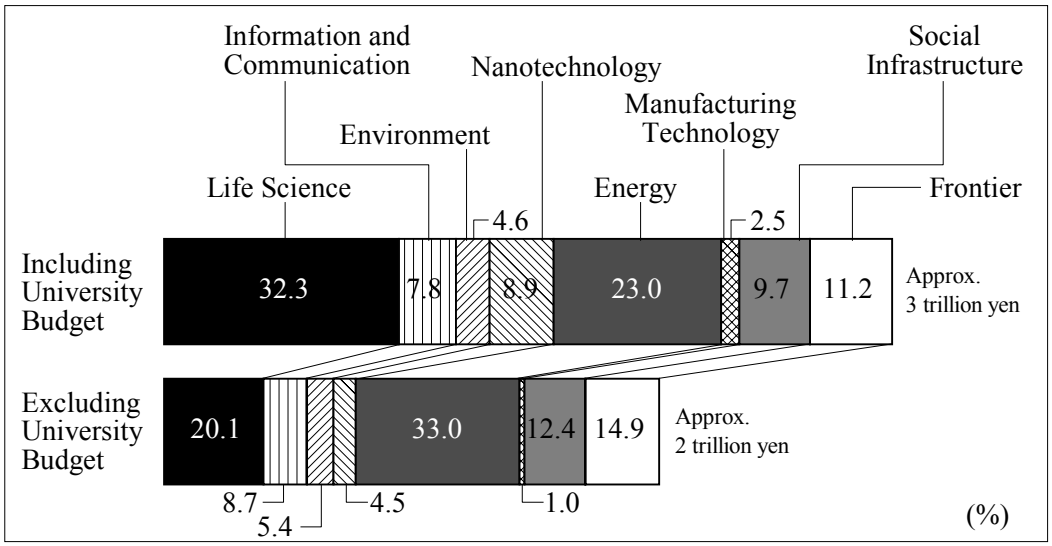
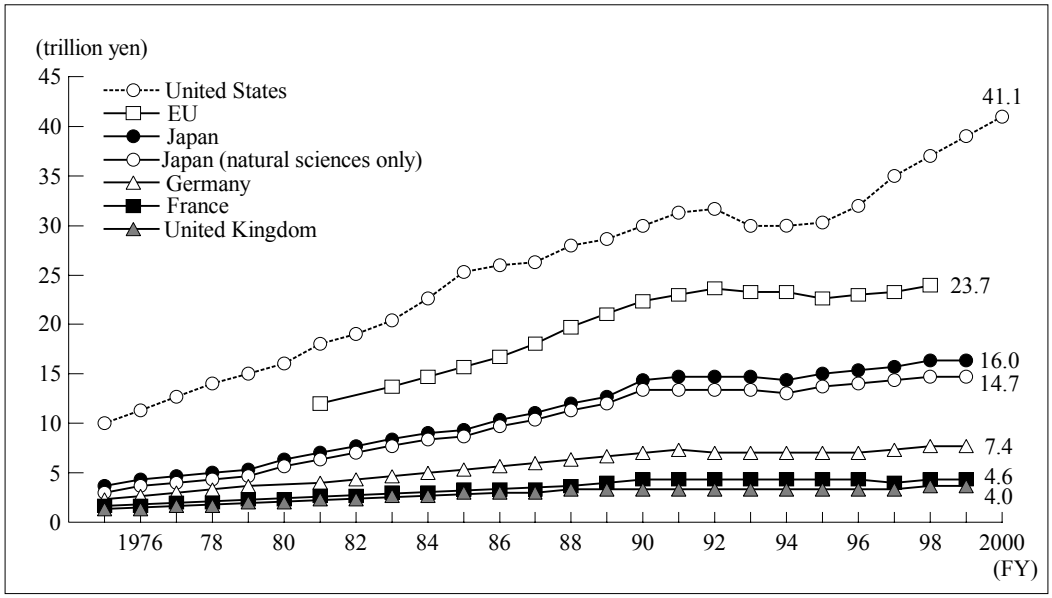
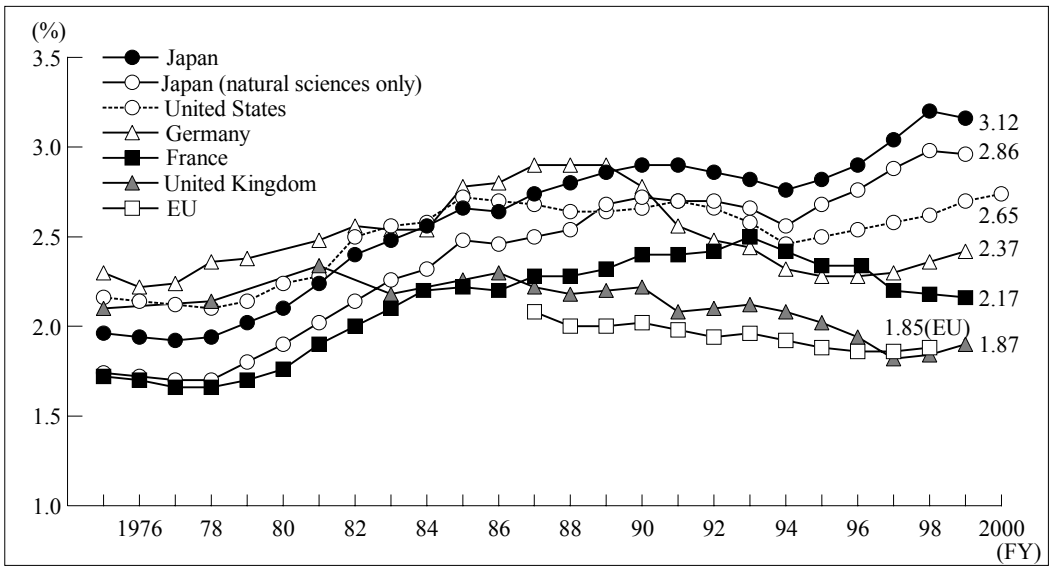


Figure 3. Budgetary allocation for science and technology in eight major areas (2003).



Note: For comparison, statistics for all countries include research in social sciences and humanities. The figure for Japan shows also the amount for natural sciences only.

Figure 4. Trends in R&D expenditures of selected countries—OECD purchasing power parity



Note: For comparison, statistics for all countries include research in social sciences and humanities. The figure for Japan shows also the amount for natural sciences only.

Figure 5. R&D expenditures as a percentage of GDP in selected countries.

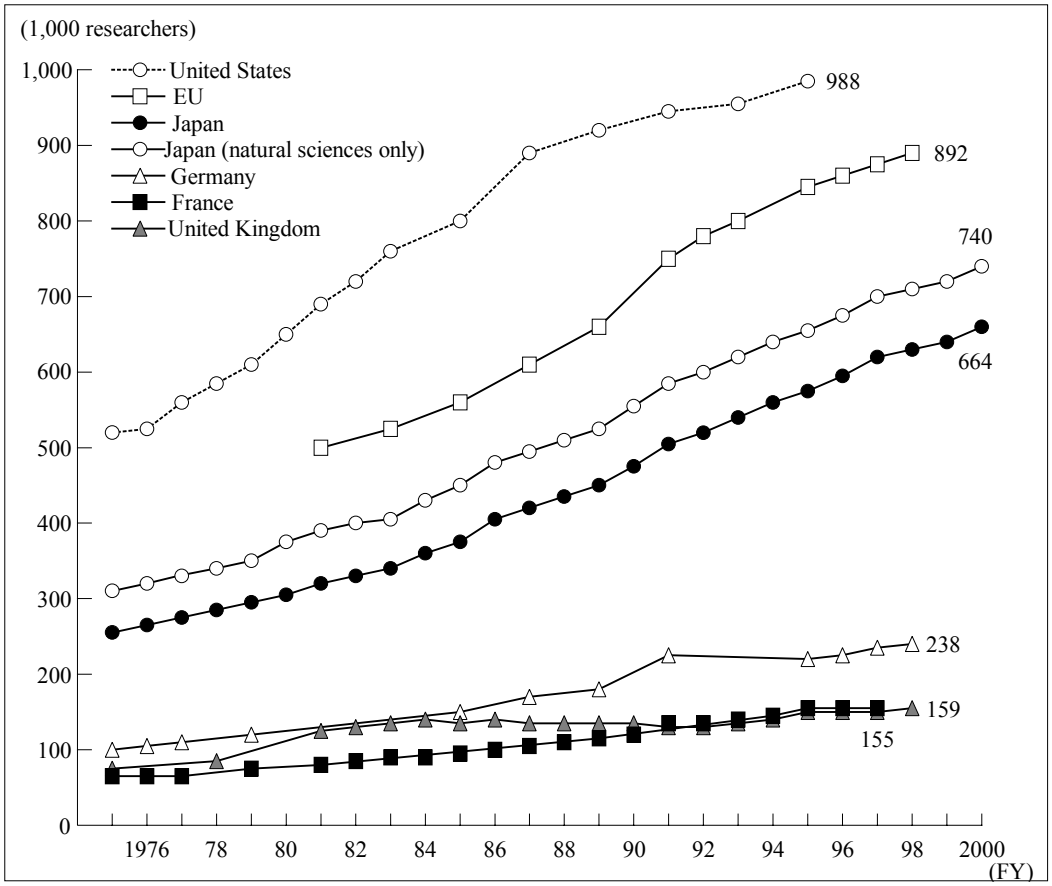


Figure 6. Trends in number of researchers in selected countries.

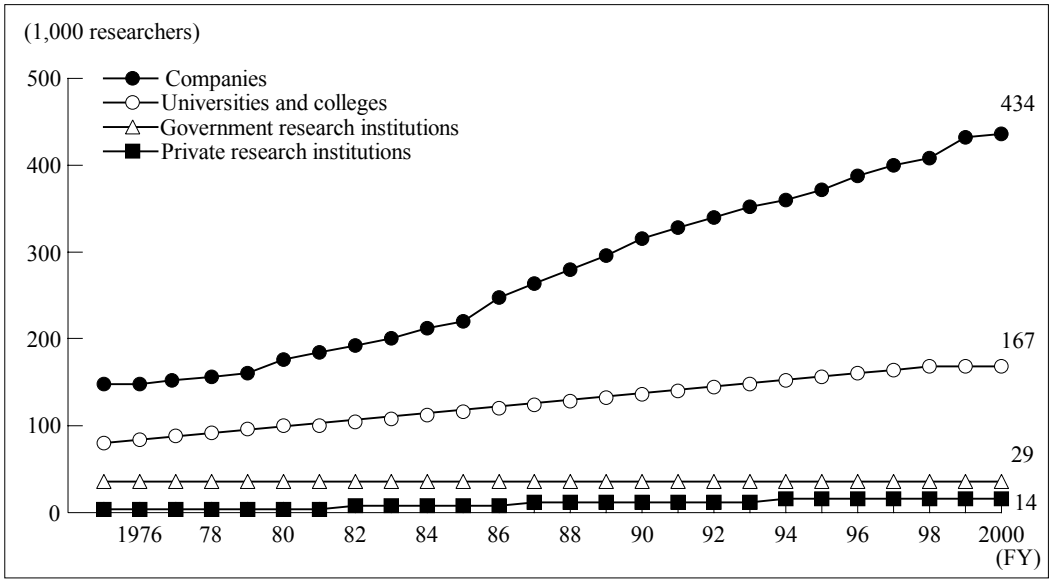


Figure 7. Trends in number of researchers by sector in Japan.

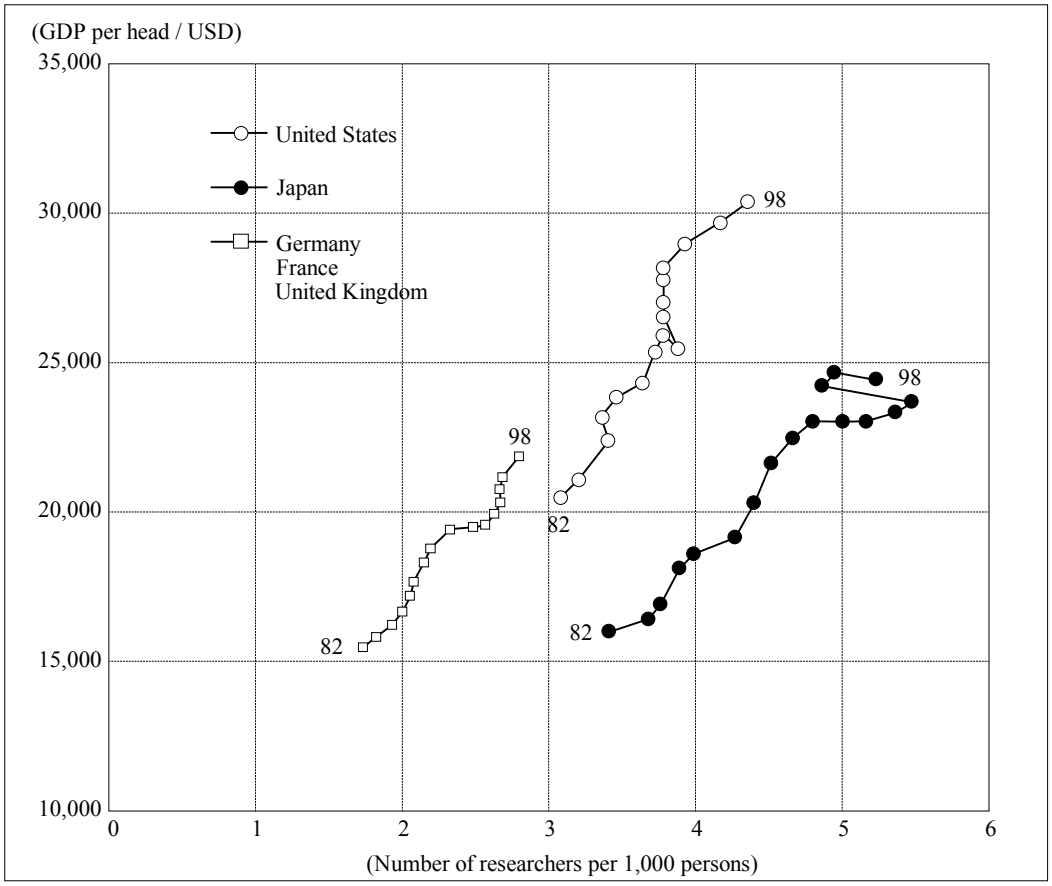


Figure 8. Relationship between the number of researchers and GDP.

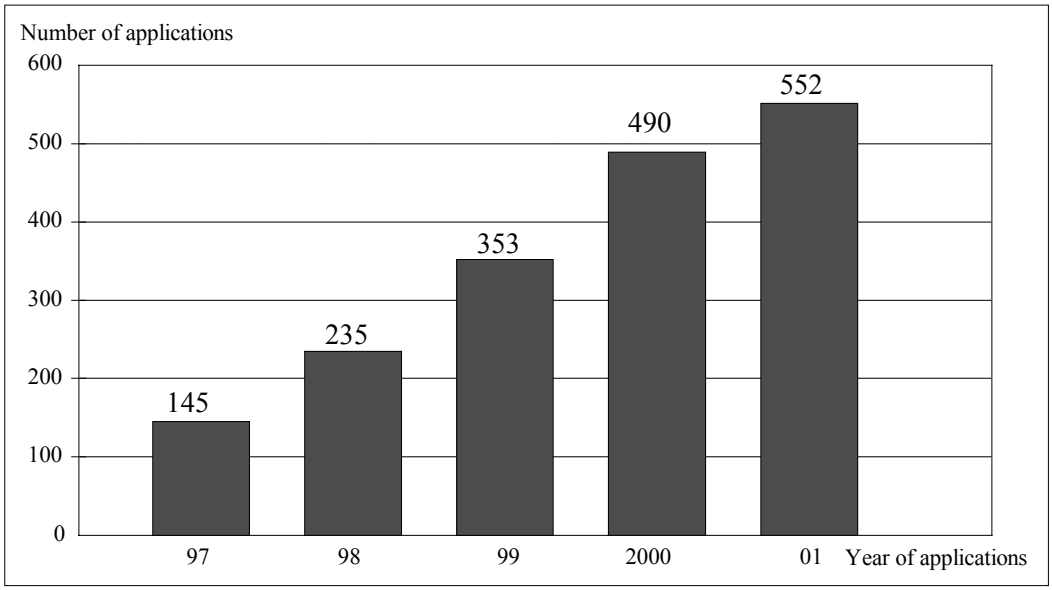


Figure 9. Number of patent applications by Japanese universities.

Table 1. Number of patents acquired: Comparison between Japan and USA.

	USA	Japan
1985	589	
1986	670	
1987	820	
1988	814	
1989	1,228	
1990	1,184	
1991	1,340	
1992	1,542	
1993	1,620	
1994	1,780	
1995	1,879	
1996	2,155	
1997	2,436	90
1998	3,151	68
1999		119
2000		161
2001		103

Source: Patent Office, Patent Administration Annual Report. NSF, Science and Technology Indicators 2002 Table 5−56.

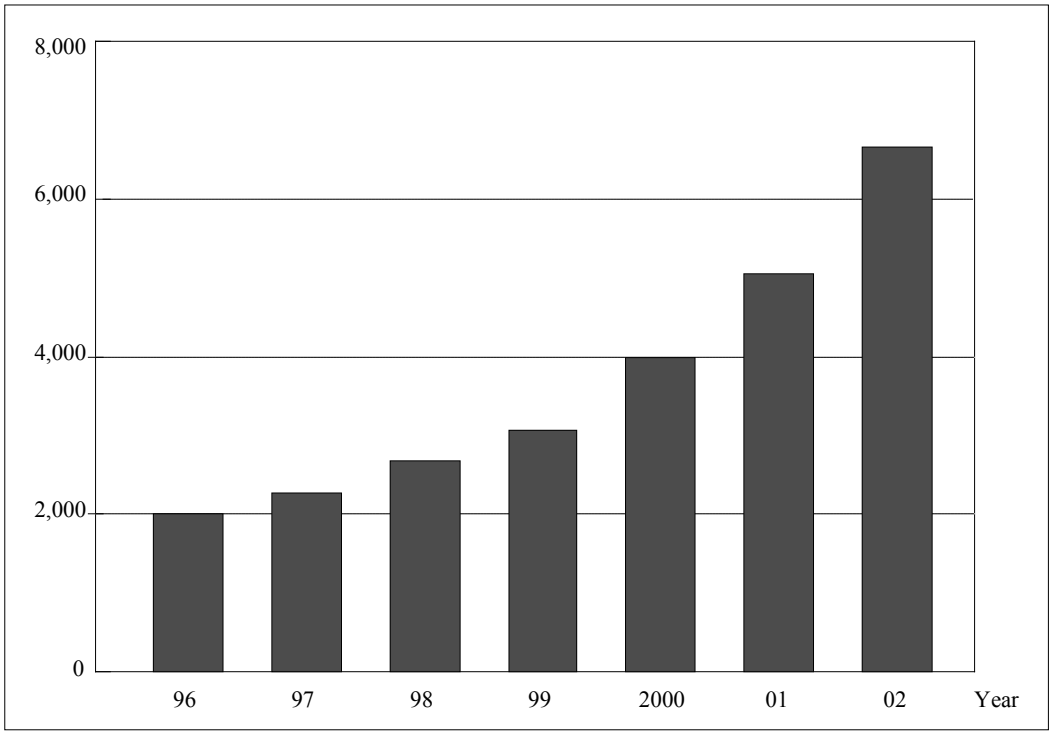
Notes: US data: Number of patents US universities acquired from the US government.
Japanese data: Number of patents Japanese universities acquired from the Japanese government.

STRENGTHENING LINKAGES BETWEEN INDUSTRY AND UNIVERSITIES

The conventional view is that a university's primary mission is education and the secondary role is R&D. In addition, universities have been given the mission of creating new industries and businesses. In future, university performance in terms of the number of patents generated and license royalties received will also be taken into account when the government decides its R&D budget allocations. It is expected that university researchers will change their mindset from a preoccupation with publication to a new focus on intellectual property.

There are three patterns in which companies and universities can cooperate as partners. First, research is commissioned by private companies to universities; second, private companies undertake joint research with universities; and third, private companies and universities jointly take part in national projects. The number of joint research projects has been increasing. As Figure 10 shows, there were some 6,700 joint research projects in 2002, a 28.6% increase compared with the previous year. The

University of Tokyo was the forerunner in carrying out 417 such projects, followed by Osaka University (265) and Kyoto University (227). Among the private companies involved in joint research, one-third of private companies were small and medium enterprises and they have shown a higher propensity to rely on university research.



Note: Figures include national research institutes and engineering colleges.

Figure 10. Number of R&D projects jointly conducted by national universities and private sector.

In the recent era of dramatic technological progress, private companies cannot afford to spend time and money undertaking basic research as they can only afford to invest in research that could generate profits in the short term. They therefore have no option but to rely on universities to conduct research that will lead to basic patents over a long time span, for example, 10 to 20 years. Furthermore, it is highly likely that the intellectual assets left unutilized over the years in universities have the potential to generate new industries and businesses. These two factors require universities to generate and utilize their knowledge assets. The recognition of the new role of universities has led to the establishment of intellectual property centers in them, as shown in Figure 11. In 2003, MEXT approved 34 (of 83) applications to strengthen the services of university intellectual property centers. A budget ranging from 40 to 80 million yen is to be allocated to each university on a single fiscal year basis for five years.

In actual operation, technology licensing organizations (TLOs) established under each intellectual property center act as agents to transfer technologies from universities

to the private sector. The TLO system came into being in 1985, and 33 TLOs had been approved as of 2002. With the passage of five years, clear differences among TLOs have become evident in their achievements and gaps in their organizational abilities have become apparent. The Research Center for Advanced Science and Technology (CAST) at the University of Tokyo operates an incubation center that has been successful in its efforts to discover dormant R&D results of university laboratories. So far CAST has transferred 66 patents to companies, representing about 20% of the patents approved by all 33 TLOs nationwide. This is followed by Tohoku Technoarc, which has transferred 36 patents. The Ministry of Economy, Trade and Industry (METI) intends to designate TLOs that have notable achievements as "super-TLOs" and select one or two to strengthen the network with private companies. Those super-TLOs will be granted 100 million yen for the purpose.

Progress is being made to promote the "cluster concept" intended to form local networks between universities and local companies in an attempt to create new industries and businesses in leading-edge fields. TLOs already in operation are expected to play an important role in promoting this concept. Since 2001, MEXT has launched 13 projects for the promotion of "knowledge-based clusters" in 15 regions, whereas METI has started 19 projects under its industrial cluster plan. For example, the biomedical cluster has attracted much attention for its integration of bio-oriented venture firms, in which Osaka University is playing a leading role.

"University-generated venture businesses" based upon technologies developed by universities have also gained momentum. Figure 12 shows the number of venture businesses launched under this scheme; a total of 424 companies had been established as of August 2002. In some cases, university professors, while continuing their teaching assignments, attempt to make commercial use of technologies they have developed. In other cases, professors and postdoctoral staff develop new business activities independently on the basis of their research results, or students start businesses based on their own unique ideas. More often, venture businesses established by students are not related to research results, and the support system for such venture businesses differs from one university to another. The IT field accounts for a roughly one-third of such venture businesses, followed by life sciences. METI has developed the "Plan for 1,000 University-initiated Ventures" and allocated 2.5 billion yen as matching funds in 2003 to foster this scheme.

It is argued that it is not easy for university professors to manage a venture business while maintaining their position in a university. Currently, the life cycle of each product is extremely short. Therefore venture businesses will lose competition in markets if they depend on a single technology. They may have the financial support necessary to launch new businesses but there is no assurance that further support needed for growth will be forthcoming and no rescue measures are in place in case of failure. Clearly there still is a host of problems and issues to be examined before determining how the unique advantages of universities can be harnessed to create new technologies.

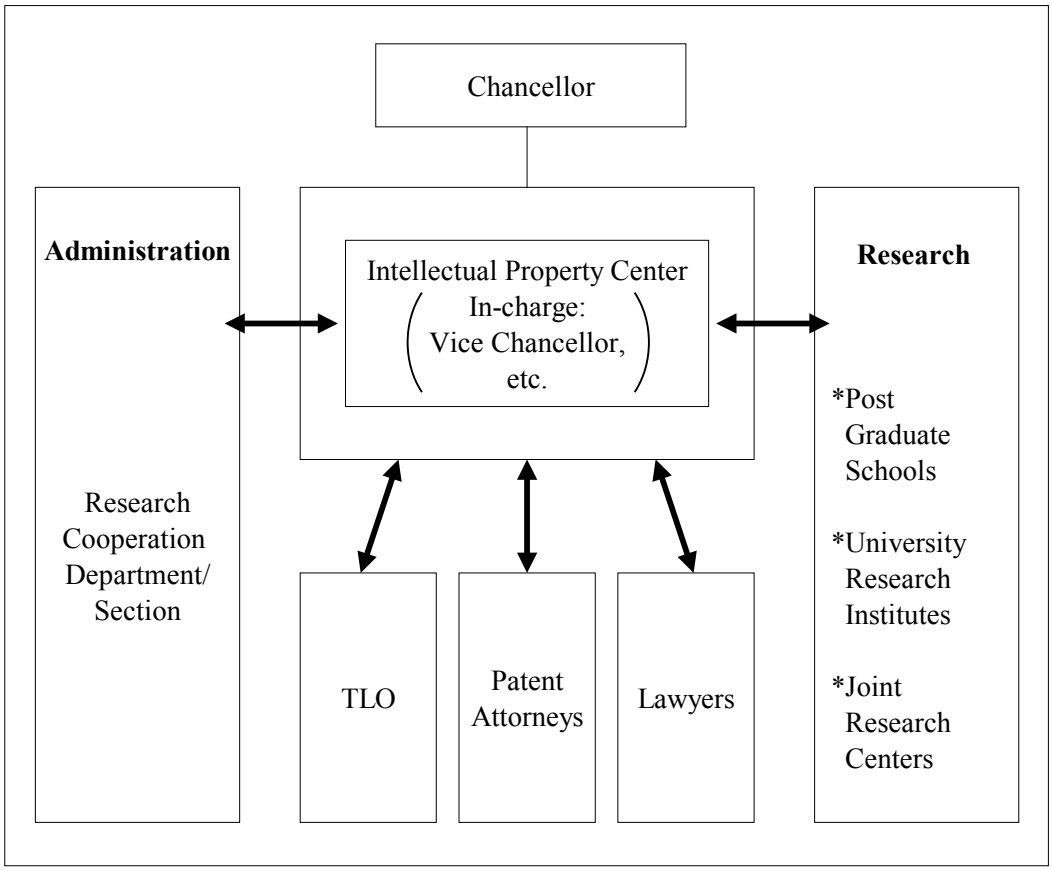


Figure 11. Intellectual property center of university (visionary illustration).

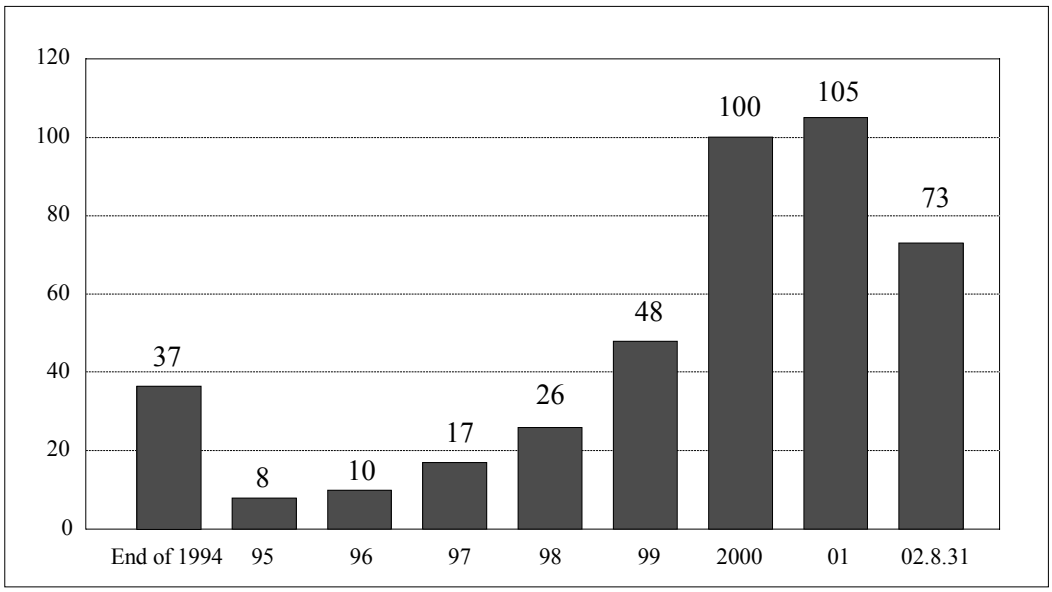


Figure 12. Growth of venture business originated from universities and engineering colleges.

CONCLUSIONS

The gap between basic and applied research is well known. It has been pointed out that much useful basic research has fallen into the valley between the two and thus remains unutilized (Figure 13). The Focus 21 Project was launched by METI in an endeavor to overcome this "Valley of Death" and to undertake the commercial application of research results. Yet, according to one theory, even if we cross the Valley of Death between basic research and invention and innovation and new business, there still is a Darwinian Sea teeming with myriad new creatures all competing with each other for survival until they eventually reach the stage of viable businesses.

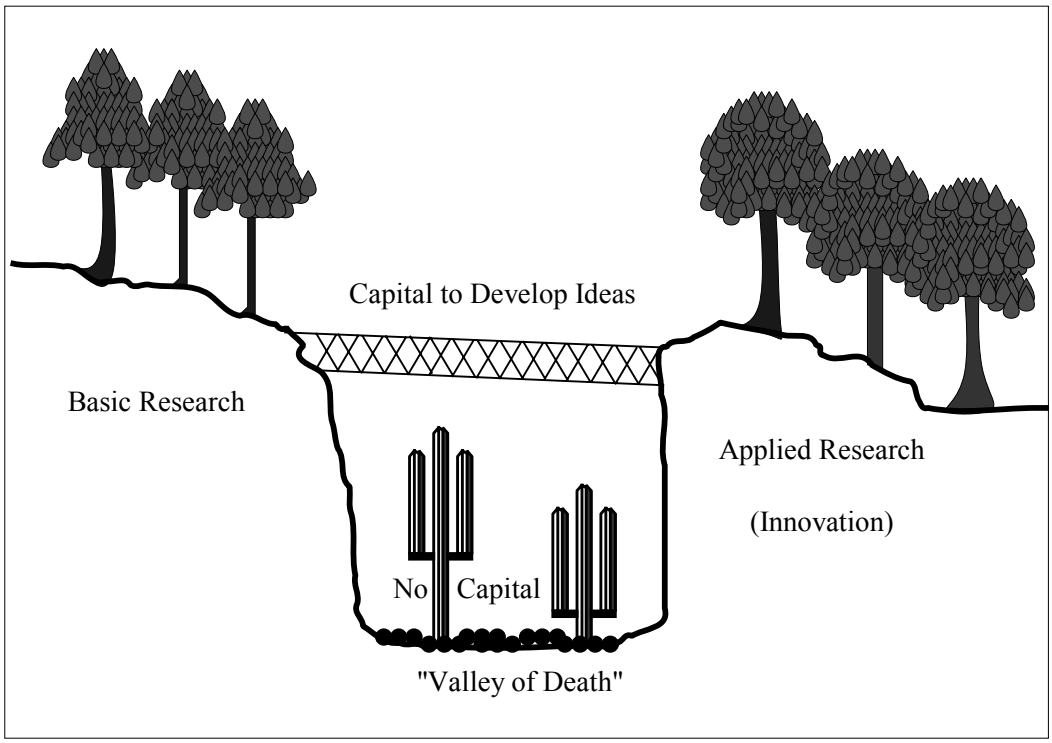


Figure 13. The "Valley of Death."

When universities promote industry-academia linkages and collaboration by making use of their intellectual property or knowledge assets, the most difficult challenge they encounter is the lack of qualified promoters. It is not easy to find a single individual who simultaneously understands technology, is well versed in patent law, and has business experience. The lack of promoters is a major factor hindering the establishment of additional TLOs, industrial clusters, and venture businesses. In this context, it is extremely timely that a number of universities are offering courses in the management of technology. The intellectual property of universities will serve society only after capable human resources are developed in a few years' time.

If and when a Japanese version of Bill Gates, Microsoft founder and originator of the IT Revolution, is born, a new vision of nation building based on intellectual property will become a reality.

Intellectual Property Rights: Japan's Policies and Strategies and Global Trends and Issues

Kouzo Oikawa
Senior Executive Director
Development Bank of Japan
Japan

In Japan at present, intellectual property (IP) is a hot issue in the mass media and the topic is mentioned almost daily in the newspapers. Although the Japan Patent Office (JPO) is one of the country's oldest governmental institutions, it has not received much attention for dealing with the examination of patent applications and the infringement of patent rights. Even now more than 80% of the officials of the JPO devote most of their time to traditional tasks and assignments. The situation is changing, not only because the examination of patent applications has attracted more interest than previously but because IP has become a national strategic issue. Related laws have been changing, and JPO officials have become extremely busy. Why has IP become such a topic of interest in Japan? First, it will be difficult to maintain competitiveness unless Japan develops higher levels of technology and creates original designs or contents that produce higher added value. This recognition has brought the attention of many Japanese to the IP system.

The first IP rights (IPRs) system was established in Venice during the 15th century. During the Renaissance, the states that now make up Italy produced numerous geniuses such as Leonardo da Vinci. Figure 1 is a translation of a letter from Galileo addressed to the Governor General of Venice and vividly illustrates the essence of IPRs. To some, modern industrialization developed through the emancipation of individual desire or will from old regimes and concepts. US President Abraham Lincoln said, "The patent system added the fuel of interest to the fire of genius." It is interesting to note that Lincoln himself applied for and received a patent when young.

- Excerpts (translation) from Galileo Galilei's Remarks
"Your Majesty, I have invented a device to raise water and irrigate cultivated land with great ease, little cost, and much benefit. ⋯ I hate, however, the invention which is mine ⋯ becoming common property ⋯ . I entreat you to forbid, for forty years ⋯, those other than myself, my descendants, and people having acquired the right from myself or my descendents to ⋯ use ⋯ the new device. Should there be anyone who violates that, I also entreat you to fine him as you consider appropriate ⋯ ."

Figure 1. Necessity of intellectual property protection—Quotations.

Economic history teaches that the prevailing IP system is closely connected with the Industrial Revolution. Thomas Edison was praised as the king of inventions as well

as the king of lawsuits. Another example is Richard Arkwright, who invented a water-powered spinning machine and introduced a manufacturing system that significantly advanced the Industrial Revolution. Arkwright, however, spent most of his life struggling with lawsuits; Karl Marx referred to him as a "thief." While he lost a lawsuit late in life, if he were alive under the present patent guidelines his manufacturing system would be considered worthy of a software or business method patent. Despite losing his court case, thanks to his long-term patent, he became not only a millionaire but was also knighted.

Economics textbooks state that the engine of economic growth is the development of technology. Many economists stress the important role of the IP system from this viewpoint. Because technology can be easily duplicated by others, the IPR system guarantees that monopolistic revenues from inventions will accrue to the inventors who invested money and effort in their development. This is thought to be the best incentive for further technological developments in which social benefits increase continuously on one hand and optimum returns to deserving individuals are secured on the other. The IP system is an indispensable form of infrastructure for economic growth.

Japan introduced its first IP system in 1885. The first priority at the time was the abolition of unequal treaties with the West in the pre-Meiji Restoration era. The government was enthusiastic in introducing advanced systems from Western countries to achieve modernization as quickly as possible and aimed to complete negotiations to lift the treaties. The rapid introduction of the IP system was fortunate for future Japanese economic development. In particular, the introduction of an examination and appeals system related to all industrial property, including patents, trademarks, and designs, was beneficial at a time of serious budget deficits. In addition, the patent office's first commissioner, Korekiyo Takahashi, built a magnificent office to attract people from all over Japan because he thought that talk about the splendid building would also spread recognition of the IP system. But, aside from the building, the level of Japanese technology in those days was far from that in Western countries. Many amusing episodes have been handed down in JPO lore. For example, one inventor applied for a patent on a new type of coffin. When it was refused, he came to the Patent Office and violently demanded approval. Commissioner Takahashi had to run around his desk seven and one-half times before finally escaping.

Reviewing the 19th century, there were not many remarkable inventions. The most famous was a wooden loom devised by Sakichi Toyoda, the founder of Toyota Motor Company. In 1905, the Japanese government introduced the utility model system, following the German system. Until 1980, the number of utility model applications each year exceeded the number of patent applications. In the meantime, there were many reforms of laws and institutions. A turning point in both international and Japanese patent systems occurred in 1980, as exemplified in the Trade-related Aspects of Intellectual Property Rights (TRIPS) agreement in the 1990s and on the agenda of the G7 economic summit in Okinawa, focusing on genetic patents and business method patents. That was the first economic summit in which IP formed part of the agenda.

As shown in Figure 2, in 1900, 2,006 patent applications were made in Japan. By 1940, the figure had increased by 10-fold, to 19,827 applications. Another 10-fold increase had occurred by 1980, to 191,020 applications. In 1990 the number reached 367,950 and in 2000 436,865. The rate of increase between 1980 and 2000 was thus

about 2.3-fold, for a slower rate than in previous years. However, it should be noted that during this time there was a rapid increase in the number of items for which patent rights were sought through single applications. Therefore, viewing the numbers for 1980-2000 as signs of stagnation does not give an accurate picture of the situation.

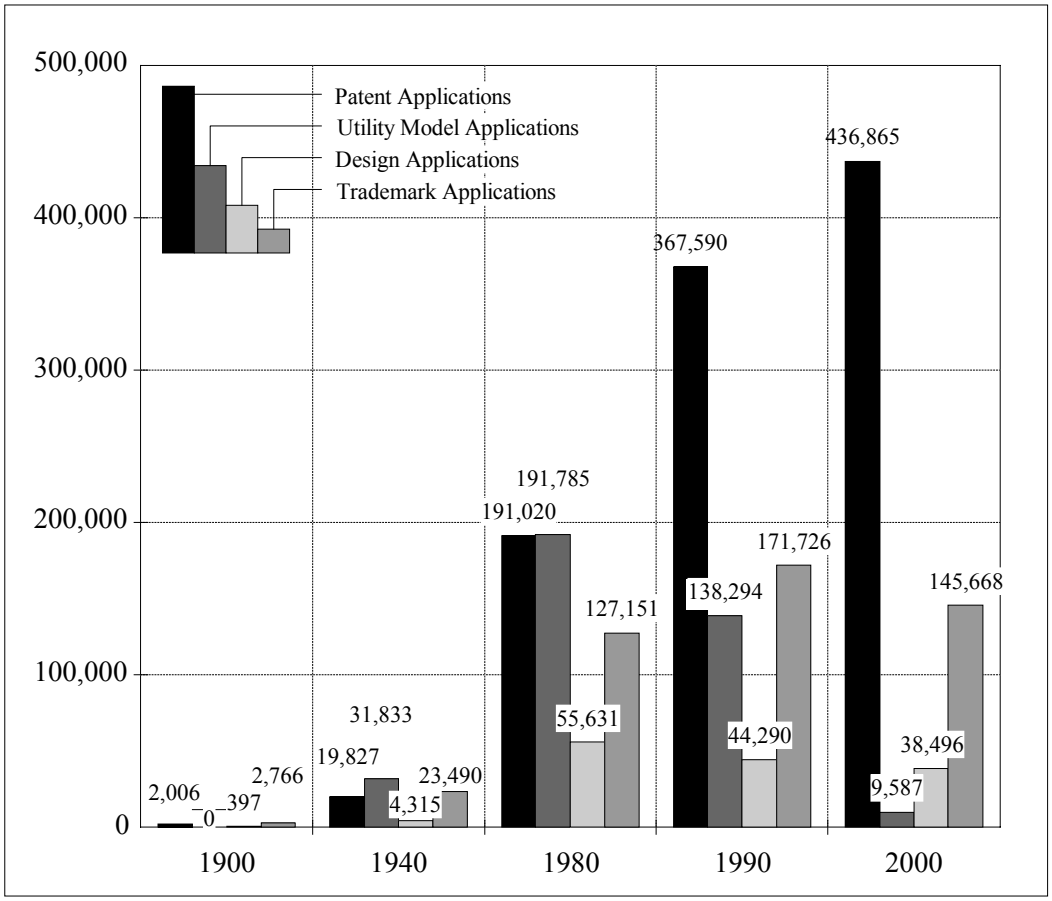


Figure 2. Changes in the numbers of industrial property applications in Japan in the 20th century.

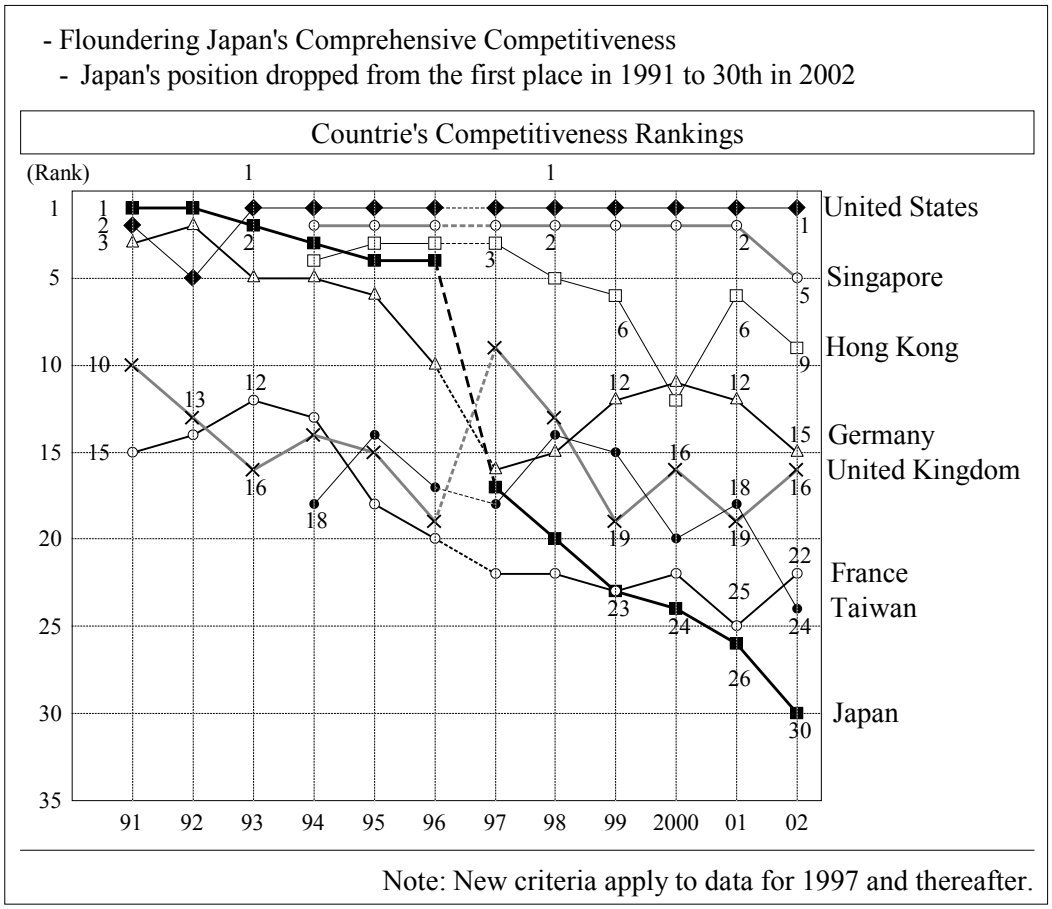
After the utility model application system was devised in 1905, the number of applications exceeded the number of patent applications each year until 1980. In 1981, the number of patent applications exceeded that for utility models for the first time. Since then, the number of utility model applications has decreased drastically, dropping below 10,000 in 2000.

There were only 397 design applications in 1900, which had increased 11-fold to 4,315 in 1940. The rate of increase was approximately the same as that for patents. In 1980, design applications numbered 55,631, a 13-fold increase from 1940, which was a more rapid rate of increase than that for patents. Thereafter, however, the number decreased, reaching only 38,496 in 2000, or only 70% of the number of design applications in 1980.

Trademark applications increased by 8.5 times from 1900 to 1940, at a pace slightly slower than that of patent applications. From 1940 to 1980, the number increased

5.4-fold, or half the rate of increase in patent applications. After 1990, trademark applications began to decrease, as in the case of designs.

Japanese applications for IPRs reached the stage of maturity in the 1990s. Simultaneously, the Japanese economic growth rate began to slow. The long economic slump of the 1990s continues in the 21st century. The IMD publishes an annual ranking of countries. In 1992, Japan was ranked first, but in 2002, only 30th (Figure 3). Although the USA faced serious economic problems in the 1980s, those were overcome and the country prospered economically in the 1990s. In 1992, when Japan's IMD ranking was first, the USA's was fifth. However, in 1993, the USA was in the first position, where it has remained since. This contrast between Japan and the USA may be clarified by comparing the differences in the number of patent applications between the two.



Source: World Competitiveness Yearbook 2002 by the International Institute for Management Development (IMD).

Figure 3. Japan's competitiveness.

Figure 4 shows the time-series statistics on US and Japanese patent registration numbers. In 1900, the USA was already the most advanced country in terms of IP, with some 40,000 patent applications. The figure in 1980 was only 2.6-fold greater. Japan

saw a 100-fold increase in applications over the same period. In one sense, it can be said that the USA had already reached a stage of maturity by the beginning of the 20th century. In addition, after the Great Depression, the granting of patents was not as popular socially, because they give monopolistic privileges to only a few. However, the rate of increase in US patent applications over the past 20 years was 2.8-fold, exceeding that seen in the previous 80 years as well as Japan's rate of increase over the same period. No comprehensive reason can be given for the significant upsurge in US patent applications. Some argue that the Supreme Court's decision in the Diamond vs. Chakrabarty case in 1980 became a trigger for judicial change. Until then, the Supreme Court was considered a strict guardian of antitrust law. Others believe that the 1982 establishment of the Court of Appeals for the Federal Circuit (CAFC) was responsible for this change. The CAFC hears all patent appeals from the various US District Courts. Many factors probably contributed. For example, the rapid decrease in the ratio of governmental expenditure for R&D may be an indication of the vitality of the private sector. In 1971, the US ratio was 57.4% and in 2000 only 27.1%. During the 1980s, nonmilitary R&D accounted for the bulk of the decrease; after the end of the Cold War in the 1990s, government spending also decreased on military R&D

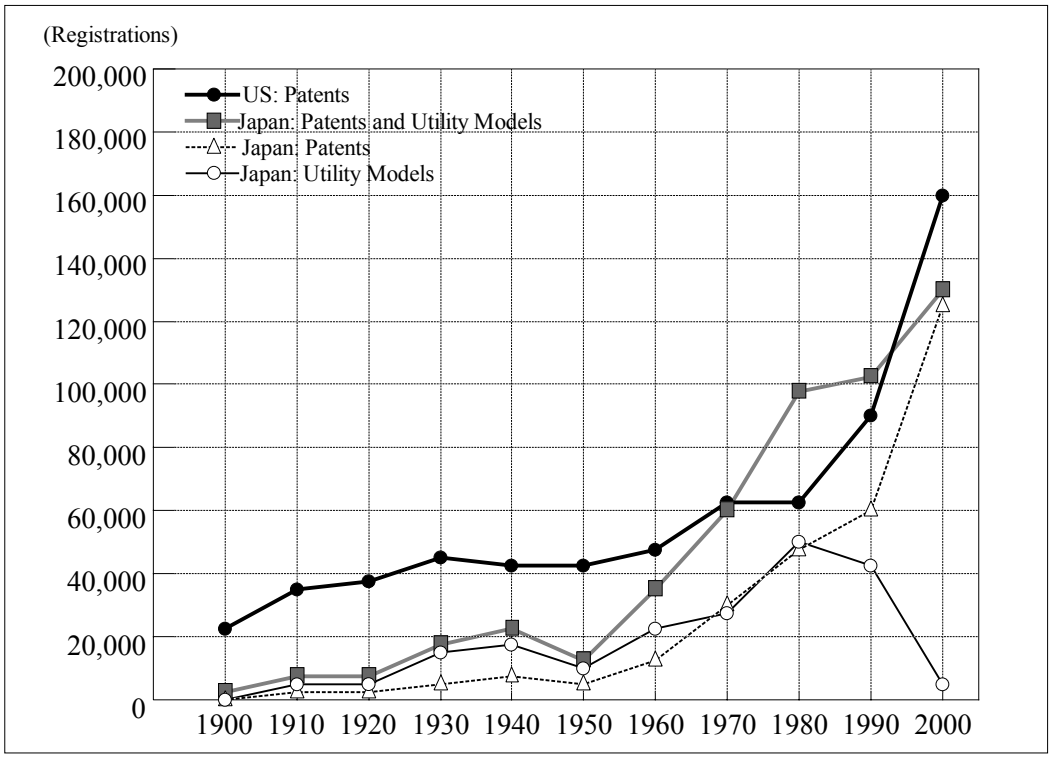


Figure 4. Changes in the numbers of patent registrations in the US and Japan in the 20th century.

In Japan, many people believe that the economic and IP revival of the USA was due to the results of the 1985 Young Report (Figure 5A and B). The Reagan administration assigned John Young, then CEO of Hewlett Packard, to analyze US competitiveness. The final report analyzed policies concerning competitiveness from the viewpoints of

technology, capital, workforce, and international trade (Figure 5A). IP was covered in an appendix to volume 2 (Figure 5B).The Young Report received a huge response in Japan because IP had not previously been discussed from this viewpoint and there had been several IP conflicts and lawsuits between Japan and the USA.

1. Competitiveness: The Quiet Challenge
2. The New Global Economy Makes Competitiveness Vital
3. Warning Signals We Should Heed
4. Improving America's Ability to Compete
   - Create, Apply, and Protect New Technology
   - Increase the Supply of Productive Capital
   - Develop a More Skilled, Flexible, and Motivated Work Force
   - Make Trade a National Priority
5. Responding to the Agenda of Competitiveness

Summary of Commission Recommendations
- Research and Development and Manufacturing
- Capital Resources
- Human Resources
- International Trade
- Other Commission Action

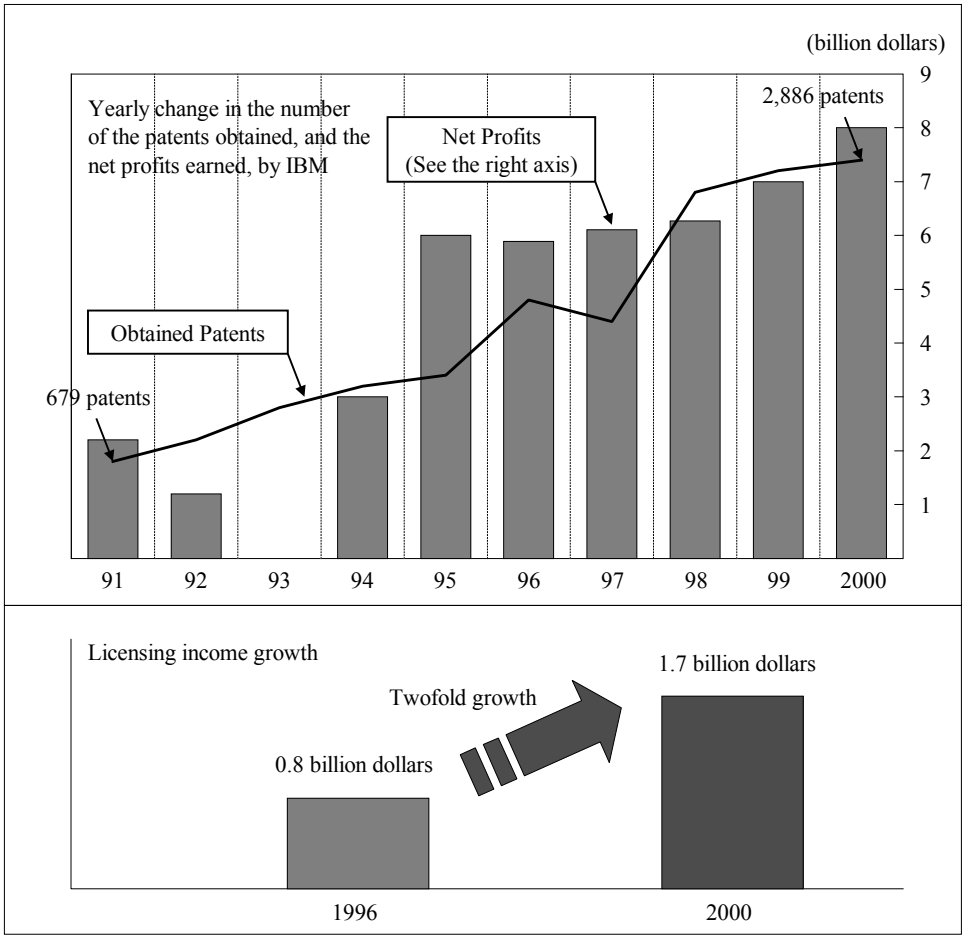
Figure 5A. Young Report (Report of the President's Commission on Industrial Competitiveness) Volume I—Contents.

- The Importance of Intellectual Property Rights to the US Economy
  - The Benefits of Technology
  - The International Challenge to US Competitiveness
- American Protection of Intellectual Property Rights
  - Recent Improvements in the US Intellectual Property System
  - Weaknesses in the US Intellectual Property System
- International Protection of Intellectual Property Rights
  - Foreign Laws
  - International Agreements
  - Future Prospects for the International Protection of Intellectual Property Rights
- Recommendations
  - Enhancing the Importance of Intellectual Property Rights
  - The Need for Improved Protection of Intellectual Property Rights in the United States
  - Strategies for Dealing with the International Protection of Intellectual Property Rights
  - Strengthening Intellectual Property Rights for the Technological Age

Figure 5B. Young Report, Volume II, Appendix D—A Special Report on the Protection of Intellectual Property Rights.

What is interesting, however, is that the Young Report is not as well known in the USA as it is in Japan. It was shelved by the Regan administration, which gave priority to so-called supply-side economic policy. Young therefore set up a private institution to promote his conclusions, and most of his policy proposals were later adopted by the Clinton administration. The Young Report may or may not have led the US economic revival or triggered the rapid increase in patent applications. However, despite a time lag, most proposals in it were implemented and are operating in the USA now. The TRIPS agreement is an especially notable result of the report.

- IBM has achieved high profitability by means of intellectual property rights.



- Since Mr. Lou Gerstner assumed the position of CEO in 1993, the company has put into practice management with emphasis on intellectual property.
- The R&D section has been reorganized to facilitate R&D activities focused on consumers' needs.

Figure 6. Revival of IBM.

After the USA regained the top IMD ranking in competitiveness in the 1990s, it also began to lead the new information era. Many Japanese think that the USA must have developed the foundations for its competitiveness through IPRs and that the Young Report laid the groundwork. Two examples are frequently cited in Japan as symbolic success stories. In 1992, the USA was deep in a serious economic depression. However, in 1993, Louis V. Gerstner was appointed CEO of IBM. His consumer-oriented R&D strategy stressed the importance of IP. Revenues from patents doubled within four years and the computer giant revived (Figure 6).

1950s and 1960s
- Only US$5,000 earned over 15 years through the transfer of research outcome

1968
- Research outcome transfer business launched with one staff member
- As much as US$55,000 earned for the first year only

1970
- Stanford University Office of Technology Licensing (OTL) established

1982
- US$ 14 million earned yearly only through the transfer of DNA-related technology
- Genetic recombination technology established by Professors Cohen and Boyer

1996
- Income from licensing expanded to US$44 million, accounting for approx. 13% of the University's research expenses
- 220 licenses with 20 staff members

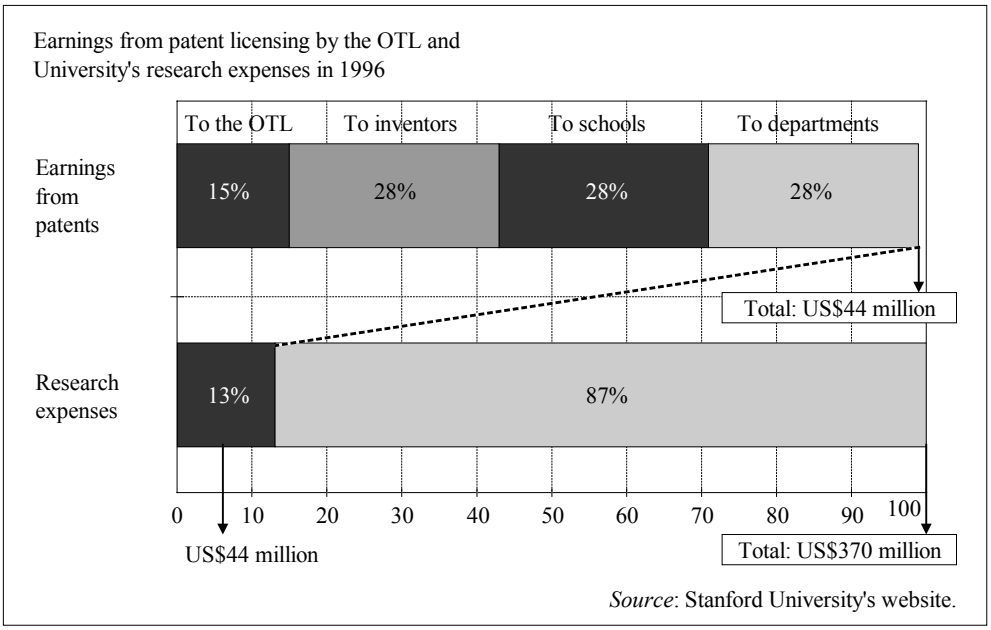
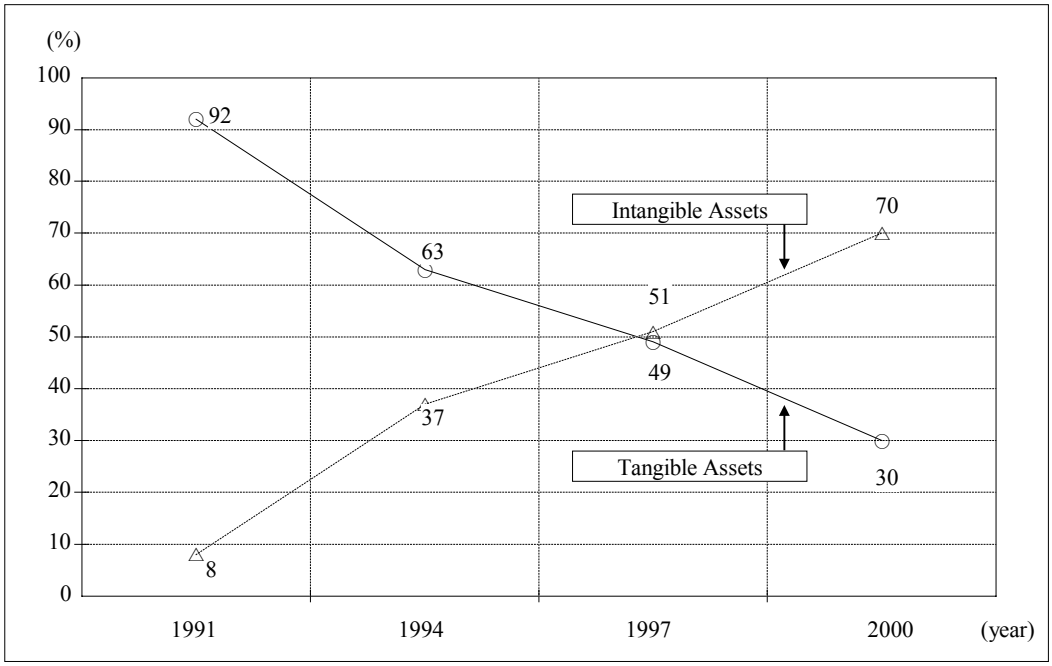


Figure 7. Example of Stanford University: Success achieved by dramatically expanding the transfer of intellectual property rights.

The second example involves Stanford University (Figure 7). From the 1950s to the 1960s, that university received only US$5,000 from the 15-year patents it owned. However, after setting up a TLO and other institutional reforms, its revenues from patents soared. The amount received in 1996 was US$44 million, the most among all US universities. Stanford University was also the birthplace of many Silicon Valley industries.

These two examples alone do not show incontrovertibly that the US economic revival was a direct result of its IP policy. Figure 8 shows the ratio of the value of intangible assets to the value of all corporate assets in the USA. The ratio of intangible assets increased from 8% in 1990 to 70% in 2000, the peak of the so-called IT bubble. Therefore most US enterprise growth during the 1990s was based on the accumulation of intangible assets consisting of IP, human capital, management capability, etc.



Source: Arthur D. Little

Note: Intangible asset value = Aggregate market value—Net asset value
= Intellectual property + Human capital + Brand power + Management capability, etc.

Figure 8. Ratio of intangible asset value to the entire corporate asset value in the USA.

Against this background, the JPO developed a new IP-oriented policy in the mid-1990s, referred to as a pro-patent policy. In 2002, Prime Minister Junichiro Koizumi outlined the keystone of a new intellectual property policy to allow Japan to become an economy based on IP (Figure 9A and B). In the current situation of declining competitiveness, developing a creative society is a topic of debate. Many believe that the most important element is stressing the importance of creativity among the public and

that Japanese respect for the importance of IP is less than that in Western countries. Thus it was decided to enact a basic law on IP and set up an IP policy headquarters under the prime minister. Figure 10A and B summarizes the basic law, which came into force on 1 March 2003.

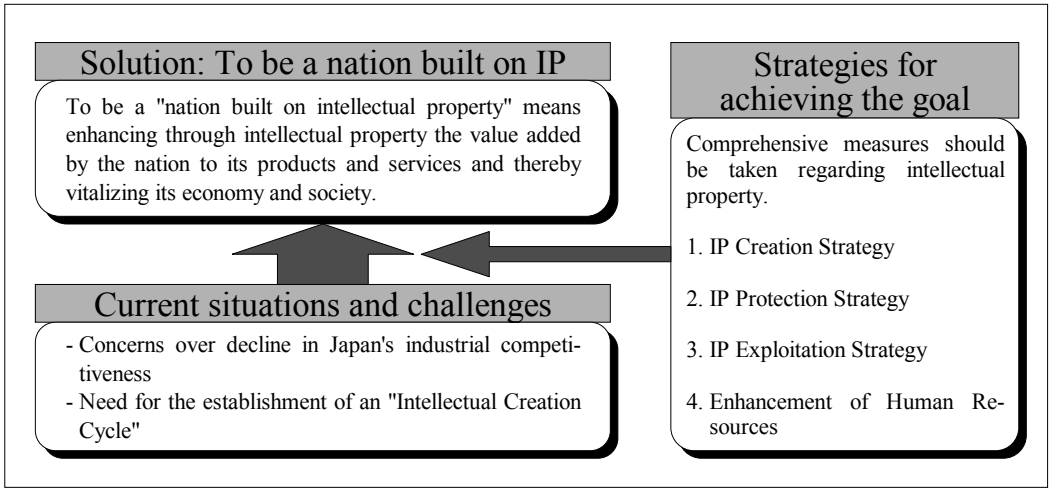


Figure 9A. Keystone of the Intellectual Property Policy Outline (as set forth on July 3, 2002) (1).

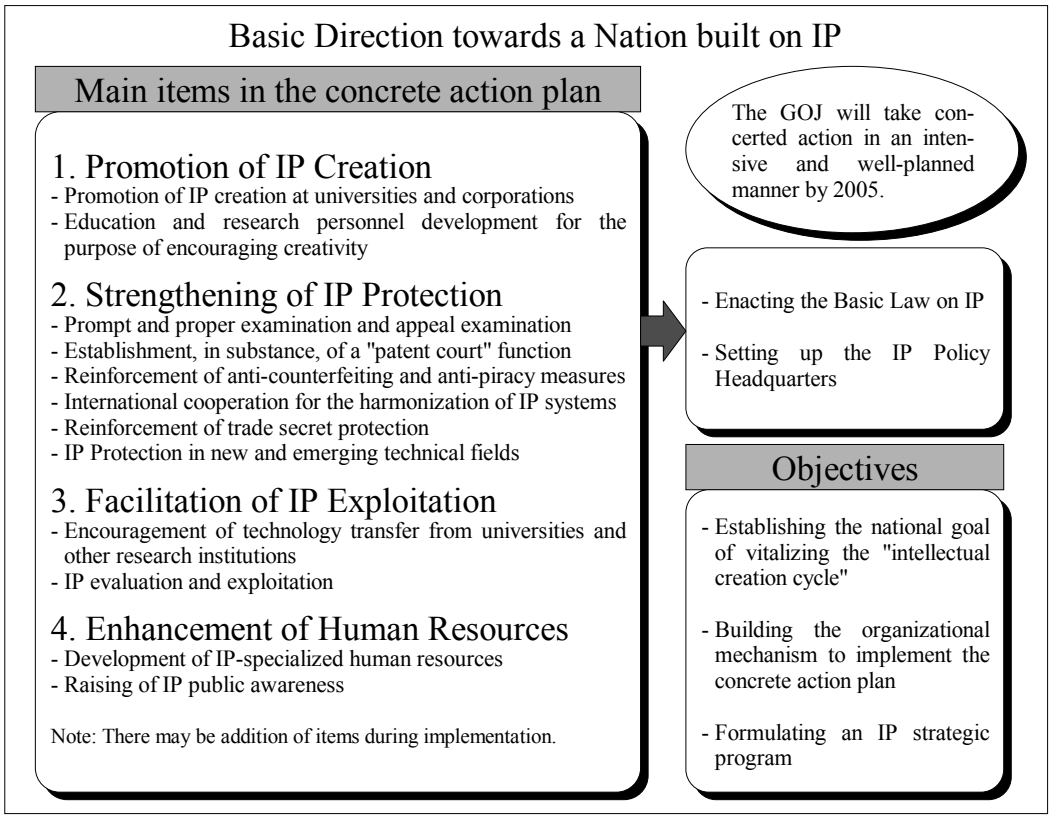


Figure 9B. Keystone of the Intellectual Property Policy Outline (2).

Necessity of the Law: In order to maintain sustainable development of the nation in response to changes in socioeconomic situations at home and abroad, it is vital to enhance the international competitiveness of Japanese industry and to realize a dynamic economy and society through exploitation of intellectual property.

Chapter 1: General Provisions

1. Definition of Intellectual Property

Intellectual property includes, among others, the following:
- patent rights for inventions;
- copyright for works such as movies and music;
- trademarks and trade names; and
- technical or business information such as trade secrets.

2. Purposes and Basic Ideas

To contribute to:
- the sound development of the national economy and the creation of rich culture; and
- the strengthening of the international competitiveness and the sustainable development of Japanese industry through the creation, protection and exploitation of intellectual property.

3. Responsibilities of the Parties Concerned
- The State, local governments, universities, and business enterprises shall mutually cooperate to take necessary measures.
- Universities and business enterprises shall make efforts to assure proper treatment of inventors, etc.

Chapter 2: Basic Measures

- Promotion of R&D activities at universities as well as encouragement of the commercialization of universities' R&D results
- Acceleration of the patent granting procedure
- Acceleration of the dispute resolution process in patent proceedings
- Strengthening of measures against conducts to infringe intellectual property rights, such as counterfeiting and piracy at home, on border, or overseas
- Promotion of international cooperation regarding intellectual property systems
- Exploration of the proper protection of intellectual property in new fields (e.g., regenerative medicine)
- Establishment of management guidelines that will be helpful for business enterprises to exploit intellectual property strategically
- Payment of special attention to business startups by individuals and the development of new business by SMEs with volition
- Development of IP-specialized human resources

Figure 10A. Summary of the Basic Law on Intellectual Property (entry into force: March 1, 2003) (1).

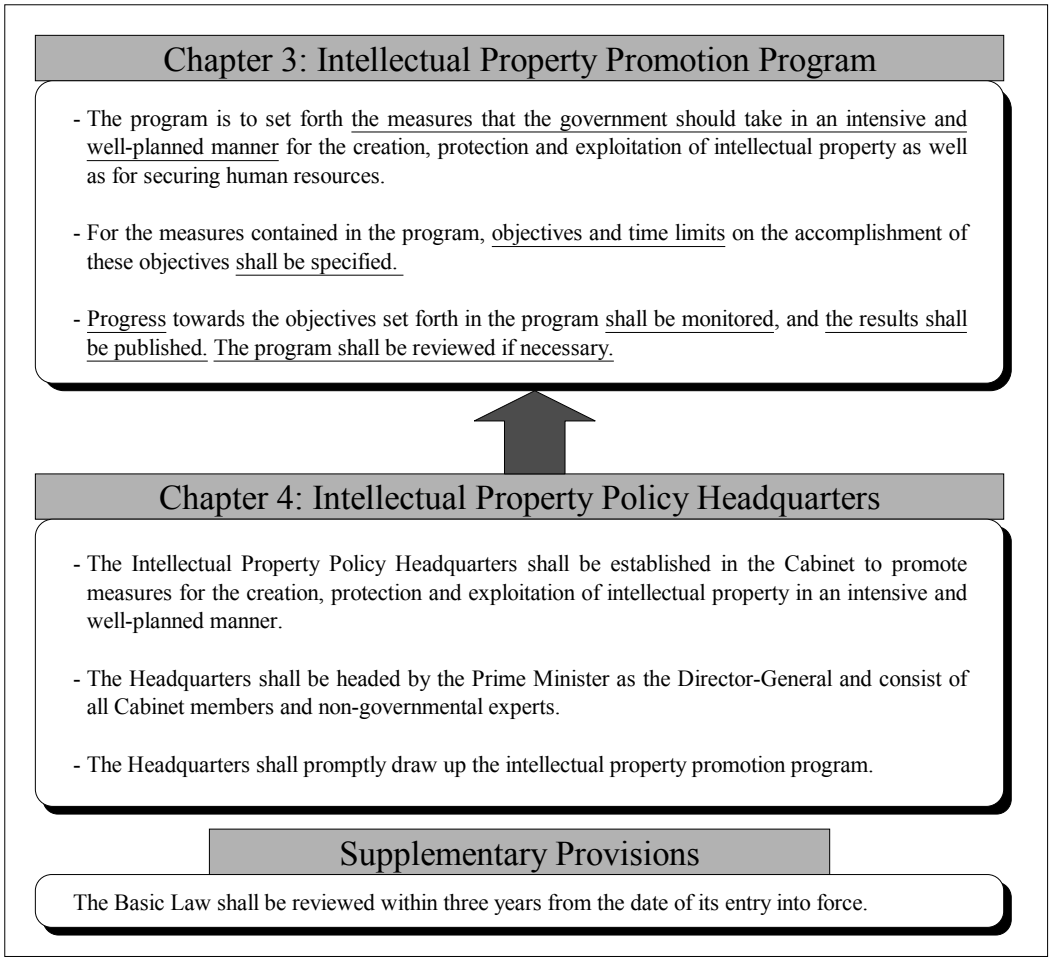


Figure 10B. Summary of the Basic Law on Intellectual Property (2).

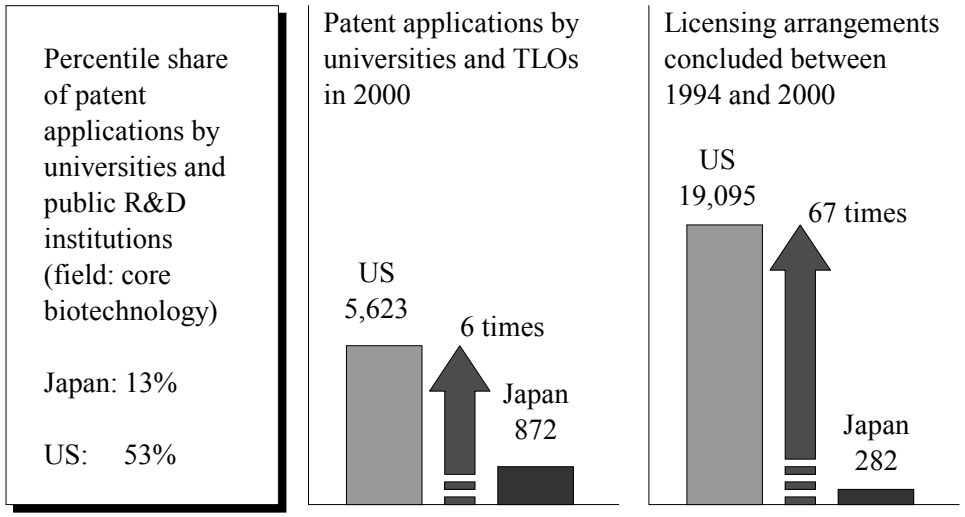
The strategic program for IP, consisting of nearly 300 policy items, is based on the four pillars of promoting IP creation, protecting IP, exploiting IP, and enhancement of human resources. The creation of IP focuses on universities and incentives for employees (Figure 11). Japanese universities trail their US counterparts in this area. Commodities with short life cycles are a feature of the contemporary economy, meaning that it is difficult for most corporations to concentrate their resources on basic research. Concurrently, because of the complicated procedures for obtaining patents, many Japanese professors prefer to publish papers rather than apply for patents. The Japanese government aims to change this environment and increase university-held patents through cooperation between industry and academia. Because national universities are subject to new regulations that make them independent administrative institutions, they are being exposed to market mechanisms. This necessitates establishing comprehensive systems for IP management and producing venture enterprises at universities, thereby increasing funds for IP-related activities in institutions. To motivate employees, abolishment or amendment of patent law provisions regarding employee inventions has been discussed. The JPO has recently finished drafting a revised patent law. In addition,

the government decided that all ministries should divest their holdings of patents for consignees in the private sector.

Numbers of patent applications and licensing arrangements by universities and technology licensing organizations (TLOs)

- The role of universities in IP creation activities is of vital importance.

- Promotion of patent applications by universities as well as technology transfer from universities to corporate bodies is indispensable.



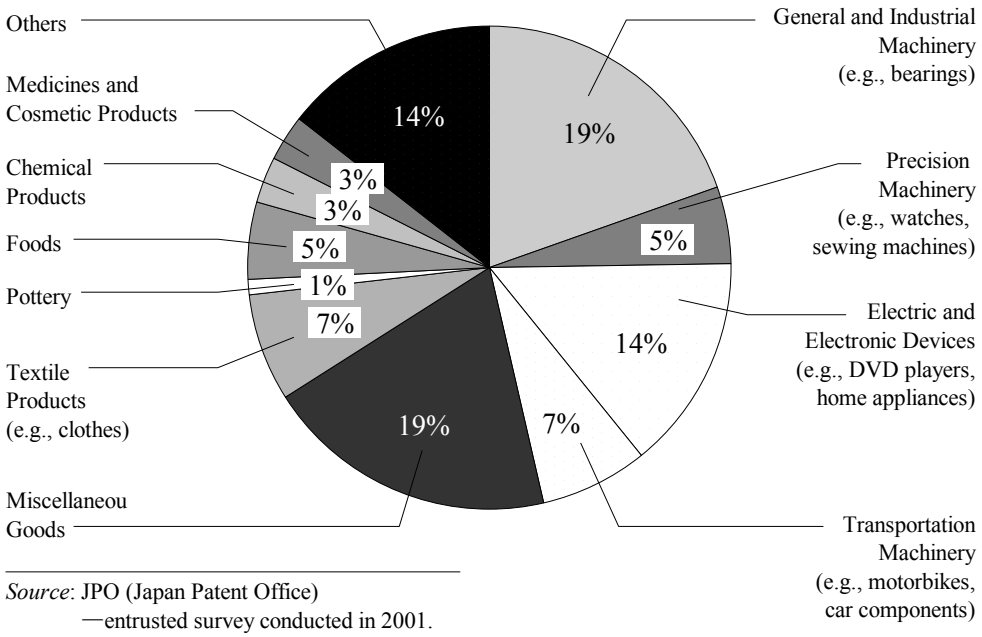
Source: Japan Patent Office.

Note:
- Data for US are based on the US fiscal year.
- Japan has 16 TLOs as of the end of 2000.

Source: AUTM Annual Report and METI, Japan.

Figure 11. Main points of the Strategic Program (1-1)
Background information regarding Chapter 1
of the Strategic Program.

The second pillar is the critical protection of IP rights. Strengthening of IP protection is equivalent to increasing the value of IP rights. The following policies will be adopted: 1) enacting a law for the promotion of expeditious patent application examinations; 2) studying methods for IP protection in new and emerging technical fields, i.e., medicine; 3) setting up an IP court function; 4) increasing efforts for the harmonization of international IP systems; 5) reinforcement of trade secret protection; and 6) strengthening measures against counterfeiting and piracy measures at home and abroad. The range of pirated commodities (Figure 12) is expanding along with the geographic areas (Figure 13). Further cooperation among countries is needed. Apart from these policies, the law has been amended so that unfair competition is prevented and trade secrets are protected more vigorously.



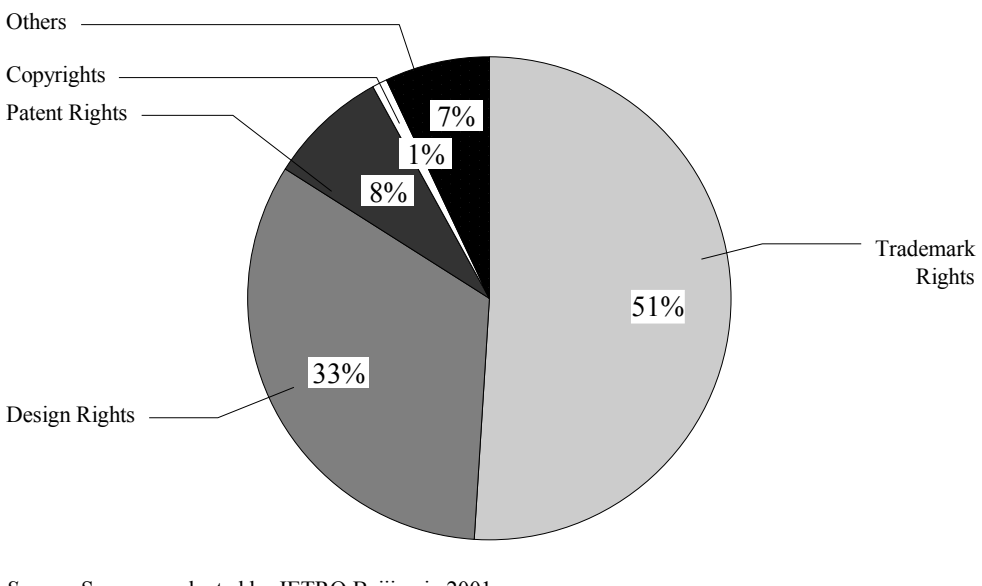
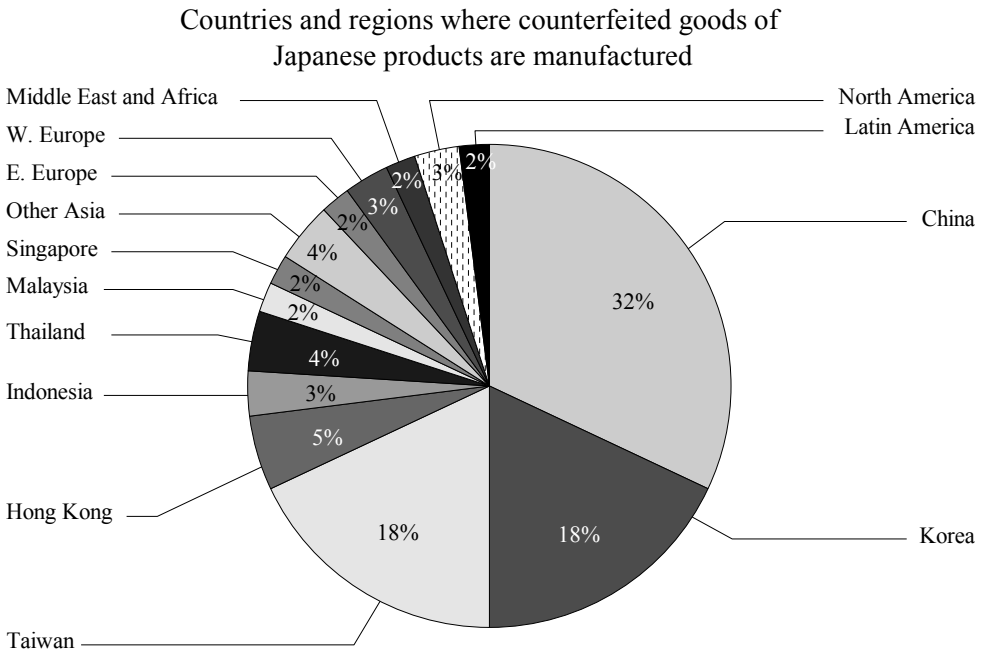
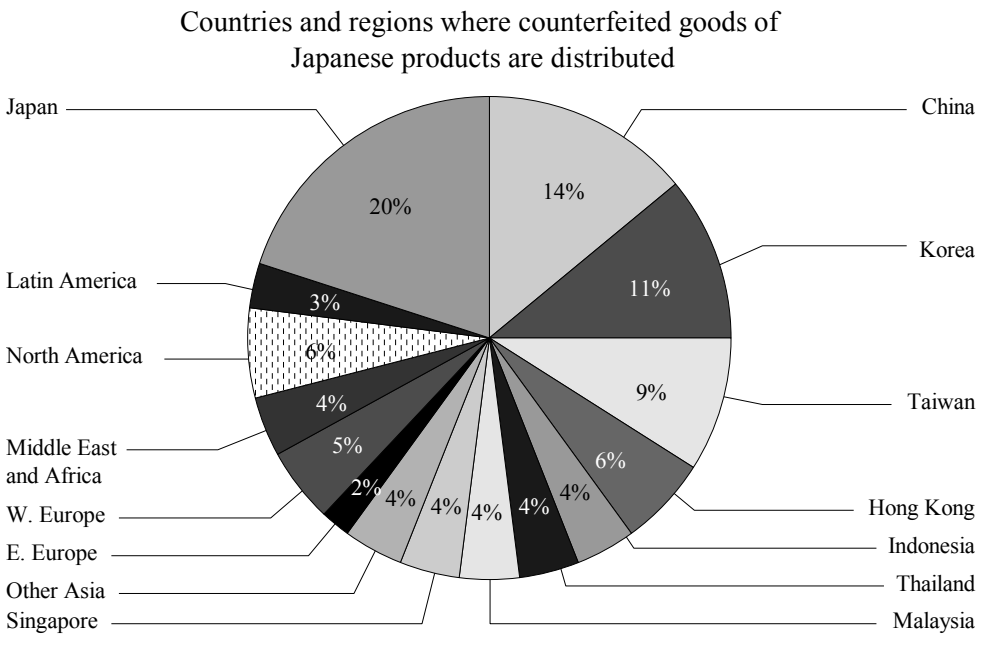


Figure 12. Main points of the Strategic Program (2-3) :
Background Information regarding Chapter 2 of the
Strategic Program Situations regarding Counterfeiting (2).





Source: JPO (Japan Patent Office)
—entrusted survey conducted in 2001.

Figure 13. Main Points of the Strategic Program (2-2):
Background Information regarding Chapter 2 of the
Strategic Program Situations regarding Counterfeiting (1).

Upon the 50-year anniversary of the patent law, Korekiyo Takahashi spoke to the public about the atmosphere in the Ministry of Agriculture and Commerce, which was previously responsible for IP matters, saying that the law's promulgation was strongly opposed by many officials. The reason for the opposition could be summarized as follows: "The patent system with a monopolistic character suppresses the freedom to copy and imitate, which is one of our nation's strong points. Accordingly, it hinders progress by our manufacturers, thus inflicting immeasurable damage on our country." However, the private sector saw the need for an IP system and submitted a petition to the government. The fundamental solution to counterfeiting problems depends upon the will of industries in the countries affected.

The third pillar, exploitation of IP, means using the rights as much as possible, as does IBM, by mobilizing dormant patents and vitalizing the trade in rights. Policies to facilitate this include facilitating strategic IP exploitation. This will involve measures including the utilization of trust systems for the collective management of IPRs. International standardization activities will be reinforced through cooperation among industry, academia, and the government. Patent pools contributing to technical standards will be encouraged. To enhance the environment for IP exploitation, measures to stimulate IP use by SMEs and venture companies will be taken.

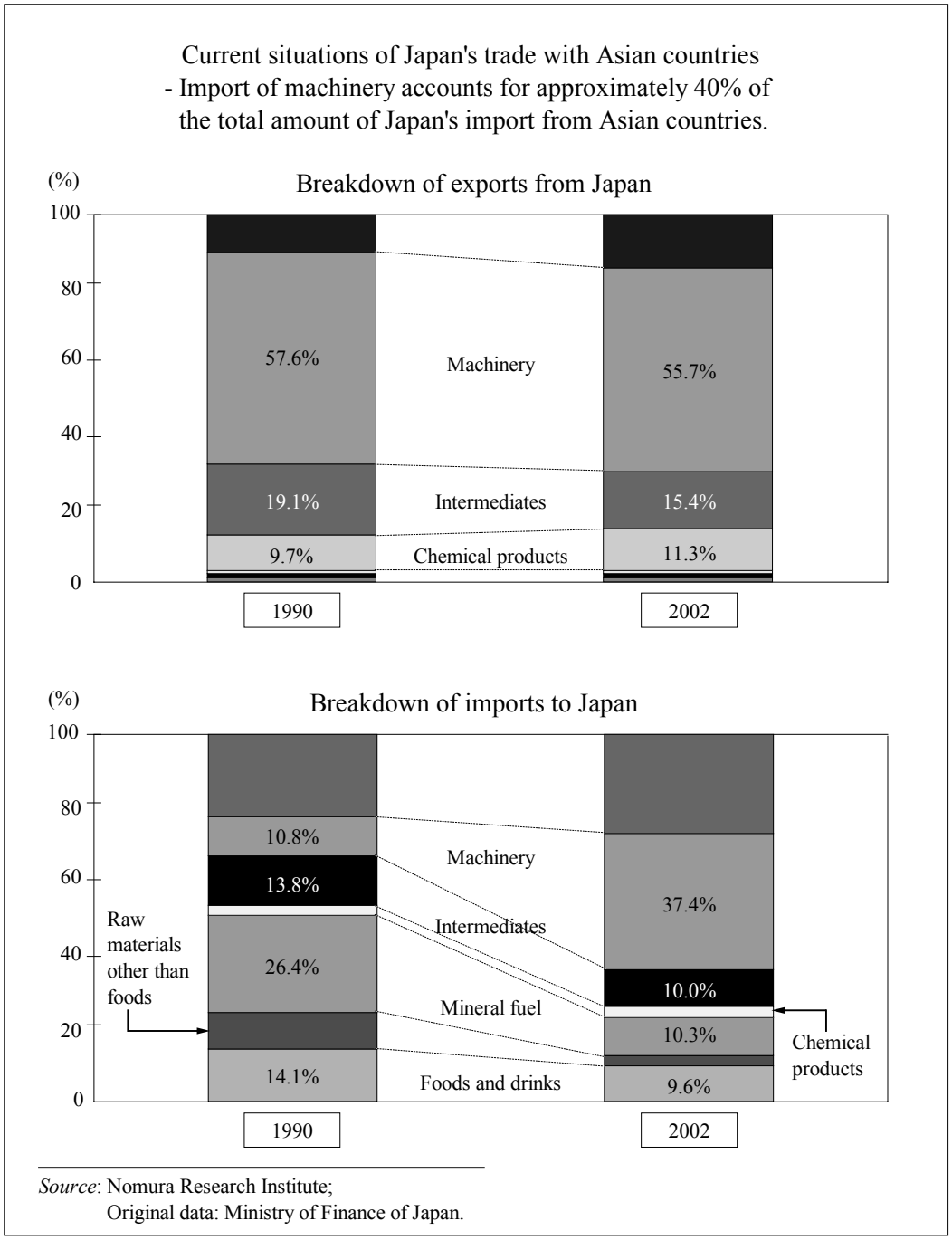
Copyright is distinguished from industrial IP in Japan. Industrial IP comes under the jurisdiction of the JPO, while copyright is the responsibility of the Agency of Cultural Affairs. Unlike other forms of IP, books can be shared easily. The Internet is a powerful means for developing new markets for contents, but it also makes piracy and copyright infringement much easier.

An expansion of content businesses is also called for. Offering attractive new content will require developing human resources such as content producers and creators, diversifying methods of financing including the utilization of commodity funds and trust systems, and developing a more favorable environment for content businesses including the enhancement of the brand image of contents produced in Japan. The "intellectual creation cycle" should be taken into account when protecting contents. An effective rights management system must be developed and standardized. Legal protection for contents should be reinforced. Content transactions could be stimulated by supporting entry into overseas markets and the use of new distribution channels including the Internet, evolving distribution systems through such means as database building and business model development, and structural reform of the content business.

The fourth pillar is human resources enhancement. There are fewer attorneys-at-law per capita in Japan than in the USA. US patent agents outnumber Japanese by more than three to one per capita. Japan must develop IP-related human resources and significantly increase the number, and upgrade the quality of, attorneys-at-law and patent attorneys. IP education systems should be improved by developing IP programs in law schools and offering management of technology courses in graduate schools and professional training centers for IP personnel. Finally, IP awareness should be inculcated among the general public.

The aim of Japan's IP policies is to provide conditions conducive to creative activity. The Japanese economy is mature, and the society is aging. All Japanese must share the risks of the future. We must develop comfortable circumstances enabling people to exercise their capabilities to the fullest extent. This need should be taken into

account in the IP policy field. Another issue is how to distribute valuable resources to technology development or creation of contents. In the government's second science and technology basic plan, the budget is distributed mainly to IT, biotechnology, environmental technology, and nanotechnology. There should be a cooperative relationship between the strategic program for IP and the basic science and technology plan.



Source: Nomura Research Institute;
Original data: Ministry of Finance of Japan.

Figure 14. Changes in Japan's trade with Asian countries and reasons behind.

In the structure of Japanese trade within Asia, there are major differences between exports and imports. During the 1990s, the ratio of commodities exported did not change very much (Figure 14). In contrast, the ratio of imported manufactured goods increased rapidly. The movement from a vertical division of labor to a horizontal one was very clear. The balance of trade in automobiles, metal processing machinery, etc. did not change but imports of agricultural machinery, communications equipment, office equipment, etc. underwent a rapid upswing.

Why is the horizontal division of labor likely to continue? Several have severely criticized classical theory on international trade economics. Professor Michael Porter of Harvard University developed a well-known theory on competitiveness asserting that the classical theory of comparative advantage cannot explain current trade between advanced countries. For example, Germany, Japan, and the USA export automobiles to each other, and those exports are increasing every year. On the other, Professor Paul Krugman of Princeton University presented a new theory that the existence of differentiated products and scale economies can form a comparative advantage. In either case, the need for an effective IP system is increasing. Differentiation makes an IP system essential, especially for trademarks. Competitiveness is supported by the exclusion of rivals from markets. Furthermore, owing to the remarkable proliferation of IT, the copying of information has become much easier than before. The technologies for which patents are sought are readily accessible worldwide after 18 months because they are published on the Internet, making counterfeiting easy. In addition, capital moves around the globe in search of low-cost operations and new markets. Technologies and human resources also move. Some companies are not able to survive the theft of their proprietary technologies, because they are relatively small and the development of those technologies was so costly. Therefore progress in the horizontal division of labor necessitates that trading companies protect their IP effectively. As a result, international applications for patents have increased dramatically.

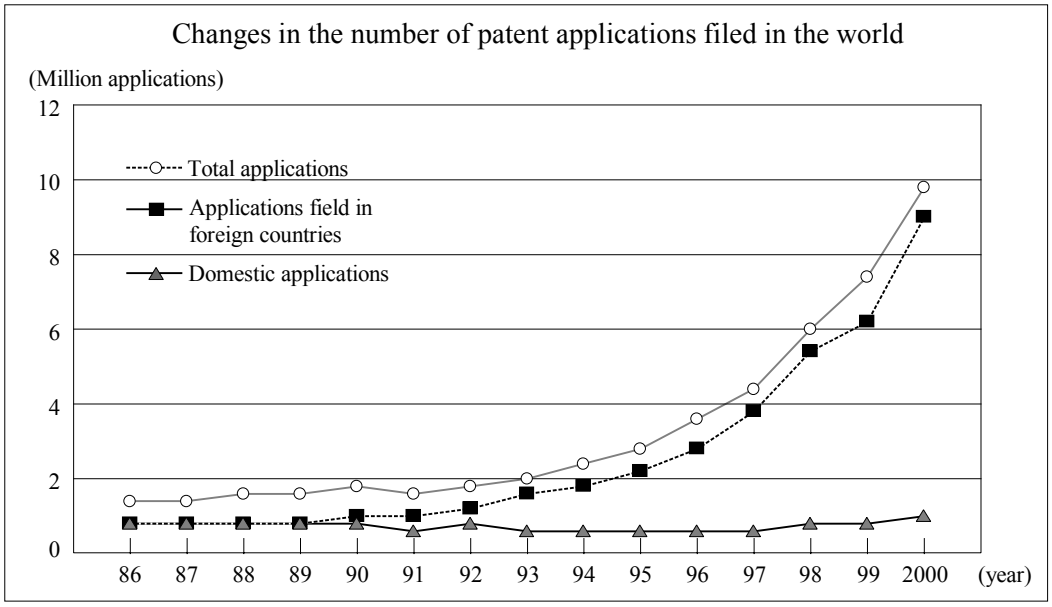


Figure 15. Worldwide growing attention to IP in tandem with economic globalization.

Comparison of situations regarding patent examination at the trilateral patent offices

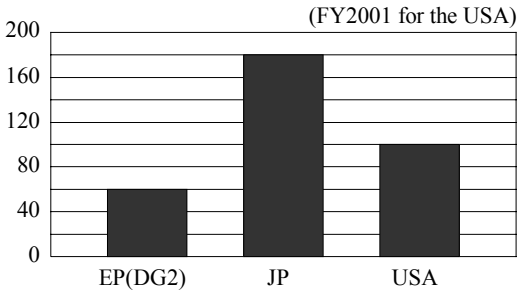
- Increases in the numbers of patent applications and examination requests and consequent prolongation of the patent pending period are challenges common to the trilateral patent offices.

Average period between filing and the first office action (in months)

Year	1999	2000	2001
EP	19.8	20.7	20.7
JP	19.7	21.1	22.0
USA	12.8	13.0	14.4

Source: Trilateral Statistical Report 2000 and 2001.

Number of finally-deposited patent applications and PCT IPERs in 2001 (per examiner)



Number of patent examiners

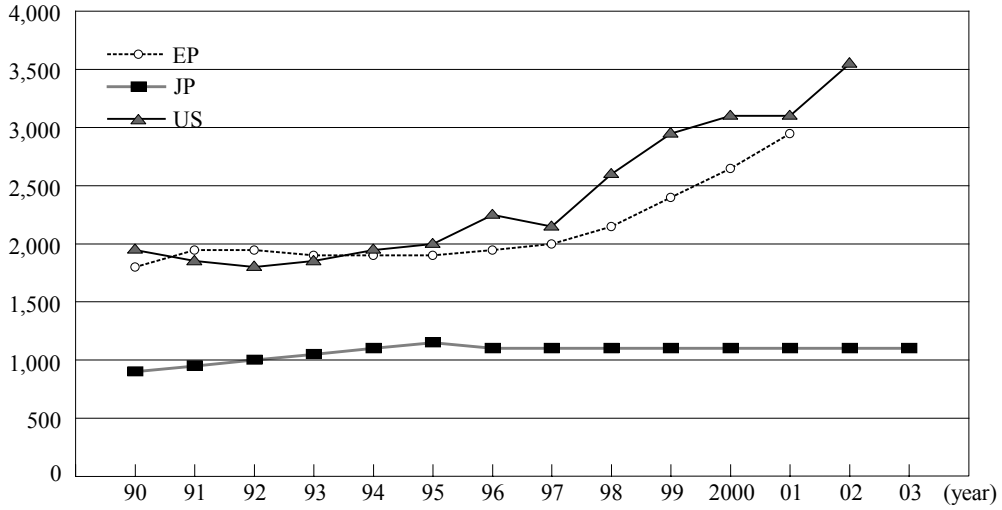


Figure 16. Patent examination situations at, and measures taken by, the patent offices of Europe, Japan, and the USA.

Figure 15 illustrates the rapid increase in the number of patent applications worldwide. As a result, patent offices in the USA, Europe, and Japan have seen rapid increases in backlogs (Figure 16). The European Patent Office started the BEST program to change researchers in The Hague into patent examiners. The US Patent and Technology Office plans to adopt measures to reduce its backlog. The JPO will increase its number of examiners even in the midst of a plan for reducing the total number of government officials. A single, worldwide patent office would solve many problems, although at the moment it is unrealistic. I propose the concept of "mutual recognition."

Issues such as sovereignty, institutional differences between countries, etc. are obstacles to this goal. We have already made efforts to harmonize the different systems among member countries of the WIPO (Figure 17) and these efforts must continue. In the long term, the percentage of Asian applications will increase, and Asian countries must cope with the patent explosion in a cooperative manner.

1970	PCT concluded
1973	EPC concluded
1978	Operations under PCT and EPC started
1995	TRIPS Agreement went into effect
1996	Operations under the Community Trademark System (Europe) started
2000	Discussions on substantive patent law harmonization and the PCT reform started at WIPO
2003	(Jan.) Operations under the Community Design System (Europe) started
2003	(Mar.) An approach towards the proposed Community Patent System (Europe) agreed upon at the Ministerial Council of the European Commission

Figure 17. Efforts towards international harmonization of IP systems since 1970s.

In September 2001, a joint statement was adopted by the Asia-Pacific Regional Forum of the WIPO (Figure 18). The JPO has been working with other forum members to develop an information network and closer relationships through the exchange of examiners and implementation of training. At the same time, three patent offices appointed as international search authorities and international preliminary examination authorities of the WIPO in Asia, the JPO, Intellectual Property Office of the Republic of Korea, and China Intellectual Property Office are examining the possibility of cooperation and support from other Asian countries.

Items in the Joint Statement adopted by the WIPO Asia-Pacific Regional Forum on the Role of Intellectual Property Offices in the 21st Century
(Tokyo, September 13, 2001)

- Protection of Intellectual Property Rights of Advanced Technologies for the Benefit of SMEs, Venture Businesses and Research and Development Institutions
- The Benefits of the Global Protection Systems and the Progressive Harmonization of Intellectual Property Laws
- Human Resource Development for the Efficient and Effective Protection of Intellectual Property Rights
- Policy and Strategy for the Use of Intellectual Property Information
- WIPO's Response with reference to the Desires Expressed by the WIPO Asian Regional Fora held in the Past

Figure 18. Joint statement adopted by the Asia-Pacific Regional Forum of the WIPO.

Infrastructure, Platform, and Environment for the Creation, Protection, and Exploitation of Intellectual Property

Dr. L.C. Lee
Duputy Executive Director (Research)
Singapore Institute of
Manufacturing Technology
Singapore

INTRODUCTION

We live in an era in which rapid technological advances and proliferating consumerism are powering one another. In such an environment, a premium is placed on innovations, inventions, know-how, proprietary work, etc. Collectively these are recognized as intellectual property (IP). Until recently, IP was considered to be the domain only of large organizations. This perception has changed significantly as there is now a wider awareness of the value of IP by individuals, enterprises, and governments. Still, the claiming and protection of IP are fraught with uncertainties and difficulties. This is particularly so for countries and companies new to this endeavor as there are many intricate issues and repercussions that often go beyond national borders.

There are compelling reasons for countries to develop the necessary IP infrastructure, services, and environment. The progressive dismantling of trade and market barriers provides both opportunities and threats for indigenous products and labels. It is not well understood that IP may sometimes need to be used as a defensive mechanism. It is not uncommon for companies to find that foreign interests can obstruct their businesses when they have not registered proprietary claims.

The divide between knowledge-based economies and labor-abundant economies is diminishing rapidly. The entry barrier to product innovation, design, and development has shrunk markedly with the easy availability of computer-aided and information and communications technology know-how and tools. The increasingly shorter time to market provides ample opportunities for smaller players to make contributions with innovative devices and artistic creations. To capitalize on and exploit their intellectual assets they will need to make the appropriate claims on IP.

Table 1 shows the figures for the patents filed and granted for a number of Asian countries. The number of patents filed and granted in terms of population per million roughly reflects the status of industrialization. The ratios of patents granted/filed are interesting as they reflect the experience and prudence in the filing of patents by the more developed economies. These statistics augur well as they show that the developing and newly developed economies are making their presence felt in the international IP arena. As IP is now very much an integral part of trade and economic agreements, the national infrastructure, platforms, and environment for IP must be carefully planned and put in place.

Table 1. Number of patents filed/granted in 2000.

Country	Filed	Granted	Granted/filed(%)
Japan	486,204	125,880	25.9
Republic of Korea	172,184	34,956	20.3
China	122,306	13,356	10.9
Singapore	70,191	5,090	9.3
India	60,942	N.A.	-
Indonesia	60,363	N.A.	
Vietnam	59,776	727	1.2
Mongolia	59,076	125	0.2
Sri Lanka	58,929	N.A.	-
Hong Kong	8,295	2,737	33.0
Thailand	5,665	541	9.5
Philippines	3,636	566	15.6

NA, figures not available.
Source: World Intellectual Property Organization, as of October 2003.

Cognizant of the importance of small and medium-sized (SME) enterprises in most economies and the assistance required by them, the World Intellectual Property Organization (WIPO) has established an SME division. The main objectives of the division are to: 1) promote greater use of the IP system; 2) strengthen the capacity of national governments to develop strategies, policies, and programs; 3) improve the capacity of relevant public, private, and civil society institutions to provide IP-related services; and 4) provide comprehensive Web-based information and basic advice on IP issues (WIPO Web sie).

TERMINOLOGY

According to WIPO, IP refers to creations of the mind: inventions; literary and artistic work; and symbols, names, images, and designs used in commerce. There are two categories of IP: industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source; and copyright, which includes literary and artistic work such as novels, poems, plays, films, musical compositions, and art such as drawings, paintings, photographs, sculptures, and architectural designs. Good references on IP are the *WIPO Handbook: Policy, Law and Use* and the WIPO Web site (www.wipo.int). Some common IP terms are defined as follows (WIPO Web site and Intellectual Property Office of Singapore Web site).

Patents are an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something by a specific person or enterprise. A patent generally provides protection for 20 years, subject to annual renewal. In the patent application, full disclosure of the invention and explanation of the mechanics by which the invention works are required. In return, the patent holder is given a monopoly to enable him/her to prevent others from using, copying, or producing the invention without his/her consent. A patentable invention can be a product or a process that gives a

new technical solution to a problem. It can be a new method of doing things, the composition of a new product, or a technical improvement on how certain objects work. A patent is a form of property and can be assigned, licensed, or mortgaged.

A trademark (or brand name) is a distinctive sign identifying certain goods or services produced or provided by a specific person or enterprise. Such a sign includes any letter, word, name, signature, numeral, device, brand, heading, label, ticket, shape, color, aspect of packaging, or any combination of these. The period of protection varies, but can generally be renewed indefinitely.

Copyright and related rights are given to creators for their literary and artistic work, including software. Related rights are granted to performing artists, producers of sound recordings, and broadcasting organizations for their radio and television programs. Copyrights do not generally protect ideas or processes, except for software.

Geographic indications are signs used on goods that have a specific geographic origin and often possess qualities or a reputation due to the place of origin. Industrial design covers the ornamental or aesthetic aspect of an article produced by industry or handicraft. Registration and renewals generally provide protection for up to 15 years.

Trade secrets/undisclosed information are protected information not generally known among or readily accessible to, persons that normally deal with the type of information in question, has commercial value because it is secret, and has been subjected to reasonable steps to keep it secret by those lawfully in control of the information.

INTELLECTUAL PROPERTY REGULATORY BODIES

WIPO was established in 1970 with the mandate to administer IP matters recognized by the member states of the UN. The roots of WIPO can be traced to 1883 when the Paris Convention for the Protection of Industrial Property was conceived. In 1974, WIPO became a specialized agency of the UN with the mandate to administer IP matters recognized by member states. The close link between intellectual property rights (IPRs) and globalized trade is signified by the cooperation agreement sealed between WIPO and the World Trade Organisation (WTO) in 1996. Today, WIPO administers 23 treaties and serves myriad roles, including: 1) harmonizing national IP legislation and procedures; 2) providing services for international applications for IPR; 3) exchanging IP information; 4) providing legal and technical assistance to developing and other countries; 5) facilitating the resolution of private IP disputes; and 6) marshalling IT as a tool for storing, accessing, and using IP information. To date, WIPO has 179 member states.

One of the most significant treaties administered by WIPO is the Patent Cooperation Treaty (PCT) concluded in 1970. The treaty makes it possible to seek patent protection for an invention simultaneously in each of numerous countries by filing an international patent application. The patent can be filed with the national patent office of a contracting state of which the applicant is a national, or resident of, with the International Bureau of WIPO in Geneva. Among the contracting states, applicants indicate those in which they wish to have effect, referred to as designated states. As of 30 July 2003, there were 122 contracted states of the PCT.

WIPO is constantly monitoring and updating its norms and standards to keep up

with technology advances and changes in business practices and traditional knowledge. In June 2000, the Patent Law Treaty was adopted to standardize the divergent requirements of different patent systems in patent applications and patents. This allows users of patents to enjoy more predictable and simpler procedures for filing national and regional patents and maintaining patents in all the contracting parties. WIPO is currently drafting a treaty to protect performers against the unauthorized use of their performances in audiovisual media. Attention is also being given to the sharp rise in Internet communications, especially for e-commerce and information and knowledge exchanges. Under its Digital Agenda, it is examining the confluence of the Internet, digital technologies, and IP. In the area of enforcement, WIPO is introducing mechanisms to provide speedy protection of new inventions and commercially valuable assets in multiple countries. To help train IP human resources for developing countries, WIPO set up a Worldwide Academy. Tailor-made programs are provided for policy advisers, development managers, and other IP personnel.

ENVIRONMENT FOR INTELLECTUAL PROPERTY CREATION

The last decade saw strong growth in the economies of many countries, especially those in Asia. While the initial aims were often to create jobs for the masses, the priorities soon shifted to moving up the value chain. In varying degrees the goal was to arrive at a knowledge-based economy. In climbing the value chain, the establishment of the necessary infrastructure and environment for creativity and innovation is critical. The education system at all levels should emphasize the importance of science and technology and imbue a spirit of curiosity and exploration. The workforce must see clear motivations and rewards for pioneering new ideas and be proactive in suggesting improvements in products, processes, and productivity. An entrepreneurial environment must prevail, allowing those with a creative flair to initiate new businesses and industries.

The circumstances in which individuals and enterprises can start new ventures have changed considerably in recent years. The emergence of the venture capital industry provides a useful source of equity funds. Very often the venture capital enterprises also pitch in with market and management support. Financial institutions are beginning to introduce special schemes for start-up companies and individuals with good business plans. Advances in information and communications technologies have made the overheads of starting a business much lower. A relatively modest outlay and a small staff are now adequate to cater for most administrative, publishing, procurement, accounting, and financial management needs. Furthermore, the Internet provides a powerful means of reaching the market and consumers globally.

WIPO set up the Division for Infrastructural Services and Innovation Promotion (DISIP) in 2000. DISIP focuses on improving and creating innovation support services, promoting innovation and creativity, assisting and providing expertise to R&D organizations and centers in commercializing inventions and in protecting IPRs. In addition, it provides advice on the development of national IP information infrastructure and IP information services and how to reward inventors and innovators for their creative ingenuity. Activities of DISIP include providing long-term training for officials working in the fields of innovation promotion and technology management, organizing

workshops and training programs on innovation promotion services and their management, organizing international symposia to promote information sharing among inventors and their associations, providing training and assistance for on-line and state-of-the-art searches of patent document collections and on-line databases, and introducing the WIPO University Initiative where IP coordinators at selected universities are linked to IP offices to provide researchers, academic staff, and students with easy access to information on IP in support of R&D or teaching. DISIP maintains a directory of innovation centers to facilitate the location of innovative support services, structures, and centers worldwide. The WIPO Award Scheme was launched in 1979 to stimulate inventive and innovative activities and improve the image of inventors through recognition of their merits as creators of substantive inputs to national wealth and development. For the young there are the Enterprise Olympics for 16−18-year-old high school students, the First International Students' Invention Exhibition, and the Young Inventors International Innovation for the Future Competition.

INTELLECTUAL PROPERTY AS A PROFIT-MAKING ASSET

Until ideas and creative outputs are converted into innovative products and services, they are of little value. Thereafter, the ownership of IPRs must be established before the inventors or creators can enjoy the fruits of their creativity by turning IP into a profit-making asset. The situation is not always simple as the cost associated with IP application and maintenance can be high. However, it is also necessary to be aware of the consequences of not proceeding with the filing of claims on IP. First, someone else may patent or copyright the invention or creation. Second, competitors may exploit the invention without any payment if the product proves successful. As they do not need to recoup the expenditure on R&D, competitors may be able to sell the product at a lower price. Third, it is difficult to sell, license, or transfer technology without IPRs.

Often too little effort is made to value IP as a tangible asset of an enterprise (*WIPO Magazine*, 2003). One survey showed that the majority of firms in the UK do not undertake a formal evaluation of their IP assets. Of 226 Fortune 500 companies surveyed in the USA, 76% did not assign value to their intellectual capital. Yet it was estimated that the intangible assets of S&P 500 companies amounted to 75% of their value (Rodgers and Ratliff, 2000). The Business Week annual ranking of top brands found that Coca Cola took the top position with a valuation of US$70.45 billion, followed by Microsoft and IBM with US$65.17 billion and US$51.71 billion, respectively. These figures represent from 70% to 99% of the market capitalizations of the companies (*WIPO Magazine*, 2003).

There are several avenues by which IP can provide commercial returns for an individual or enterprise. The most direct means of value generation is through income derived from licensing, sale, or commercialization of IPR-protected products or services. To license IP, it is necessary to evaluate its worth. While this is as much an art as a science, some systematic approaches can be employed (*WIPO Magazine*, 2003). The most common method is the income approach that estimates the present value of a stream of revenue that would result from the use of the underlying IP asset during its economic life. A growing form of licensing is through franchising. Typically, the three components of a franchise are the stipulated way of operating the business, the use of a

distinct trademark or service mark, and the payment of joining and operating fees and/or royalty fees.

The financial sector is increasingly prepared to consider IP as collateral. Venture capitalists are strongly influenced in their decisions to invest in start-up companies by IP portfolios. Banks are starting to grant loans to enterprises with IP as security. It is well documented that artists have been able to obtain advances from financial houses based on future royalty streams from their copyrighted works. The share prices of some companies have been known to rise sharply upon the granting of key IPRs.

IPRs are not always acquired for direct monetary gain. Sometimes they are obtained for strategic product dominance and marketing reasons. This modus operandum is usually employed by large corporations to maintain their market share in certain products or markets. They constantly trade and cross-license IP and/or maintain patent pools with their competing counterparts. This approach is occasionally also used by smaller companies to protect their core technologies (McCombs and Ehmke, 2001).

SME INTELLECTUAL PROPERTY PROFILE

Most economies are composed predominantly of SMEs. The image of SMEs has undergone considerable change. Whereas traditionally SMEs were stereotyped as largely conservative, family-controlled businesses, the evolving perception is that SMEs can be agile, vibrant, and innovative. A significant number of these enterprises are now led by technology-savvy entrepreneurs with fresh ideas and clear goals. Increasingly, SMEs are utilizing IP as an important part of their business strategy.

Some would go as far as to say that "all businesses can benefit from patent protection, but small businesses can't survive without it" (Wilder, 2001). Evidence of the growing prominence of small companies on the IP scene is shown by the share of IPRs granted to start-up firms and independent inventors in the USA (Rivette and Kline, 2000). In 1972, the share of start-up and first-time patent recipients was only 5%. By 1992, the number had risen to 23%. The US Patent and Trademark Office distinguishes between small and large entities in its statistical computations. In 2000, the proportion of patents filed by small entities constituted 30.5% (21.6% of US-based and 8.9% of foreign applicants) of all filings. Although the corresponding figures for Asian countries are not available, it is expected that the trends would be similar.

Due to their limited resources the strategy adopted by the SMEs on patent ownership differs from those of large corporations. Patent applications are not only expensive to formulate and file but are also costly to maintain. Patent maintenance fees increase with time. Table 2 shows the strategies likely to be adopted by enterprises of various sizes (Cordsen, 1998). Generally, large companies are prepared to file patents on most inventions to enlarge their IP portfolios both as a preemptive means for product dominance and for potential for cross-licensing with competitors. At the other end of the scale, many SMEs do not file for IPRs either through ignorance or due to their modest financial and manpower resources.

With the rising tide of globalization, SMEs are forced to venture beyond their own shores to look for new markets and to follow the large manufacturers that are relocating to lower-cost countries. The Japanese SME Ubukata Industries, a manufacturer of electronic sensors used in motors and other equipment, can be used as an example

(Aggarwal, 2003). Ubukata's entire production was sold domestically until about 15 years ago. Now 80% of its products are shipped overseas to 16 countries, including China, the USA, and Europe. According to Chief Executive Shinya Ubukata, "Now I have to incur high costs in getting international patents to protect my products from being imitated. As more Japanese manufacturing shifts overseas, the SME suppliers will find it hard to meet the patent costs."

Table 2. Patent development strategies for enterprises.

Overall strategy	Example of patentee	Remarks
Every patentable invention patented, both nationally and internationally	Contract research organizations 10 years ago; some large Japanese companies	Strategy may either be due to lack of marketing competence or dictated by the wish to be seen as high-tech, regardless of price
Every patentable invention patented; only those showing potential for substantial profit subsequently patented internationally	Many technology-based large and medium-sized companies	Filing of patents seen as insurance. When serious costs occur, cost-benefit analysis decides future steps
Patents filed selectively based on profitability forecasts. If forecasts prove too optimistic, application withdrawn before becoming public (15 months)	Many technology-based SMEs	Probably most efficient way of using the patent system. Danger of losing patent rights if predictions too negative
No filing of patents. Patent literature scrutinized to avoid infringement of existing rights. Occasionally prophylactic publication to prevent others from protecting	Both large and small companies, often in the electronics industry	Technology is developing so fast that it is outdated before the patent is issued; a cheap but dangerous strategy
No patents filed and patent literature not studied	Many SMEs	Strategy based on ignorance. Good possibilities may remain unexplored. Company in danger of being put out of business by patent-active competitors

THE SINGAPORE EXPERIENCE

The dot.com era was exemplified by a profusion of IT- and Web-based products and services, an endless stream of start-up companies, and easy access to venture capital funding. Although the dot.com bubble has burst, it left a number of positive legacies. One is that information and communications technology is now ubiquitous around the globe. Another tangible outcome is the lasting influence on creativity, entrepreneurship, and risk taking. While the venture capital industry was dealt a severe blow, it has regained its footing and good novel ideas, inventions, and creations generally encounter few problems in securing equity funding. Although the dot.com sector captured the most attention in its time, there were significant concurrent technology and business developments in the non-IT domain. Today, both IT- and non-IT-related innovations continue to power the advent of new products and artistic creations. The combined effects of a strong product design and development base and fostering a knowledge-based economy render it imperative for countries such as Singapore to put in place comprehensive IP machinery.

IP development in Singapore is best described as being still in its infancy. Although a national program to become a high-tech, high value-added economy was launched in the early 1980s, relatively little attention was given at the time to IP issues. This is because the innovative and creative part of the value chain was largely resident in the corporate headquarters of the multinational corporations (MNCs). IP-related outputs generated in Singapore were rather few. The situation saw a significant change when the first National Technology Plan was introduced in 1990/91. The MNCs as well as local companies were provided attractive financial incentives and comprehensive infrastructure support to start design and R&D activities in Singapore. At the same time, innovation and entrepreneurship were extensively promoted and nurtured in schools, universities, and public and private organizations.

SMEs represent a sizeable part of the Singapore economy. They comprise around 90% of total establishments, employ half of the workforce, and generate one-third of the total value added. As the productivity of the local SMEs is only about half that of their larger local counterparts and MNCs, a dedicated effort referred to as SME 21 was started in 2000 to build up their capabilities. The national criteria for a local SME are at least 30% local equity, fixed assets not exceeding S$15 million, and employing up to 200 workers for nonmanufacturing companies. The mission of SME 21 is to transform SMEs in terms of entrepreneurship and innovation, form a strong base and strategic partnerships with foreign SMEs and MNCs, and manufacture high value-added products and/or provide professional services globally. More details of SME 21 can be found at www.spring.gov.sg. The Singapore Standards, Productivity and Innovation Board acts as the first-stop agency to help SMEs in technology, business, and manpower improvements and match their needs to the appropriate partners, assistance schemes, and training programs.

The Association of Small and Medium-sized Enterprises (ASME) was established in 1986 as a self-help organization. ASME brings together entrepreneurs to exchange and share experiences and aspirations. It also acts as a point of contact with government bodies, embassies, and other external organizations to advance the interests and well-being of its members. In 1995, 100 local SMEs with good potential to develop into

global companies were identified by the Singapore Economic Development Board (EDB) for nurturing into "promising local enterprises" (PLEs) with an annual turnover of at least S$100 million. The PLEs that achieved this turnover figure numbered 52 in 2000, 83 in 2001, and 91 in 2002. This is well within the target of 100 companies by 2005. By 2002, the pool of companies in the PLE initiative had grown to 420. The average turnover of each company rose from S$80 million in 2001 to S$85 million in 2002. A Ministry of Trade and Industry 2002 survey showed that manufacturing-sector PLEs had about S$565 million in fixed assets and created 5,600 jobs, while those in the service sector contributed S$58 million in business spending and generated 400 jobs. Table 3 summarizes the framework for the creation, protection, and exploitation of IP by SMEs.

Table 3. Framework for IP creation, protection, and exploitation.

Infrastructure	- Agency for Science, Technology & Research (A*STAR) - Universities and A*STAR research institutes - Intellectual Property Office of Singapore (IPOS) - One North (Science/technology research hub) - EDB's Technopreneurship 21 (T 21) - SPRING Singapore's SME 21 - ASME - Action Community for Entrepreneurship (ACE) - Venture capital industry - National Arts Council - Colleges/schools for the arts - National venues for creative and performing arts
Platform	- Use-inspired research by the A*STAR research institutes and universities - High-tech start-up companies - EDB/SPRING/A*STAR financial incentive schemes - A*STAR/Singapore Science Centre youth/school outreach programs
Environment	- Five-year national technology plans - Push toward knowledge-based, high-tech economy - Entrepreneurship drive - Proliferation of information & communications technologies - Globalization of trade, products & services - Free trade agreements - Active policing & enforcement of IPRs

Intellectual Property Creation

The key components of a strong IP infrastructure are the agencies and institutions to nurture R&D and artistic talent, funding and financial incentives to encourage activities leading to IP generation, and programs and events to promote a mindset of creativity and

enterprise. The blueprints for R&D and innovation in Singapore are set out in the National Technology Plan. The five-year plans covering 1991−95, 1996−2000, and 2000 −05 were supported with budgets of S$2 billion, S$4 billion, and S$7 billion, respectively. A large part of the budget is allocated for the setting up and running of public research institutes, providing incentives to companies to start design and development departments, and inculcating awareness and interest in science and innovation among the population. The Agency for Science, Technology & Research (A*STAR, previously the National Science and Technology Board) is the lead agency for R&D and currently oversees 12 research institutes that collectively have more than 1,000 researchers. The institutes, with disciplines spanning the physical and biomedical sciences and engineering, act as a technology bridges between universities and industry. Since the focus of the research institutes is on "use-inspired" research, IPRs form an important part of the outputs. IPRs in the form of patents are licensed out to local companies for commercialization or transferred out through start-up companies.

A*STAR has embarked on a comprehensive science outreach initiative to interest and engage students and the young in science, technology, innovation, and enterprise. One program to bring research to the classroom involves the assignment of researchers as mentors to students and teachers. In collaboration with the Ministry of Education, four clusters of science and technology were established as platforms to stimulate and cultivate an interest in science and research among students. The centers provide an avenue for secondary and junior college students to interact with researchers from universities, polytechnics, research institutes and centers, and industry. Workshops and conferences are conducted regularly and annual exhibitions and competitions are held for students to showcase their projects and to get feedback. A*STAR also partners the Singapore Science Centre in the Upstream Project, which comprises a comprehensive range of programs and activities. Included in the Upstream Project initiative are the annual National Science Talent Search, Sony Creative Science Award, Tan Kah Kee Young Innovator's Award, National Junior and Senior Robotics competitions, Singapore Science and Engineering Fair, and Innovator's Week. More details can be found at the www.a-star.edu.sg Web site.

Universities, polytechnics, and schools play a critical role in nurturing future generations of talent. Whether the products of these educational establishments possess the inclination and aptitude to create and innovate depends heavily on the curricula, teaching methodologies, and training in attitudes and mindsets. Universities are placing increasing emphasis on economically relevant research and entrepreneurship. While much of the research outputs is channelled to publications in journals and at conferences, the number of patents filed has been rising steadily. In statistics from the WIPO Web site, the National University of Singapore (NUS) filed 28 patents in 2002, which was in ninth place among PCT applications from developing countries. This was ahead of Philips Electronics Singapore Pte. Ltd, ranked 10th with 24 applications. The Nanyang Technological University (NTU) was in the 27th place with 10 applications.

The Industry and Technology Relations Office (INTRO) of the NUS was set up in 1992 to promote technology transfer and facilitate joint research between the university and industry. INTRO manages a portfolio of technologies which has generated 150 licensing agreements and spun off 35 technology-based companies. This flow of

high-tech SMEs serves as a useful catalyst to help transform their peers in industry. The Innovation and Technology Transfer Office (ITTO) was established in 2000 to promote and transfer NTU innovations and intellectual capital to industry and help spin off companies. The Innovation Centre within the ITTO provides incubation space for small technology companies to carry out R&D. These companies can tap the pool of expertise and excellent facilities of the university. One noteworthy program of the ITTO is the TechnoGarage, which provides a well-equipped physical space for students to develop their ideas. The students can apply for a TechnoFund of S$5,000 to S$20,000 to support their developments and have access to mentors who will help them to produce business plans and link up with venture capitalists and potential customers.

The drive to generate a dynamic arts scene to complement technoeconomic national development provides increased space and good opportunities for the emergence of indigenous creative work. The National Arts Council (NAC), which was set up in 1991, spearheads the development of the arts to make them an integral part of the culture and society. One key function of the NAC is the development of artistic talent and arts organizations. It administers a total of 27 financial assistance schemes that include grants, scholarships, and bursaries, arts awards, arts housing, and competitons. Tertiary institutes such as the Nanyang Academy of Fine Arts and the Lasalle-SIA College of the Arts cater for those with a creative and artistic bent. A secondary school for the arts is being considered. For the creative and literary arts to develop, suitable display and performance venues are required. The recent opening of the multipurpose Esplanade-on-the-Bay theater complex was a strong boost for the arts scene.

Intellectual Property Protection

The decision to proceed with the filing for protection of IP, especially patents, is a vexing one for individuals and SMEs. A major consideration is the cost associated with the application and maintenance. Due to the complexity of patent documents and the legal skills required, it is generally advisable to engage the services of a patent lawyer or agent. To qualify for patent protection, an invention must have three attributes: 1) it must be new or novel; 2) it must not be obvious and should involve an inventive step; and 3) it must be industrially applicable, i.e., if it is a product it can be made and if it is a process it can be used. Patents are granted upon application in a formal procedure through a national patent regulatory authority. An important condition for the granting of a patent is that the invention must be clearly and fully described so that anyone with ordinary skills in the art can retrace the steps. The scope of the protection is defined by the "claims." Rigorous patent searches are advised to avoid infringement and also to ascertain whether the patent is worth filing. A good knowledge of the prior art reduces the likelihood of the claim scope being narrowed during prosecution. The patent, when granted, confers on the owner the right to prevent others from exploiting the invention for a fixed period, which is normally 20 years. The additional question the inventor must confront is whether to file only in the home country or to pursue international patenting. For such multiple filings there may be translation costs on top of the filing costs.

A registered trademark can continue indefinitely, subject to renewal every 10 years. It is not necessary to register a trademark to use it. A trademark can be considered as a form of property which can be licensed or assigned. Unlike patents, trademarks that are

already in use can still be registered without any time limit. However, trademark registration is required to pursue a lawsuit of infringement. It is possible to have priority claims in trademarks. If an applicant has a corresponding application filed in a Paris Convention country or WTO member country it is permissible to claim priority from the first filed application, provided that the registration in Singapore is filed within six months from the date of the first filing.

In Singapore, as in most countries, copyright protection is automatic. Where copyrights are filed, the cost is usually low and the procedure simple. They are used mainly for protecting advertisements, Web pages, etc. As long as a work is independently created it has copyright protection. It does not matter if there is another work that is the same or similar as long as it can be proven that there was no copying from that other work.

A registered design lasts initially for five years from the date of filing. The registration can be renewed every five years for a maximum of 15 years. Singapore, like many countries, allows priority claims in the application for design registration.

The inventor or enterprise may choose to keep the IP as a trade secret. The law protects this information as a secret from everyone except key people in the company. The company can impose nondisclosure agreements in employment contracts or with those who come in contact with the company to protect the confidentiality of the information. Legal action can be taken against persons who reveal this secret information to others, especially if they are aware that it is a secret. There is no registration procedure and there is no time limit in which the secret may be protected.

There are potential inherent problems associated with not filing for IPRs. The worst scenario is that someone else may patent the invention and consequently restrict the use of the IP. A second scenario is that when the product is successful, competitors will enter the market without the need to pay any fees. SMEs are particularly vulnerable as large companies can sell the products more cheaply because of their economics of scale and their superior distribution networks. The third problem is that it is extremely difficult to license IP without ownership of the rights.

The first instrument for IP protection in Singapore was the Trademarks Act of 1937. The Registry of Trademarks and Patents was set up primarily as a regulator of trademarks and the re-registration authority of UK-registered patents. This arrangement was found to be satisfactory as the number of filings was small. In 1999, the number of filings rose to a level where it was found necessary to restructure the Registry of Trademarks and Patents as the Intellectual Property Office of Singapore (IPOS). The vision of the IPOS is to foster a creative Singapore where ideas and intellectual efforts are valued, developed, and exploited. This is achieved through the provision of an infrastructure, platform, and environment for IP creation, protection, and commercialization. The core functions of the IPOS are:

1) provision of a sound legal and administrative framework for the promotion and protection of IP;
2) formulation and review of IPR policies and legislation;
3) maintenance and dissemination of IP information and documents;
4) representation of the Singapore government internationally as an IP agent;
5) collaboration with other organizations and IP offices on IP programs; and
6) promotion of awareness, respect, and effectiveness of IPRs.

Table 4. Major milestones of the IPOS.

1937	- Trademarks Act came into force - Registry of Trademarks and Patents set up mainly as regulator of trademarks and for re-registration of UK-registered patents
February 1995	- Patents Act came into force, establishing an independent patent system
September 1999	- Registry of Trademarks and Patents restructured as IPOS to oversee all IP laws in Singapore
July 2000	- e-Patents, an on-line portal for patent transactions over the Internet, launched
November 2000	- Registered Designs Act came into force and Registry of Designs set up - SurfIP, a one-stop search portal with multiple patent search databases, launched - First IP Week 2000 held
April 2001	- IPOS converted to statutory board under Ministry of Law
October 2001	- Concluded negotiations on IP chapter of Japan-Singapore New Age Economic Partnership Agreement
December 2001	- Concluded negotiations on IP chapter for European-Singapore Free Trade Agreement
January 2002	- eTrademarks, an on-line trademark filing system, launched - Patent agent registration system implemented
April 2002	- Human + Intellectual Property (HIP) Alliance launched to promote IP awareness - April designated IP month, with high-profile public events and business seminars
June 2002	- IP Education and Resource Centre launched
November 2002	- Intellectual Property Creation, Protection, and Exploitation Program launched
January 2003	- Concluded negotiations on IP chapter for US-Singapore Free Trade Agreement - IP Academy launched
March 2003	- IP Parade, a networking platform for IP owners and investors, launched

Despite its short history, the comprehensive infrastructure and service support functions of the IPOS are impressive. Its Web site (www.ipos.gov.sg) provides information on a spectrum of IP services and activities. The major milestones of the IPOS are listed in Table 4. To improve the access to IPOS services, e-patents were introduced as a facility for on-line submission of patent applications, annual renewal of

patents, etc. SurfIP is a first-stop IP portal that can be used for searches for prior art, business intelligence gathering, and licensee sources. The Human + Intellectual Property (HIP) Alliance is a public outreach and education program to raise public awareness of IP. The slogan for the HIP Alliance is "Live for Real," a call to respect originality and IPRs in literature, films, music, fashion, and software. The IPOS engages the IP community through roundtable discussions and it has recently formed a taskforce consisting of members from business associations and government statutory agencies to help prepare for changes in the IP laws to meet the requirements of various free trade agreements.

To encourage individuals and SMEs to protect IPRs, the EDB set up a S$10 million Patent Application Fund called PLUS. The support covers professional and official fees and other related charges for patent filing. The level of support is capped at S$30,000 for each invention, which is estimated to be half of the total cost of processing a patent in Singapore.

As part of efforts to develop the IP infrastructure, the IPOS together with the Ministry of Manpower (MOM) launched the Strategic Manpower Conversion Programme in Intellectual Property (SMCP [IP]) to build up a thriving pool of IP manpower and specialists for protecting, exploiting, and managing IP assets. The SMCP (IP) draws on MOM's Manpower Development Scheme for those who wish to reskill themselves for a new career in the growing IP sector.

The IP Academy was set up with the mission of promoting education and training, research, and scholarship in IP. The education charter is to provide continuing education and lifelong learning opportunities for IP professionals, businesses, and research organizations. The research charter is meant to strengthen national IP capabilities and stay abreast of developments in the international IP community. Over the next five years, the EDB aims to create a new IP management sector with about 5,000 jobs.

Table 5. Number of patent applications filed in Singapore.

Year	Re-registration applications	Direct national filings and PCT applications entering national phase	Total
1990	1,028	-	1,028
1991	1,104	-	1,104
1992	1,354	-	1,354
1993	1,426	-	1,426
1994	1,818	-	1,818
1995	2,329	2,412	4,741
1996	2,802	12,357	15,159
1997	2,140	6,048	8,188
1998		6,367	6,667
1999	-	6,679	6,679
2000	-	7,720	7,720
2001	-	8,133	8,133
2002	-	8,070	8,070

Source: IPOS.

Since Singapore established the independent patent system in 1995 and the setting up of the IPOS, there has been a steady increase in the number of patents filed in Singapore (Table 5). However, the number of patents granted to Singapore residents is still relatively low (Table 6).

Table 6. Number of patents filed/granted to Singapore residents.

Year	No. of patents filed	No. of patents granted*
1995	145	20
1996	224	30
1997	288	20
1998	311	30
1999	374	50
2000	516	110
2001	523	170
2002	624	240

Source: IPOS.
* Figures rounded to the nearest tens.

IP Exploitation

An excellent example to illustrate the gains derived from IP for an individual or SME is the sale of the manufacturing rights by James Russell for the compact disk in 1980 to Philips and Sony. This achievement is particularly significant when it is realized that Philips holds 75,000 patent rights. From another perspective, an increasing number of start-up companies depend on IPRs to sustain and grow their core businesses. Some of those companies have since become large corporations. A worthwhile case to highlight the foresight of exploiting an invention is how the mouse and graphic-user interface developed at the Xerox Palo Alto Research Center were commercialized by Apple on its Macintosh computers (Field, 2001). At the Massachusetts Institute of Technology, 2,000 patents are filed annually, and scores of start-ups generate more than US$30 million a year. For many SMEs, the returns are not directly from the sales or licensing of IP, but more as a form of insurance for the long-term viability of the company. IP can also be employed as assets to secure equities or funds.

The extent to which IP can be effectively exploited depends on the resourcefulness of the inventor or enterprise and the availability of funds for commercialization and marketing. In Singapore the drive toward a more entrepreneurial economy is given high priority. The EDB initiated the T21 Technopreneurship Programme in 1999 to focus on the four key areas of education, facilities, regulations, and financing. In education, the school system is being revamped and the universities developed into world-class institutions that will not only produce trained manpower but will also serve as generators of business opportunities. For infrastructure support, a science and technology hub, the One North, was created as a first-class facility to attract international talent to research organizations and knowledge-based high-tech industries. Rules and regulations are being reviewed to remove obstacles to entrepreneurship. In the area of financing, a US$1 billion Technopreneurship Fund was allocated to attract venture capital activities to Singapore. Under T21, a number of schemes were introduced to help SMEs. In the

Technopreneur Investment Incentive Scheme, the EDB shares the risk of high-tech ventures with investors. A start-up company qualifying for this scheme can issue a certificate for up to S$3 million of investment to investors, who can then deduct any investment loss from taxable income. The Director and Advisors for Technopreneurial Enterprise scheme assists in the placement of experienced businesspeople to guide start-up companies, particularly in financial management and marketing. The Locally-based Enterprise Advancement Programme (LEAP) supports organizations such as industry groups, business and trade associations, and incubators. These LEAP partner organizations are seen as multipliers and growth accelerators. Start-ups are encouraged to work with LEAP partners to expand and move up the value chain. They can tap a capability development grant managed by the EDB for new initiatives.

In May 2003, the Action Community for Entrepreneurship (ACE) was launched to bring together a diverse group of people wishing to create a more entrepreneurial and creative environment. The public-private organization is open to businesspeople, workers, civil servants, and students. The roles of ACE are to: 1) serve as a peer support group for entrepreneurs by entrepreneurs; 2) drive the implementation of initiatives, programs, and projects to nurture entrepreneurship; 3) interface between the private sector and the government; and 4) raise the profile of entrepreneurs and reach out to the public. ACE has identified five action areas: rules, financing, culture, global entrepreneurial executives, and IP. "BlueSky evenings" are held for informal networking sessions for entrepreneurs to meet other entrepreneurs, "angels," venture capitalists, bankers, lawyers, consultants, etc. More information on ACE can be found at www.ace.org.sg.The NUS set up an Entrepreneurship Centre to nurture the spirit of entrepreneurship and innovation among the university community through education and outreach programs and to advance knowledge of technology venture practices. The center offers a range of technopreneurship-related courses for undergraduate and graduate students as well as continuing education programs for alumni and other professionals.

The NUS has appointed a technology broker to help market IP outside Singapore. The Venture Support initiative was set up in 2002 to provide up to S$300,000 for staff, student, and alumni start-up companies. A business incubator will provide office space and related support. The NTU also has a Technopreneurship Centre, which according to Director Professor Tan Teng Kee, "promotes an entrepreneurial culture by planting the seeds for new ventures, preparing entrepreneurs through technopreneurship education, and providing the infrastructure to perpetuate and support new start-ups and ventures."

The lifeline of technology-based companies can often be traced to venture capitalists. Typically, enterprises receiving equity funds from venture capitalists and business angels are start-ups with enthusiastic business plans and innovative products or services. These companies depend heavily on inventions, novelties, ideas, and IP ownership to succeed and grow. In Singapore, the venture capital industry has regained its vigor after the bursting of the dot.com bubble. By mid-2003 there were 150 fund management companies in Singapore managing S$16 billion worth of venture capital funds, a small increase from 144 firms with $15.2 billion in 2002 (Tan, 2003). It was reported by the independent research firm Thomson Financial that, of the US$1.86 billion invested in the Asia-Pacific region, US$226.6 million was invested in Singapore. It is estimated that more than 700 companies in Singapore have received funding of

some type from venture capitalists. This figure compares well with that of Israel, which has slightly more than 800 firms. Two years ago, the EDB introduced the S$50 million Start-up EnterprisE Development Scheme (SEEDS). Under this initiative, SEEDS will jointly invest with venture capitalists in start-up companies. According to the Chairman of the EDB Teo Ming Kian, "SEEDS has so far participated in the funding of 80 companies with innovative ideas, high growth potential, and the ability to reach international market." Singapore is likely to start what is probably the first permanent school dedicated to the training of venture capitalists. The Singapore Venture Capital and Private Equity Association is planning to join with the Singapore Management University and Insead to form an Asia-Pacific Venture Capital and Private Equity Institute.

One significant development that is expected is a private equity exchange in which SMEs can raise funds "over the counter" (OTC) (Guevarra, 2003). Based on the Taiwan model, the OTC market provides a more expedient way to raise equity than by listing on the stock exchange or through venture capital funds. The Taiwan Prelisting Market has more than 400 dealers, with more than 2,000 SMEs generating a trading volume of around US$40 billion each year (*Straits Times*, 14 September 2002). Other models that are being reviewed are the London Off Exchange, a low-cost trading facility that allows start-up businesses to trade share options or raise small sums of money, and the Shenzhen High Technology Property Exchange, which even allows the trading of IPRs. One disadvantage of selling shares in the private share markets instead of working with private equity investors is the loss of opportunities for hand-holding by those private investors.

Connections, or the lack thereof, can make or break an enterprise. SMEs and start-up companies usually require greater assistance in this area. The IPOS recently initiated IP Parade as a platform for the trading and exchange of IPRs between IP owners, IP service providers, and IP investors. A listing of IP is featured on SurfIP for sustained market exposure and to allow interested investors and collaborators time to pursue opportunities. SurfIP is particularly important for SMEs that lack the resources to take a product to market and are looking for licensees. Conversely, there are cases in which an SME may be looking for business opportunities and is willing to take out a license to commercialize patented products. The IP showcased includes technologies, franchises, trademarks, and designs, as well as copyrighted works. The scope of IP Parade extends to the organization of exhibitions and conferences, such as the Optimal 2003 Exhibition and Conference that brought together more than 200 IP sellers and buyers.

CONCLUSIONS

Ms. Shona Tan-James of IE Singapore pointed out that firms need the three C's of competence, connections, and capital (*Straits Times*, 11 October 2003). These requirements are more acute for SMEs. Of the three C's, the most fundamental is probably competence. As competency is often a form of intellectual capital, this creates a dilemma for SMEs. Should they keep IP as a trade secret and depend on the loyalty of their employees to protect it? Or should they safeguard it with IP instruments, with the associated costs and the need for full disclosure? It is not inappropriate for the filing of

IPRs to be equated with the purchase of insurance. It is difficult to ascertain whether the investments made will result in the expected returns.

It is important to realize that the ownership of IPRs does not necessarily mean that competitors will not be able to utilize an invention. The legal aspects of IPR filing and claims are complex. While patent agents and lawyers can help considerably in protecting IP, large companies with their deeper resources can frustrate and hamper the smaller players. In this respect, isolated IPR claims are particularly vulnerable. The situation is much improved if the inventions are covered by a portfolio of IPRs. It is also advisable for the claimants to commit time and resources in prior searches and patent mapping to guide technology development.

Despite the numerous obstacles confronting SMEs in IP creation, protection, and exploitation, it is an undertaking that they can ill afford to ignore. The progressive mass customization of products and services and the sharp reduction in life cycles require companies to be agile and responsive. Large companies have responded to this by outsourcing more of their manufacturing and service functions to subcontracting SMEs. Very often large companies demand that these SMEs move up the value chain and take responsibility for design and development. The emerging high-tech entrepreneurial start-up companies are increasingly changing the profile of SMEs. These companies are now much more savvy in IP matters. Their greater concerns are the other two C's of connections and capital. There is little doubt that SMEs in the 21st century face a different set of challenges from their predecessors. In a knowledge-based and technology-driven environment, SMEs can no longer play a passive and subservient role. The acquisition and ownership of intellectual capital can potentially be an important launchpad for innovative and progressive SMEs. While some SMEs will naturally find the transition in the industrial landscape bewildering, others will seize the opportunity to grow rapidly.

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Protection of Intellectual Property for Small and Medium Enterprises

Dr. Leah Lo
Director, Technology Transfer Office
National Health Research Institutes
Taipei, Taiwan, Republic of China

INTRODUCTION

Intellectual property rights have become very important. The protection of intellectual property is critical to small and medium-sized enterprises (SMEs). In particular, intellectual property is the lifeblood for science- and technology-based enterprises that devote so many of their resources to R&D. This paper discuses the importance of intellectual property and how SMEs can protect it and proposes some practical suggestions for intellectual property protection.

WHAT ARE INTELLECTUAL PROPERTY RIGHTS?

Patents, trade secrets, trademarks, and copyrights all form part of intellectual property that can be protected. Among them, trademarks and copyrights are unambiguous, while in some cases patents and trade secrets involve gray areas. When an invention or innovation has been developed, it is important to choose the appropriate legal protection. Some indications for whether to file for patent protection or treat it as a trade secret include whether: 1) secrecy is difficult or impossible to maintain; 2) the invention has good prospects for obtaining strong patent protection; 3) the likelihood of independent invention is high; 4) the commercial prospects for the invention justify the cost of patent protection; and 5) the product life and development time scale fit the patenting process. If an invention meets any of these conditions, a patent application can be considered.

In most countries, patent applications require formal registration with the authorities. Most require an examination process before a patent is granted. A patent right is not an affirmative right, but the right to exclude others from making, using, and selling the patented objects. In other words, a patent grants monopoly rights for a certain period of time, usually 20 years from the application date, to the patent owner. In return, the patent owner must disclose his/her invention. Patent rights are only granted to novel, useful inventions that are not obvious developments from another patent.

There is an emphasis on novelty. There can be no such "prior art" existing either from others or from the patent applicant. When determining whether prior art from others exists, the inventor must ensure that there is no public use or sale, no public domain knowledge, no patent, and no previous description in a printed publication. If the inventor made a public announcement prior to applying for a patent, he/she may seek a grace period to compensate for the disclosure. Nevertheless, it should be remembered that a patent should precede publication. Important patents may sustain a company's life.

The differences between the potentially patentable matter and prior art must be analyzed to determine what is not obvious. Would the subject matter as a whole have been an obvious development? This must be considered as an ordinary skill in the art when the subject was invented. Hindsight is not allowed.

Knowledge may be considered a trade secret when the invention cannot be analyzed based on the product, the likelihood of independent invention is low, patent protection is unlikely to be strong, a patent would require the publication of valuable intellectual property, the product life is short compared with the time required to obtain patent protection, and the cost of maintaining secrecy is not too high. If there are no other means available to protect the invention, then trade secret status is the appropriate choice. Trade secrets have no statutory protection period and do not provide protection against any other independent invention. The inventor must withhold information from the public, and therefore a feasible secret protection policy and process to secure secrets must be in place.

Trademarks are another valuable form of intellectual property for enterprises, and it is usually necessary to register them. It is important to have an easily distinguishable logo, for example, the large golden arches forming the letter "M" represent McDonald's. A trademark protects the association of goods and/or services with a company or business, e.g., when someone sees the McDonald's trademark, he or she immediately associates it with the fast-food chain's hamburgers, French fries, and other products. The golden arches cannot be used by others, since they are a registered trademark for which the proprietary rights are protected against any unauthorized use.

THE IMPORTANCE OF INTELLECTUAL PROPERTY

Intellectual property rights are intangible assets. They may enhance a company's value, generate revenue, and be the lifeblood of SMEs. Intellectual property rights can be used as an offensive tool against competitors or as a defensive shield to avoid challenges from others. In addition, they are currently part of the rules of international trade.

Partnering with a multinational corporation (MNC) is a fast track to the international market for SMEs. As shown in Exhibit 1, a strong patent position, products in the development phase, unique technology, products in the early research phase, and platform technologies are all major factors considered by MNCs when evaluating potential SME partners. The same situation holds true when venture capitalists consider investment. As shown in Exhibit 2, a strong patent position, products in the development phase, unique technology, products in the early research phase, and platform technologies are the main criteria for venture capitalists.

Table 1 lists the top 10 damage awards resulting from patent litigation in the USA. In the highest, Eastman Kodak was obligated to pay Polaroid almost US$900 million for patent infringement. Table 2 is a comparison between the market value and book value of the top 10 biotechnology companies in the USA. Taking Biogen Inc. as an example, its market value is more than eight times its book value. The market value of this company is based not only on the revenue generated from product sales but also on its intellectual property rights. The situation is the same for the other companies on the list.

Exhibit 3 summarizes the results of benchmarking studies done by Arthur D. Little. During the past decade, most enterprises underwent a dramatic change in their asset

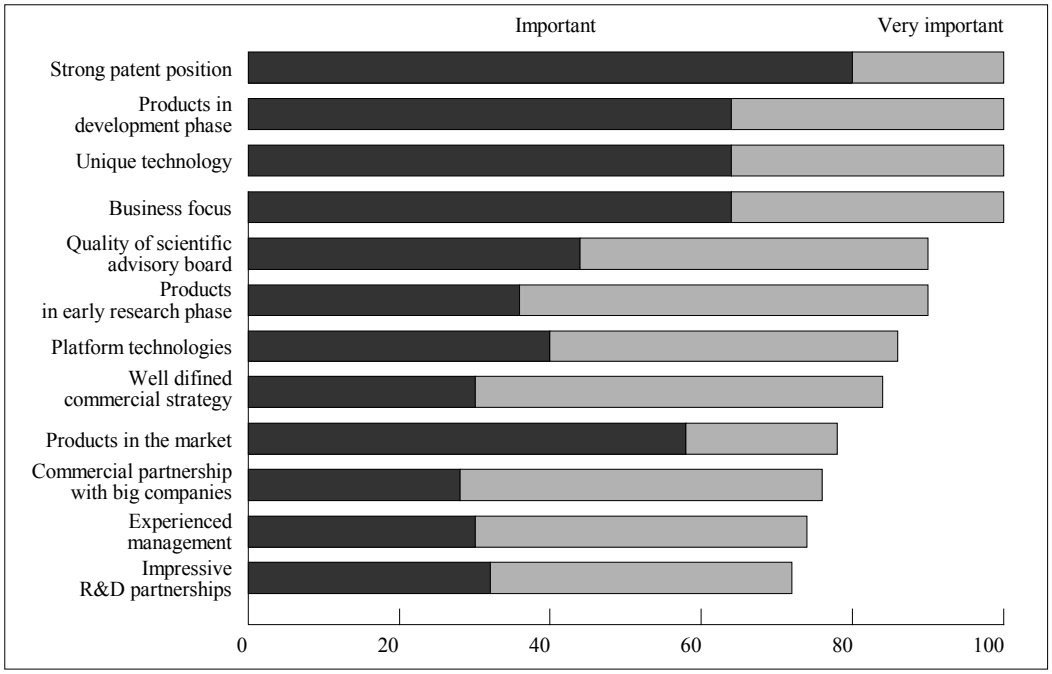
structure. In 1991, intangible assets accounted for only about one-tenth of total assets in most enterprises. Three years later, intangible assets accounted for as much as 40% of total assets. By 1997, the ratio of intangible to tangible assets was approximately one to one, and by 2000, intangible assets were responsible for 70% of total assets in most enterprises.

Table 1. Top 10 damage awards from patent litigation in the USA.

Case	Year	Award (US$)
Polaroid Corp. vs. Eastman Kodak Co.	1991	873,158,971
Haworth Corp. vs. Steelcase Corp	1996	211,500,000
Smith International Inc. vs. Hughes Tool Co.	1986	204,809,349
Stac Electronics vs. Microsoft Corp.	1994	120,000,000
Minnesota Mining and Mfg. vs. Johnson Orthopedics	1992	116,797,696
Viskase Corp. vs. American National Can Co.	1996	102,308,000
Mobil Oil Corp. vs. Amoco Chem. Corp.	1994	85,000,000
Dow Chemical Co. vs. US	1996	75,000,000
Fonar Corp. vs. General Electric Co.	1995	61,950,000
Stryker Corp. vs. Intermedics Ortjopedics, Inc.	1995	57,469,810

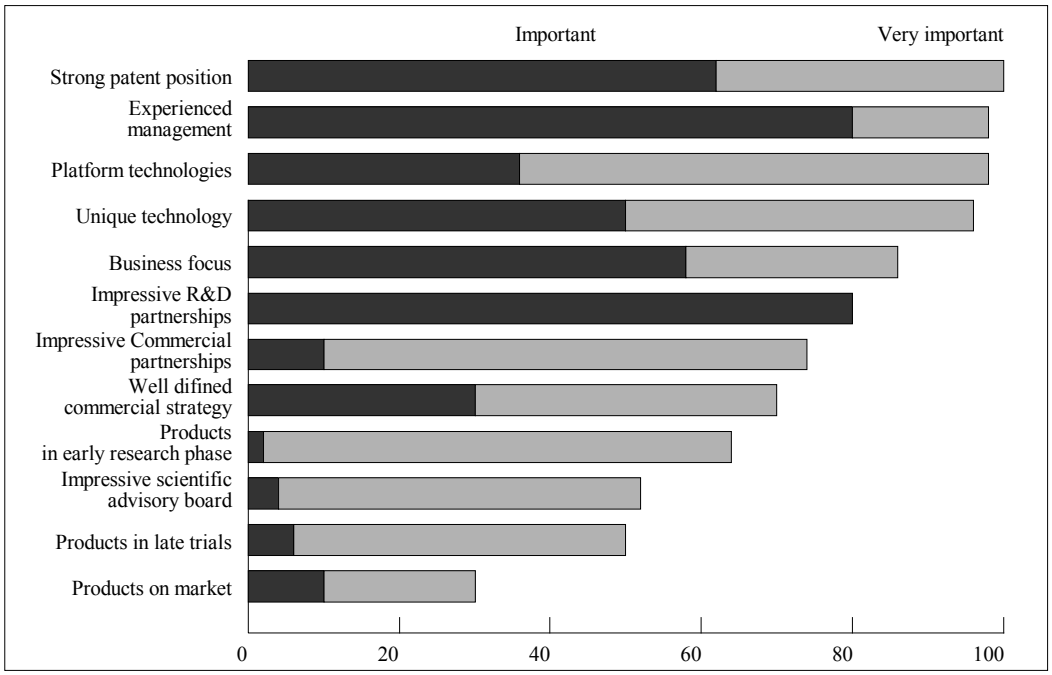
Table 2. Market value versus book value of the top 10 US biotechnology companies.

Rank	Company	Market value (US$ million)	Book value (US$ million)	Market value as % of book value
1	Biogen Inc.	9541.57	1,106.40	862.40
2	Genzyme General	7,878.40	1,750.28	450.12
3	Millennium Pharm. Inc.	6,473.76	1,462.28	442.72
4	Sepracor Inc.	2,490.14	−214.67	−1,159.97
5	Vertex Pharm. Inc.	2,202.99	386.90	569.40
6	Alkermes Inc.	1,252.57	161.35	776.30
7	Charles River Lab. Intl. Inc.	975.65	116.93	834.41
8	Praecis Pharm. Inc.	972.63	146.53	663.77
9	Bruker Daltonics Inc.	858.11	124.17	691.06
10	Inverness Medical Tech.	802.89	121.38	661.44



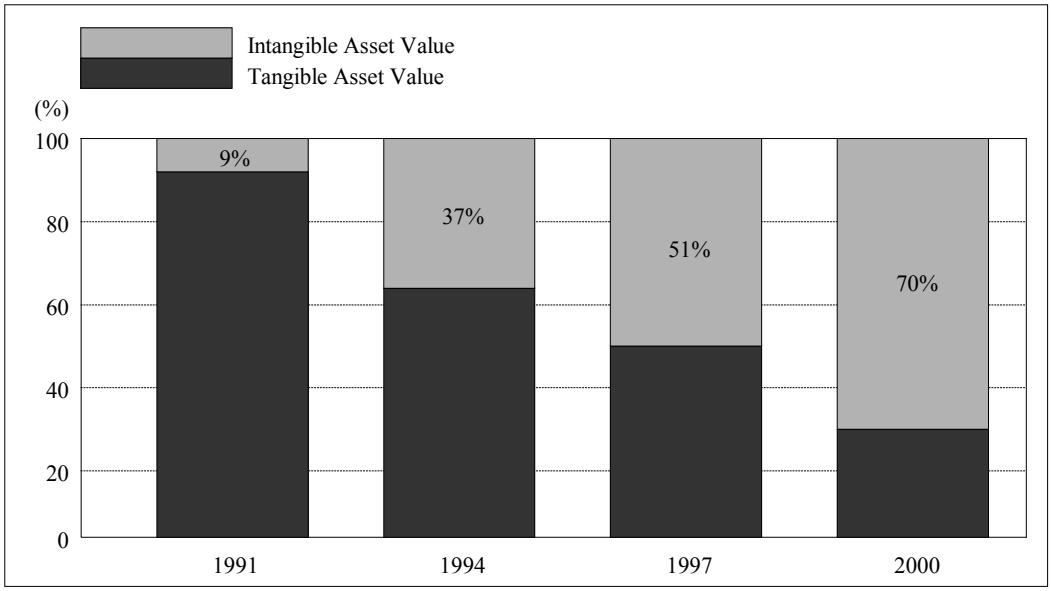
Source: Ernst & Young European Life Science 1998 Report.

Exhibit 1. What multinationals look for in potential partners (%).



Source: Ernst & Young European Life Science 1998 Report.

Exhibit 2. Venture capital: criteria for investment (%).



Note: 1997, 1998, 1999, Arthur D. Little benchmarking studies, 2000, estimated.

Exhibit 3. Asset valuation trends.

HOW SMES CAN PROTECT THEIR INTELLECTUAL PROPERTY

Exhibit 4 illustrates intellectual property protection schemes for enterprises with different scales and technology levels. Regardless of the level of technology, a large-scale enterprise with abundant resources can easily allocate the necessary personnel and budget for intellectual property management. An intellectual property division fits perfectly into this type of company's organization chart. Conversely, an SME with limited resources must prioritize its resource demands. In this situation, a thorough intellectual property strategy is necessary regardless of whether the technology level is low or high. Therefore prior to developing an enforceable intellectual property management policy, it is important to identify the core for protection and to identify the scale of the company.

Scale of Company	Big	IP division IP strategy	IP division IP policy IP strategy
	Small	IP strategy	IP personnel (division) IP policy IP strategy
		Technology Level --- Low	Technology Level --- High

Exhibit 4. Intellectual property policy for different firm scales and technology levels.

The intellectual property protection policy must fall within the company's business scope and its mission or target. To understand the strength or core competence of the company will be beneficial in building up a strong patent portfolio. Financial resources and professional personnel are the key elements in enforcing the intellectual property management policy. In addition, the culture of the company is one of the most important factors in the success or failure of the intellectual property management policy, and it is very difficult to change a company's culture within a short period of time. It should be emphasized that a process-by-process intellectual property management protocol must be enforceable, comply with the company's business strategy and scope, comply with the company's operating system, and in some circumstances setting milestones is necessary.

Management policy should be to have separate protocols for different intellectual property rights. For example, early disclosure to the intellectual property management office is encouraged for early patent filing, whereas disclosure is prohibited if the best method of protection is deemed to be as a trade secret. Considering the balance between cost and benefit, sometimes prioritization is essential. Campaigning for the intellectual property management policy is an obligation of management, and for this good communication is the most important activity among the relevant parties. The intellectual property management office must communicate with R&D staff to protect the company's intangible assets and keep managers updated on the core competence status of the company to receive sufficient financial support for executing management policy. Internal training is necessary to provide employees with a "common language" for communicating and consequently enforcing the intellectual property management policy successfully.

Auditing of intellectual property rights becomes another important subject when a company accumulates a certain amount of intellectual property rights. The purpose of auditing is to examine whether the patent portfolio covers the company's core technology or, based on the portfolio, it should streamline its R&D focus.

Auditing also allows a review of whether the applications of intellectual property rights meet the company's best interests and an evaluation of whether licensing in or licensing out may help the company to pursue its strategic objectives. Dow Chemical's experience can serve as an example. Although Dow Chemical is neither a small nor a medium-sized company, its experience shows how an audit of intellectual property rights can be meaningful. Dow Chemical has 4,000 R&D personnel, an annual R&D budget of US$1 billion, and 29,000 patents. It costs a lot of money to maintain so many patents. After an audit, the management office found that only 51% of patents were directly associated with the core technology of its business. Of the remaining 49% of patents, 36% were licensed out and 11% abandoned. Consequently, Dow Chemical saved US$50 million in patent maintenance fees and earned US$100 million in licensing fees.

PRACTICAL EXAMPLES OF INTELLECTUAL PROPERTY MANAGEMENT

Exhibit 5 illustrates the general R&D process. The diagram presents many potential intellectual property rights existing in the R&D process. Initiating the manufacture of a commercial product usually starts with a market survey. That survey information, which provides information on market demand and ideas on product design, forms a trade

secret. Based on the product design, product specifications are generated, which are a unique trade secret. The R&D proposal for this specific project contains secret information. To execute the R&D proposal, the company accumulates increasing trade secrets and patentable information. A pilot run or prototype production may create an opportunity for copyrights and trade secret declarations. When the company introduces the product on the market, publications help to announce it. Copyright applications can be filed, and trademarks serve as the brand name for the product.

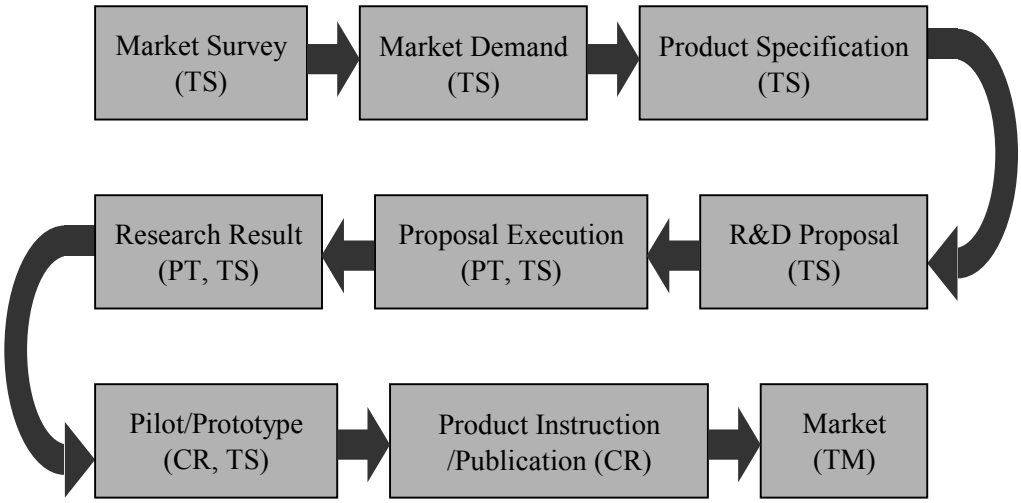


Exhibit 5. Potential intellectual property rights evolving from the R&D process.

During the R&D process, laboratory notebooks or logbooks are very important documents serving as the record of events leading to a patentable invention. The notebooks contain legal information. Dates of the conception of the technology and dates of the practice of the technology must be recorded. Those involved in the invention write logs in and sign the notebooks. The notebooks also contain evidence related to the priority of patent claims. Using a bound laboratory notebook can avoid claims of fraudulence. Everyone involved in the research process should have his/her own signed notebook. In most cases, researchers have more than one notebook and the records must be traceable; for example the pages of each notebook must be numbered consecutively. When an experimental record extends beyond one page, it is necessary to cross-reference the pages, dates, and any related supplementary notebooks. The notebooks must be stored in a safe place. It is also important to record conversations that took place in the laboratory. All researchers should write legibly in permanent ink, using the past tense. Only one idea or experiment is recorded on each notebook page. Data sheets, such as photographs, can be incorporated into the notebook record by affixing it to a separate page or a blank portion of a page with white glue and writing across the corner of the insert onto the page. Unused, blank portions of a page should have a diagonal line drawn through them. If a researcher wants to make a change on a notebook page, one-line

cross-outs should be made, signed, and dated, but words/lines should not be obliterated using correction fluid or an eraser. All experimental variables critical to the performance of the experiment (i.e., time, temperature, quantities) should be recorded to enable someone with a comparable background to duplicate the experiment based upon the notebook. Abbreviations and special terms should be noted. When signing the notebook, researchers must use their full names, not simple initials, and the date should be written in full. The records must be countersigned and dated promptly, preferably once weekly. The countersignatory is a person who understands the work but is not a potential co-inventor.

An inventor must contribute to the conception of the claimed invention in at least one of the claims in the patent application. If the invention involves more than one person, as is often the case, then joint inventorship is claimed, and each inventor must have made some inventive contribution to at least one of the patent claims. Each inventor has undivided ownership interest in the patent. It is common for employees to transfer patents by "assignment" to their employers. The assignee then owns the monopoly rights to the invention and can license the patent rights to a third party.

SMEs wishing to protect their intellectual property should establish and enforce a practical intellectual property rights management system. Maintaining good laboratory notebook records protects a company's inventions. SMEs should remember to store all confidential information in a secure place. Internal training is necessary so that all employees understand the importance of intellectual property. An inventor should submit a disclosure memo promptly and completely. Employees should be warned against any disclosure of confidential information to a third party in casual conversation. Last but not least, commitment from top managers ensures the success of an intellectual property management system.