Section 3　Formation of attractive economic agglomerations

【Key points】

1. Efforts abroad to form economic agglomerations

With the advance of globalization and companies able to look beyond national borders to site their business where they choose, economic agglomerations are attracting growing attention as innovation matrices.

A number of experiments are being undertaken around the world toward the creation of attractive economic agglomerations. The merits of economic agglomerations lie in facilitating face-to-face exchange among companies and individuals, with the various activities of the diverse economic agents within the agglomerations producing new companies and maximizing the environment in terms of generating innovative business models and developing new knowledge. The aim is accordingly to exploit the merits of economic agglomerations to create innovation "hothouses".

2. Issues facing Japan in creating attractive economic agglomerations

Within East Asia not only spawning numerous production hubs but also engaged in a string of reforms toward the formation of R&D hubs, the merits of Japan's economic agglomerations too will need to be increased in order to spur innovation. Key elements will include: (1) building university-centered knowledge-intensive networks; (2) improving urban amenities to attract creative human resources; and (3) developing technology and industries which exploit regional characteristics.

1. Efforts abroad to form economic agglomerations

(1) Agglomeration and innovation

With the advance of globalization and companies able to look beyond national borders to site their business where they choose, economic agglomerations are attracting growing attention. Where classical agglomeration theory in economics concentrated on the cost reduction and economies of scale aspects of agglomeration, the focus has changed in recent years to the promotion of innovation, with the new agglomeration theory emphasizing flexible production systems in place of mass production, training and the foundations for creation. For example, Porter (1998) and Crafts and Venables (2001) argue that the meaning of agglomerations (which Porter describes as "clusters") as matrices for the birth of innovation is being lost today with the "end of distance".

Even where information technology (IT) made further advances and the cost of transporting

goods fell, the possibility of creating new knowledge through face-to-face communication endows economic agglomerations with enormous significance for innovation. Moreover, in creating innovative new business models, a major role is played by links between companies, the various types of business infrastructure underpinning companies and the emergence and development thereof, and networks with supporting industries. The more concentrated the information in the region, the greater the possibility of fostering new cooperative ties, and the more likely the emergence of external economies. Further, if not only business partners but also multiple rival companies in the region form agglomerations, companies will be motivated to achieve differentiation through innovation.

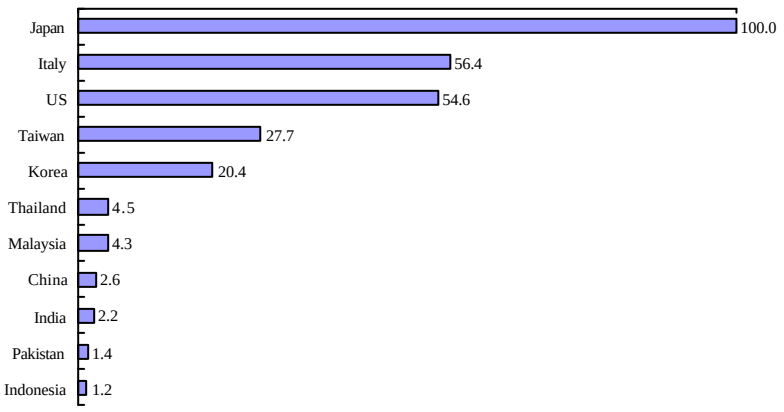
Moves are underway abroad in a number of regions to use the merits of agglomeration to seize the advantage in innovation competition. At one time, it was feared that many of these regions would experience an economic decline as a result of the industrialization of the developing countries and the newly industrializing countries, but rather than transferring this responsibility, the regions promoted innovation to overcome their difficulties. In this section, we look at economic agglomerations in the "third Italy", Silicon Valley and elsewhere, before identifying tasks involved in forming attracting economic agglomerations in Japan.

(2) Italy and economic agglomerations

(a) The textile industry in Italy

The textile and apparel industry is one of Italy's representative industries. Textile industries are often considered as labor-intensive and therefore better suited to developing countries which have low labor costs. However, despite Italy's status as a developed country and wage levels which are no longer particularly low (Fig. 4.3.1), Italy's textile industry retains an important position in the Italian economy (Fig. 4.3.2).

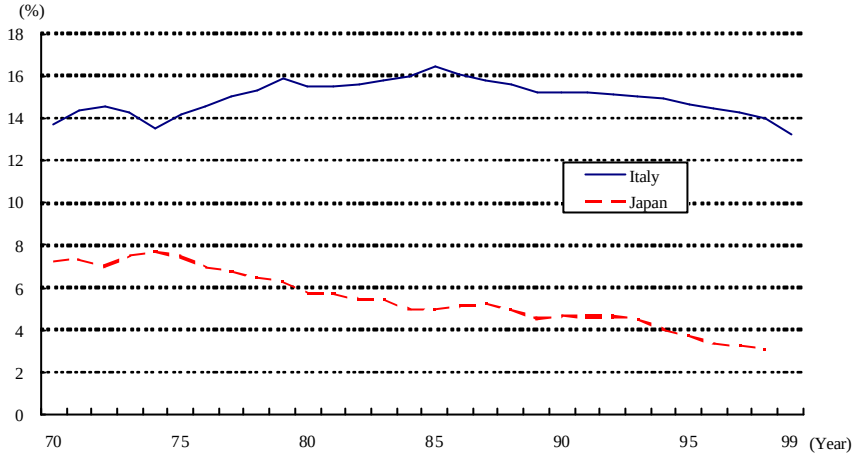
Figure 4.3.1 Wage levels in spinning industry (cotton)



Note: Indexes where Japan is 100 per hour (fall 2000 survey)

Source: *Monthly Report of Japan Spinners' Association*, July-August 2001 (Japan Spinners' Association)

Figure 4.3.2 Ratio of textile industry in manufacturing industry in Japan and Italy (value-added base)



Note: Manufacturing and the textile industry are as defined in ISIC (Rev. 3) 15-37 and 17-19.
Source: *STAN Database* (OECD)

The strength of the Italian textile industry lies in its great originality, competition based on differentiation and individualization, and a ready response to market needs. Italy's textile industry experienced a crisis in the 1980s when textile products from newly industrializing countries began to arrive on the market. Competitiveness declined particularly for medium- and low-grade products, where cost competitiveness is vital, and the weaker companies began to disappear. However, Italian companies reshaped their corporate philosophies to embrace a market orientation, choosing to garner market approval by creating products that stood apart from those of other companies. They introduced innovation, which, coupled with the superior production technology of their craftspeople, enabled them to sustained their competitiveness.

(b) "Flexible specialization"

Agglomerations played an important role in enabling Italian companies to achieve this transformation. Italian textile industry agglomerations include Biella (woolen goods), Prato (woolen goods), Como (silk products) and Carpi (knitwear), etc. These agglomerations are not simply production sites, but also have planning, sales and incubator functions, and encourage corporate innovation. This is why the agglomerations have retained their traction. In Japan, by comparison, companies (yarn manufacturers, trading companies, wholesalers, apparel, etc.) outside of agglomerations generally hold on to the planning and sales initiative.

Italian agglomerations are characterized by a high ratio of small and medium enterprises (SMEs) and division of the production process. The SMEs compete on the basis of their individuality, namely planning and development of products differentiated from other companies, technology and knowhow, small lot production, and a quick response. As that competition has expanded, individualistic companies have gathered in certain regions, creating

agglomerations which take advantage of the flexible networks which Piori and Sabel (1984) describe as "flexible specialization" to realize small-lot production of a wide range of products over a short cycle.

"Organizer companies" called impanatore (Prato) or converter(Como) play a key role in binding together regional networks and in planning and sales. Many of these organizers do not have their own production facilities but instead determine market trends as fashion creators, planning and designing new products, order for which are then placed using their detailed knowledge of local companies and craftspeople, with the organizers coordinating production. Organizers can combine experts from different parts of the production process in response to market needs. This pool of detailed information within each region opens the way for flexible process division. The fashion sensitivity and creativeness of the organizers combined with the individualistic technology of the craftspeople enables the supply of a diverse range of products in response to changing consumer needs.

"Flexible specialization" has been the foundation of Italy's agglomerations. However, since developing countries began to industrialize in the 1980s, those companies within Italian agglomerations which have not been able to deal with growing imports and changing have gradually been weeded out, in some cases breaking the links in the complete production process fostered within agglomerations and procuring from beyond the agglomeration. Some regions are also seeing the emergence of more fixed inter-corporate relations than in the past, with some large-scale companies handling end-to-end production also appearing[1]. Signs of change are therefore appearing in the "flexible specialization" which has been the strength of Italy's agglomerations to date.

Because one weakness of these clusters has been the relatively limited linkage with large companies in pursuing innovation, regions have worked to attract universities and establish research institutes, hold fairs as opportunities to sell themselves to the world market, and foster human resources. Further, textile machinery manufacturers with high-level technology and service businesses handling planning, design, development, marketing and consulting are also located in around agglomerations, supporting manufacturing activities. These agglomeration functions have also underpinned innovation in Italy's textile industry.

(3) Silicon Valley as a "high-tech Mecca"

(a) "High-tech Mecca"

Silicon Valley is a "high-tech Mecca" located to the southeast of San Francisco in the United States.

Silicon Valley's history began in 1937 when Hewlett Packard was born in a Palo Alto garage with the assistance of Professor Fred Terman from Stanford University. The semiconductor rush led the area to be labeled "Silicon Valley", with today's prototype essentially forming in the early 1970s. Up until then, the area was no more than Stanford University and a handful of high-tech companies, with the Silicon Valley originally an orchard area home, for example, to the apple orchards for which Apple was named. Since the 1970s, Silicon Valley has undergone a substantial evolution alongside the computer rush of the 1970s, the computer networking rush of the 1980s and, following a temporary slump, the recent software and Internet rush.

This self-sustained transformation in industrial structure has been encouraged by a process of innovation which constantly carves out a new leading edge.

The rapid industrialization of recent years in developing countries and East Asia in particular has triggered a global supply glut and deflation. The electronics industry, where competition is particularly intense, has seen development lead time and product life-cycles shrink, with the key to corporate competitiveness increasingly lying in whether a company can sustain a process of innovation to rapidly deliver to the market products embodying the latest ideas and technology. Traditional production regimes are therefore being reviewed to enable companies to focus the bulk of their management resources on their core business, fighting for the advantage in the innovation competition, while comparatively weak areas are being outsourced or production facilities consolidated, as companies seek to establish optimal procurement and production systems on a global scale.

Amid these changes, Silicon Valley has utilized networks to sustain its superiority in the innovation competition. One characteristic phenomenon in Silicon Valley has been modularization. In Silicon Valley, the advantage belongs with those industries which are based on a modular architecture, namely the standardization the connection points between parts—"modules"-so that these can be combined into a diverse range of products. Silicon Valley companies have devised ways to dispose of prior adaptation, with the flexible combination of parts and business leading to innovation[2].

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[1] Ogawa (1998).
[2] Fujimoto, Takeishi, Aoshima (2001), pp 10-13; Aoki, Ando (2002), pp 195-6.

Modularization has produced numerous ventures supplying products based on innovation in very specific areas of specialization. This in turn has sparked vigorous innovation competition among venture companies, while also creating a development mechanism through cooperation between ventures, as well as between ventures and large companies.

(b) Institutional and cultural factors behind Silicon Valley's development

Silicon Valley innovation has been underpinned by venture companies. In addition to the development of modularization, a number of institutional and cultural factors underlie the sheer abundance of venture companies which have been spawned in Silicon Valley.

Firstly, in terms of systemic factors which have been advanced across the United States as a whole, fund-raising mechanisms such as the supply of risk money, particularly in the form of venture capital investment, public stock offerings, and capital gains through M&As, have played a major role. The stock option system has also given stockholders the incentive to make their business succeed. Further, academia-industry cooperation have evolved steadily since the Bayh-Dole Act of 1980, with the emergence of venture companies leading the innovation competition based on technology "seeds" from universities also boosting venture numbers.

In addition to these systemic factors, a specific focus on the Silicon Valley region reveals cultural factors such as the acceptance of independence as a natural drive, a trend which began with the "eight traitors" who "span out" from the Shockley Research Institute, and acceptance of contact between ventures and large companies as equal partners. Moreover, while independence always carries the risk of failure, the Silicon Valley culture respects those who take risks and accept challenges, and is also tolerant of failure. The supply of risk money and systems smoothing the way for failed entrepreneurs to try again have also underpinned this culture.

Silicon Valley is also home to Stanford University, which could be described as the core of the region, as well as many other universities and research institutes, which supply superior human resources and technology to the region as well as sparking many university-initiated venture companies. In addition to active exchange among individuals and also companies, abundant business infrastructure has clustered in the region, including venture capital dedicated to supporting enterprise, law firms and accounting offices, building a knowledge-intensive network, and this has led to the formation of a community where information is closely shared. The existence of this community means rigorous standards of selection and consequent stiff competitive pressure placed on companies, but it has also served to link the various modules in

the production process, and individuals looking to set up their own businesses have been able to lower the start-up hurdles by using this network. The Joint Venture Silicon Valley Network and other groups have also plugged gaps in the network.

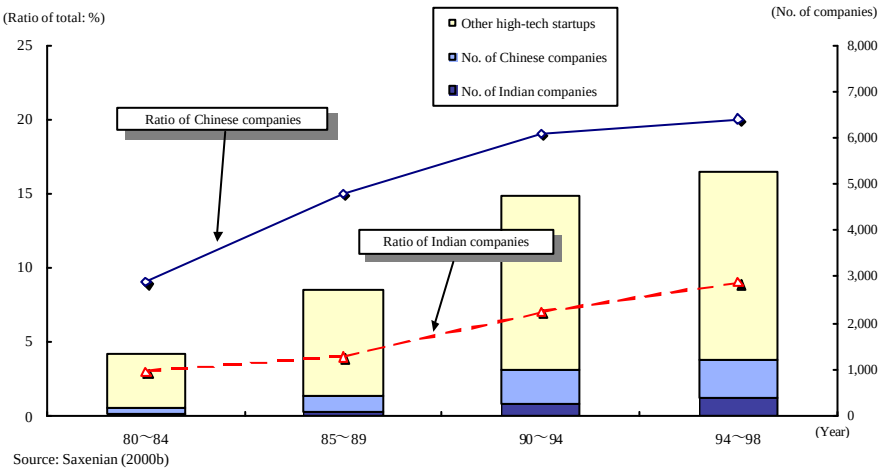
Silicon Valley has seen a succession of startups underpinned by the depth of these systems, culture and networks, while the virtuous cycle of success stories created as a result has encouraged the emergence of the next generation of ventures, supporting vigorous innovation.

(c) Silicon Valley and globalization

Special note should also be made of the way in which Silicon Valley has developed using the merits of globalization. The area has gathered capital and brains from all over the world to gain the advantage in innovation competition, specializing in knowledge-intensive and high-value-added sectors while at the same time using offshore agglomerations as production bases for those parts of the production process with low added value. One of Silicon Valley's strengths is the worldwide network which has developed.

Firstly, the world's brains are gathered in Silicon Valley. Particularly with universities clustered around the area, and its location on the west coast where immigrants have always been numerous, Silicon Valley has attracted many talented personnel from abroad. There are particularly large concentrations of Chinese and Indian immigrants, to the extent that Indians and Chinese have become synonymous with IC. These "high-tech immigrants" who came to the United States looking for a chance have actively established venture companies and contributed to innovation (Fig. 4.3.3).

Figure 4.3.3. Number and ratio of companies under Chinese or Indian management of all high-tech startups in Silicon Valley



Source: Saxenian (2000b)

Entrepreneurs and researchers who have succeeded in Silicon Valley then return to their home towns and use their personal networks to build linkages between Silicon Valley and their own agglomerations. Well-known examples of these linkages include hardware in Taiwan and software in India.

For example, in relation to Taiwan, a boom occurred in the number of returnees from the late 1980s through the 1990s, as they left Silicon Valley for the Sintek high-tech agglomeration of Taiwan. This trend was supported by active government efforts such as the development of accommodation and schools (English education) for the returnees and their families, as well as the introduction of generous tax breaks. These human resources set up companies in Sintek and used their networks with Silicon Valley to realize international process division. They also brought back elements of Silicon Valley culture such as vigorous startups, SME agglomerations, close communication, joint projects based on utility rather than form, and collective learning beyond the bounds of company organizations. Saxenian (2002a) notes that a cross-border community has formed as a result between the two agglomerations across the Pacific Ocean.

Silicon Valley has established a clear position for itself in the midst of globalization, linking networks with the world, and achieving growth.

(4) Urban revitalization and economic agglomeration: New York

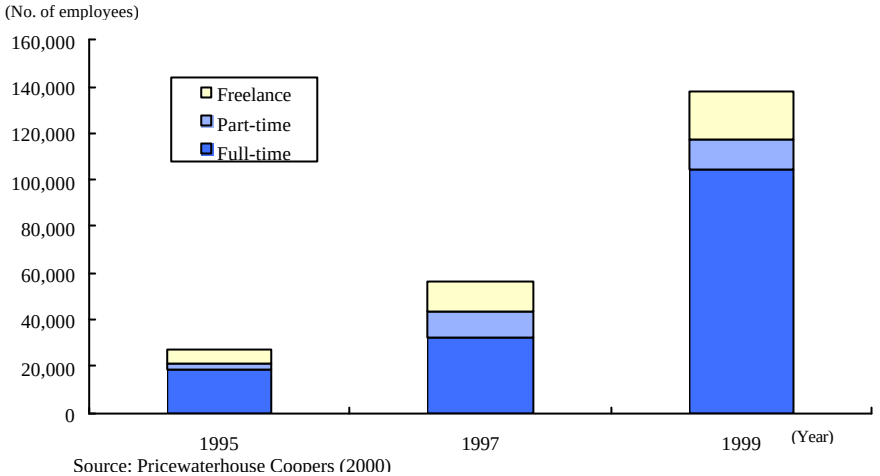
(a) Urban revitalization and economic agglomeration

There are cases where urban revitalization and the formation of economic agglomerations have become linked. One of the best-known is Silicon Alley in New York. Many large cities in the United States have experienced the "donut" phenomenon, namely the hollowing-out of the city center. New York too went through a period when the decline of urban functions became a major problem. Following the stock market crash of 1987, the city suffered a severe recession, and downtown buildings in particular began to empty out. However, the agglomeration in New York of new industries—more specifically, the multimedia industry which grew alongside the advent of the Internet age, and particularly content-related industry (the "new media" industry)—enabled the inner city to sustain its vigor.

Silicon Alley is centered on the Flat Iron district, which is sandwiched between East River and Manhattan's 5th Avenue between 14th and 30th, and is gradually extending south to 41st. Even more recently, a growing number of companies have been locating in the suburbs in response to skyrocketing rents in the downtown area, causing the geographical spread of the new media industry. This new media industry which has developed in Silicon Alley had created 138,000

jobs by 1999 (Fig. 4.3.4).

Figure 4.3.4 Number of employees in New York new media industry



Source: Pricewaterhouse Coopers (2000)

(b) Government and private sector roles

In Silicon Alley, government urban revitalization efforts have underpinned agglomeration formation.

To overcome the Wall Street slump and recession following the stock market crash of 1987, New York City focused increasingly on the new media industry. Mayor Rudolph Giuliani, who took up his post in 1995, instituted a plan for revitalizing the Lower Manhattan economy with the help of the financial world, preparing various tax breaks. Information infrastructure was added to old buildings and housing, creating the necessary conditions for venture companies to do business.

The New York City government also worked with the private sector to create an environment facilitating investment in development, adopting methods which stressed private-sector power. One of these private-sector groups was the Alliance for Downtown New York (ADNY), which was established in 1995 with the aim of inner city revitalization. The ADNY designated the districts which it covered as the "IT District", and set up "The Plug'n'Go" and other programs to encourage the formation of a new media agglomeration. The New York New Media Association (NYNMA) has also played a role in providing local support for the new media industry, the newness of which meant that networks were weak[3].

[3] Konagaya, Tomizawaki (1999)

(c) Background to agglomerations

The above efforts bore fruit and a new media agglomeration formed in Silicon Alley backed also by the situation in the United States as a whole, namely the US economic expansion in the 1990s and development of the Internet, as well as exploitation of the potential strengths of New York as a city.

One of these potential strengths was the presence of related industries. Industries closely involved with content production are concentrated in New York, including television, broadcasting, advertising, publishing and clothing design. These industries not only became major clients for the new media industry, but also supplied it with human resources.

Secondly, in addition to related industries, infrastructure providing the services needed to conduct business was also clustered in New York, including consultants, law firms, accounting offices, and personnel dispatch agencies. The business environment was therefore geared to setting up businesses. New York is also a key US financial center, and financial institutions became not only a key source of money but also clients for the new media industry[4].

The third element was the concentration of creatively talented human resources and the presence of the amenities allowing this. In particular, the Soho area of New York is known as a community of young artists working in content design and graphic design. These human resources are key in underpinning the new media industry, and many companies in Silicon Alley note the easy access to these personnel as the greatest attraction of New York (Fig. 4.3.5).

Figure 4.3.5 Factors emphasized by multimedia companies in choice of Silicon Alley as a location (ranking according to questionnaire survey)

	Importance of factor in choice of location	Attractiveness of New York
	1996	1996
Access to editors and artists	1	1
Access to customers	2	6
Access to software engineers and programmers	3	9
Access to content owners and strategic partners	4	3
Overall business costs	5	11
Proximity to others in same industry	6	7
Technological infrastructure in place	7	8
Overall quality of life	8	10
Image and credibility	9	4
Local tax system	10	12
Access to investors	11	2
Presence of educational institutions	12	5

Source: Yukawa (1999), Coopers & Lybrand (1997).

[4] However, looking at the sources of new media industry fund-raising in New York (2000), 50 percent depended on self-financing, followed by individual investors (22%), venture capital (12%), joint funding (8%), public assistance (4%) and bank financing (4%) (Pricewaterhouse Coopers,

These artists have gathered because of the free and cultural atmosphere peculiar to New York and high-grade amenities such as cinemas, theatres and galleries. Once people start to gather, an urban atmosphere builds which reflects the values and the lifestyles preferred by those people, while information-sharing advances, producing an even denser agglomeration. The presence of educational institutions and appropriate spaces for these people to live and work have also been important factors in causing human resources to agglomerate. In particular, many universities and art schools are located in New York, drawing people from all over the world and producing outstanding creators and technicians.

These potential strengths underpinned efforts to form an agglomeration, and the Silicon Alley agglomeration has certainly produced results.

(5) Formation of R&D hubs in East Asia

With the emergence of China as a production base, East Asia too has began to work actively toward the formation of agglomerations with an R&D emphasis. As with high-tech industry agglomerations in developed countries, universities have become local cores, but a characteristic of East Asia is the way in which governments are working actively in systemic design and academia, industries and government are joining forces.

For example, in Taiwan it was feared that the transfer of operations over to mainland China would lead to industrial hollowing out, and academia, industries and government worked together to boost Taiwan's R&D ability. The Taiwanese authorities worked to create bases using the agglomerative merits of production and research in Sintek where scientific research institutions are concentrated, as well as building two new large-scale industrial parks in Tainan and actively soliciting supporting industries and foreign companies related to the high-tech industry, forming new agglomerations.

China too has been advancing systemic reforms and working strenuously to form R&D hubs in order to build a nation based on science and education. Particularly well-known in this regard is Zhongguancun, situated in the outskirts of Beijing. Zhongguancun has around 70 large and small universities, among them Beijing University and Tsinghua University, as well as more than 200 research institutions including the Chinese Academy of Sciences, and has used these agglomerations to become a high-tech R&D hub. To exploit the agglomeration of brains, China has been pursuing various systemic reforms to promote academia-industry cooperation. These reforms are characterized by (1) prompt follow-ups to entrepreneur and researcher initiatives;

2001).

(2) promotion of creation of the conditions for technological innovation based on market mechanisms; and (3) emphasis on human resources and particularly network creation to underpin academia-industry cooperation[5].

Zhongguancun currently embraces not only local companies but also many foreign companies, among them Microsoft, which moved into China in 1996, and the number of businesses set up by returnees is also increasing. Where the area housed 974 high-tech companies in 1990, numbers have grown steadily to reach around 8,200 by the end of 2000, attracting growing domestic and foreign attention to Zhongguancun.

2. Issues facing Japan in creating attractive economic agglomerations in Japan

(a) Issues in self-sustained development using regional initiatives

East Asia has seen the emergence of not only numerous production hubs, but also steady progress with reforms toward the formation of R&D hubs. With East Asian economies staging a rapid technological catch-up, Japan cannot afford to delay its reform program if it is to lock in innovation and return to a growth trajectory. Moreover, given that the East Asian economy will grow still further, with the geographical concentration of industry accelerating through trade and investment liberalization, this has become important also from the perspective of not only national but also regional competition and partnership. The formation of attractive economic agglomerations has therefore become a critical issue for Japan too.

Economic agglomerations have been one of the main forces underpinning the growth of the Japanese economy. However, Japan's agglomerations have tended strongly toward specialization in production functions, with planning, sales and other aspects left to outside companies. As East Asian economic agglomerations able to handle low-cost production grow, extra-agglomeration companies with planning and sales functions are transferring their production functions out of Japan. As a result, some agglomerations within Japan are beginning to lose their traction.

To break this trend and ensure that Japan's economic agglomerations demonstrate their full potential, the agglomerations must offer not simply cost competitiveness, but also become innovation matrices with their own attractions. This will require (1) building knowledge-intensive networks centered around universities, (2) boosting the functions of urban amenities to attract creative human resources, and (3) developing the conditions to foster technologies and

[5] Lessons from China as a Nation Based on Science and Education: University-Initiated Ventures (Atsushi Sunami, 2001; see RIETI website (http://www.rieti.go.jp/columns/archives.html)).

industries taking advantage of local characteristics, building agglomerations which utilize the merits of diversity.

As noted in *Structural Reform of the Japanese Economy: Basic Policies for Macroeconomic Management* (adopted by Cabinet decision on 26 June 2001), Japan has traditionally stressed balanced nationwide development, so that regions have developed with no particular characteristics. However, as regions pursue their own particular styles of development and revitalization through competition based on knowledge and creativity, individualistic economic agglomerations realizing innovation will need to be formed and this trend linked to self-sustaining development.

(2) Building university-centered knowledge-intensive networks

As noted above, foreign agglomerations are playing an important role as innovation bases, with universities providing superior human resources to regions and supplying technology to companies. Business infrastructure is also concentrated in these agglomerations and a knowledge-intensive network is built up between companies and universities.

To utilize the merits of agglomeration to achieve innovation, Japan too needs to build knowledge-intensive networks and encourage the development of regional science and technology and the emergence of new services and business models. Therefore, it will be vital to (1) boost educational functions to ensure a diverse supply of human resources to regional areas, (2) promote academia-industry-government cooperation, and (3) support university-initiated ventures.

(a) Role of universities in supplying diverse human resources to regional areas

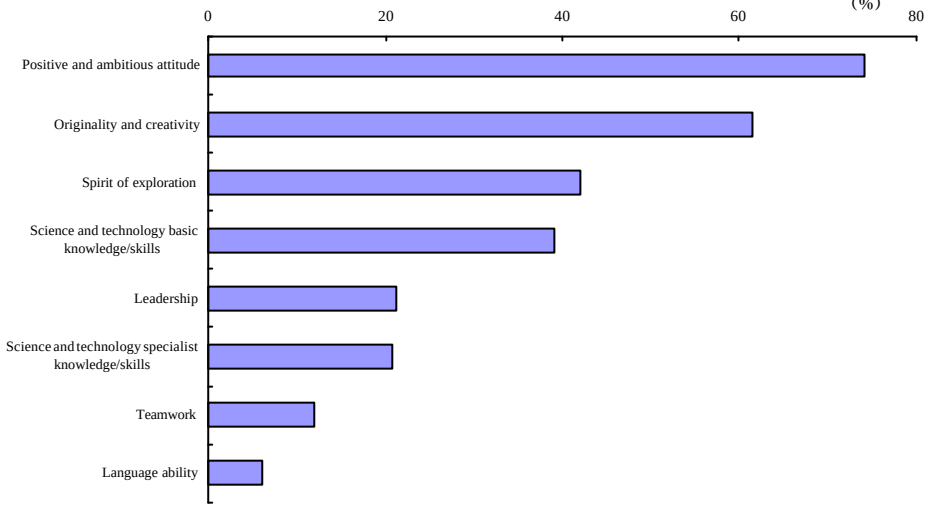
Supporting growth in high growth areas and promoting innovation hinge on the development of the human resources to underpin these efforts, an area where education has a crucial role to play.

Japan's development to date has been supported by the high levels of basic knowledge and educational capacity which have been in place since the days of private elementary schools. Even today, key education indexes such as university enrolment rates remain high, and education opportunities are sufficiently guaranteed even compared to other nations.

At the same time, corporate management is seeking higher levels of education than ever before. For example, company-related personnel are concerned about the decline in the

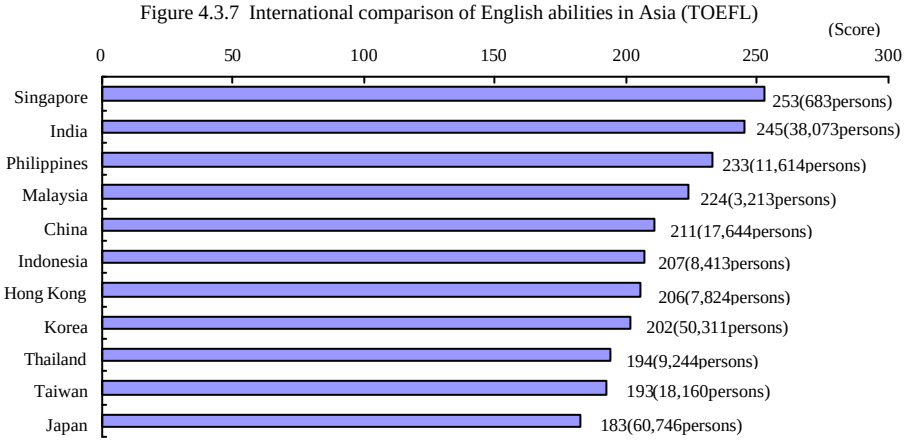
creativity and drive of students and young researchers (Fig. 4.3.6). This emphasis reflects the search by companies and management faced with global competition for human resources who can act on their own initiative, as well as highly creative personnel. Moreover, while English language skills are becoming essential in terms of communication in a global era, the TOEFL scores recorded in Japan remain low compared to other parts of Asia (Fig. 4.3.7). Factors such as these have brought into doubt the international competitiveness of Japan's universities in particular[6], and the government is currently advancing university reform.

Figure 4.3.6 Components of decline in quality of young researchers as noted by private enterprises (questionnaire survey)



Source: Ministry of Education, Culture, Sports, Science and Technology (2001b)

Figure 4.3.7 International comparison of English abilities in Asia (TOEFL)



Note:
1. Data comprises scores, with the number of persons in parentheses.
2. Scores for tests implemented June 2000-July 2001. Computer-scored; full score 300 points.

Source: TOEFL Test and Score Data Summary, 2001-2002 edition (Educational Testing Service); provided by Council Exchanges

[6] While it is a questionnaire survey, the IMD's international competitiveness rankings have not scored Japan's university education highly in recent years.

A nation's foundations are supported by its people, and whether their individuality and creativity is utilized or wasted depends to a great extent on education. In that sense, education is absolutely critical. Educational institutions take various forms, and while the emphasis in Japan has often been on in-house company education, that situation is now beginning to change, with expectations rising in regard to higher education at universities in particular. Improving the educational functions of universities supplying a diverse range of human resources to local regions is a key factor in forming the agglomerations which lay the foundations for innovation.

The basic perspective in improving the education functions of universities must be the introduction of appropriate competition among universities and the supply of diverse options and opportunities, with students as the main entities in selecting among these. Development of these conditions should promote education more closely aligned to social and regional needs. More specifically, anticipatory national regulations such as the approvals requirement for the establishment of university departments need to be relaxed to the greatest possible extent, allowing greater autonomy in university operation, while multiple evaluations by third-party private institutions must be conducted to ensure the quality of education services.

Universities also need to provide the kind of education which will foster human resources with a high degree of specialization. To produce adequate results from the academia-industry cooperation discussed below, the quality of engineers must be boosted to create the seeds which are the prerequisite for innovation, and entrepreneurs and management personnel need to be fostered and secured to utilize the technology thus developed. To foster human resources with a high level of specialization, higher education institutions need to be developed to provide systematic education in the management techniques and management technology which will create technology and use this in the strategic development of new business. This will require expanded exchange outside universities, including the further introduction of internships through coordination between universities and industry, systemic upgrading to encourage matriculation to graduate school by working members of society, improved training for highly-skilled experts[7], and the utilization as lecturers of experts working on the front line of industry.

(b) Efforts toward academia-industry cooperation

In addition to their function as human resource development institutes, universities also play

[7] In 1999, a specialist graduate school system was introduced to allow universities to provide education focused on developing highly-specialist experts, and as at FY2002, six universities had set up six such specialist graduate schools. The Central Council for Education is also currently deliberating the establishment of a new graduate school system and graduate degrees in modes suited to the development of highly-specialist experts.

major and diverse roles in the innovation system, including the transfer of technology seeds to industry and technological guidance and consulting for companies. As has been observed, many foreign agglomerations are centered around universities which provide these diverse functions.

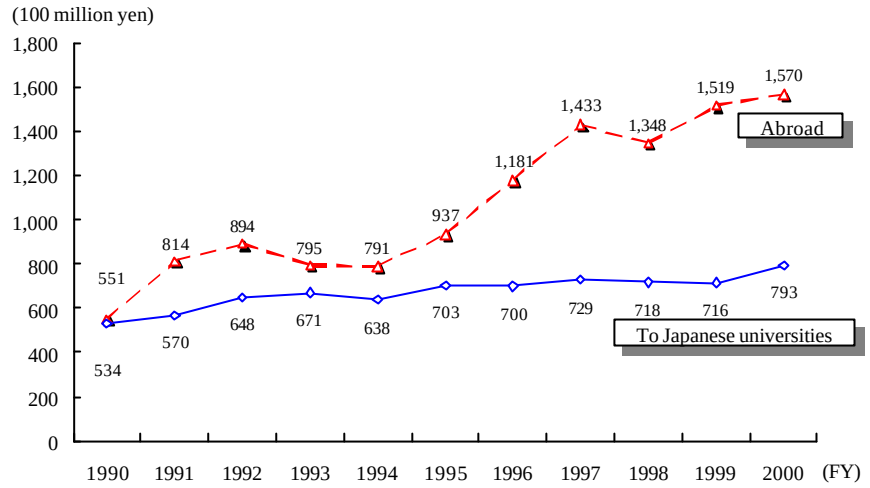
In the case of innovation in Japan, there has been a strong tendency to depend on the application of leading-edge technology introduced from the US and Europe, and to focus on improving production systems. However, now that the catch-up with the US and Europe has been completed and the offshore shift of companies has opened the way for efficient production in developing countries, Japan needs to develop the capacity to achieve the kind of innovation which will open out frontiers in new industries. Given that universities absorb a fifth of total research spending in Japan, as well as employing one in three persons engaged in research, the enormous potential of universities within Japan's innovation system is the subject of growing expectations[8].

A forerunner in academia-industry cooperation, the United States has seen companies subject their R&D investment to a process of selection and concentration since the late 1980s, pursuing tie-up strategies in areas outside their core business. Universities acted as important partners in this process. Progress was made in developing the necessary conditions for academia-industry cooperation, including the 1980 Bayh-Dole Act, which enabled universities to hold the rights to patents emerging through government-commissioned research as the US sought to use university brains to boost industrial competitiveness. US universities also became the center of regional agglomerations and contributed substantially to the stimulation of regional economies when these were struck by the economic recession which began in the late 1970s. There were also examples of university-related personnel taking the initiative and succeeding in industrial structure transformation, as was the case in Austin, Texas.

In Japan too, companies have begun to use R&D tie-up strategies. In the US, the stimulation of regional economies was achieved based around universities as partners in these tie-ups, but as can be seen in Figure 4.3.8, Japanese companies continue to look to foreign research institutions rather than local universities closer to home for their R&D results. Companies rate foreign research institutions higher than Japanese universities in terms of their drive to acquire intellectual property rights, information disclosure by research institutions, and the level of research (Fig. 4.3.9), and this is causing an offshore outflow of research capital.

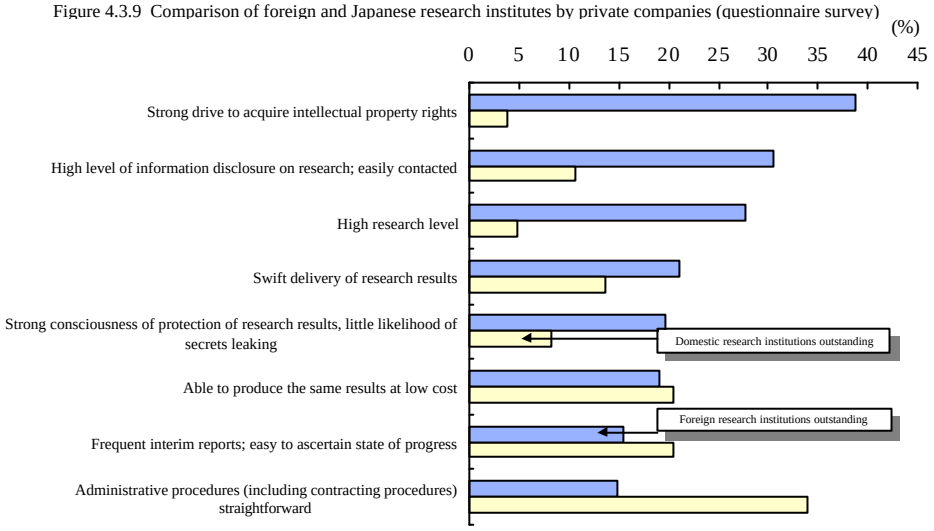
[8] Data according to *FY2001 Science and Technology Research Survey Report* (Ministry of Public Management, Home Affairs, Posts and Telecommunications).

Figure 4.3.8 Trends in research funds paid by private companies to Japanese universities and abroad



Source: Science and Technology Research Survey Report (Ministry of Public Management, Home Affairs, Posts and Telecommunications)

Figure 4.3.9 Comparison of foreign and Japanese research institutes by private companies (questionnaire survey)



Source: Ministry of Education , Culture, Sports, Science and Technology (2001b)

Japan's universities too have many intellectual assets with promise as the "seeds" of new industries. University intellectual assets also frequently have a distinctly local flavor[9]. However, many of these remain in hibernation and are not being adequately exploited. Recognizing the need for systemic reform to take advantage of the rich stores of knowledge slumbering in universities, the government has been working toward organized academia-industry cooperation(Fig. 4.3.10).

[9] According to Yonekura (p. 151, 2001), ideas which could be used for individualistic regional development based on universities include food genomes and biotechnology in Hokkaido, new material research in Sendai, Tohoku, fuel cells and hybrid cars in Nagoya, philosophy and venture businesses in Kyoto, and environment technology in Kyushu.

Figure 4.3.10 Main academia-industry cooperation measures in Japan

Date	Measure	Content
Dec. 1996	Expansion of scope of Worker Dispatch Law	Addition of researchers and research assistants to scope of the law.
March 1997	Facilitation of use of research results	Priority implementation right for patents derived from results of commissioned research or joint research by private companies and national universities, etc., extended from seven to ten years.
March 1997	Expansion of joint research	Expansion of cases where staff from national universities, etc. can engage in joint research at private-sector research facilities.
April 1997	Neutralizing measure of joint-position regulations	Permission granted in principle for joint posts where staff from national universities, etc., engage in R&D or technical guidance outside working hours.
April 1997	Redressing the lack of benefit from joint research leave	Redressing lack of benefit from joint research leave taken by staff from national universities, etc., in terms of retirement benefits.
June 1997	Inter-ministerial conference on academia-industry cooperation	Launched among the 12 relevant ministries.
June 1997	Introduction of fixed-term contracts for national university staff	Measure allowing introduction of fixed-term contract systems for staff at the discretion of universities.
March 1998	Creation of contract models for joint research with private universities	Creation of model agreements, office invention regulation and rule for joint research between private universities and private companies, etc.
May 1998	Promotion of transfer of research results from universities, etc.	Formulation of Law Promoting Technology Transfer from Universities to Industry, promotion of development of TLOs to encourage the transfer of research results from universities, etc., to private enterprises.
July 1998	Cheap use of land owned by national universities, etc.	Reduced land rents when private enterprises build joint research facilities on land owned by national universities, etc.
Aug. 1999	Reversion of patent rights on government-commissioned R&D to the commissioned companies	Japanese version of the Bayh-Dole Act fully allows the intellectual property rights deriving from government-commissioned R&D to revert entirely to the commissioned company.
April 2000	Neutralizing measure of regulations on national university lecturers, etc., jointly serving on boards in private companies	Provisions in Law to Strengthen Industrial Technical Ability lead to formulation of National Personnel Authority regulations allowing university staff to serve on the boards of private companies to promote the commercialization of research results, and to take leave when the post cannot be held simultaneously. University staff also able to serve as auditors of private companies, and as TKO directors.
April 2000	Measures facilitating input of capital from private companies into national universities	Provisions in Law to Strengthen Industrial Technical Ability open the way for more flexible absorption of funds provided by private companies to national universities through multiple-year contracts and elimination of detailed discipline classification. Provisions also developed in relation to the donation of scholarships to public universities.
April 2000	Free use by TLOs of national university campuses	Law to Strengthen Industrial Technical Ability allows TLOs to use national university facilities free of charge.

Source: Ministry of Education, Culture, Sports, Science and Technology materials

For example, one reason that the intellectual assets of universities have not been exploited has been the absence of specialist organizations to manage patent rights and conduct functional and strategic transfers. This shortfall sparked recognition of the need for technology licensing organizations (TLOs) to organize rights for university research results and transfer them to companies, resulting in the May 1998 formulation of the Law Promoting Technology Transfer from Universities to Industry. Results have already emerged—for example, in the time from when the law entered into force in August 1998 up until April 2002, 27 TLOs were approved

(Fig. 4.3.11), with 356 implementation permissions[10] granted up to March 2002.

Figure 4.3.11 Approved/authorized TLOs (as at April 2002)

Approved				
Date of	Name of TLO	Related universities	Date of establishment	Mode of establishment
4 Dec. 1998	Center for Advanced Science and Technology Incubation	University of Tokyo	3 Aug. 1998	Joint-stock company
	Kansai TLO Co., Ltd.	Kyoto University, Ritsumeikan University, etc.	30 Oct. 1998	Joint-stock company
	Tohoku Techno Arch Co., Ltd.	Tohoku University, etc.	5 Nov. 1998	Joint-stock company
	Nihon University Business Incubation Center (NUBIC)	Nihon University	15 Nov. 1998	University organization
16 April 1999	Institute of Tsukuba Liaison Co., Ltd.	University of Tsukuba	20 May 1997	Joint-stock company
	Waseda University Intellectual Property Center	Waseda University	1 June 1996	University organization
26 Aug. 1999	Circle for the Promotion of Science and Engineering	Tokyo Institute of Technology	6 Sept. 1946	Foundation
	Keio University Intellectual Property Center	Keio University	1 Nov. 1998	University organization
9 Dec. 1999	Yamaguchi Technology Licensing Organization Ltd.	Yamaguchi University	1 Nov. 1999	Limited company
24 Dec. 1999	Hokkaido Technology Licensing Office Co., Ltd.	Hokkaido University, etc.	6 Dec. 1999	Joint-stock company
19 April 2000	TLO Hyogo (inside New Industry Research Organization (NIRO))	Kobe University, Kwansei Gakuin University, etc.	18 March 1997	Foundation
	Nagoya Industrial Science Research Institute	Nagoya University, Nagoya Institute of Technology, etc.	1 July 1943	Foundation
	University Industry Partnership	Kyushu University	17 Jan. 2000	Joint-stock company
14 June 2000	Center for Research Collaboration	Tokyo Denki University	1 April 1997	University organization
21 Sept. 2000	Yamanashi TLO Co., Ltd.	Yamanashi University, Yamanashi Medical University	22 Aug. 2000	Joint-stock company
4 Dec. 2000	TAMA-TLO Co., Ltd.	Kogakuin University, Toyo University, Tokyo Metropolitan University, etc.	12 July 2000	Joint-stock company
25 April 2001	Meiji University Intellectual Property Center	Meiji University	17 Oct. 2000	University organization
	Yokohama TLO Co., Ltd.	Yokohama National University, Yokohama City University, Yokohama College of Commerce, etc.	20 Dec. 2000	Joint-stock company
	Techno Network Shikoku Co., Ltd.	University of Tokushima, Kagawa University, Ehime University, Kochi University, Kochi University of Technology, etc.	15 Feb. 2001	Joint-stock company
30 Aug. 2001	Foundation for the Promotion of Industrial Science	Institute of Industrial Science (University of Tokyo)	25 Dec. 1953	Foundation
	Osaka Industrial Promotion Organization	Osaka University, etc.	10 July 1984	Foundation
	Kumamoto Technology and Industry Foundation (Kumamoto TLO)	Kumamoto University, etc.	2 July 1971	Foundation
10 Dec. 2001	Tokyo University of Agriculture and Technology TLO Co., Ltd.	Tokyo University of Agriculture and Technology	1 Oct. 2001	Joint-stock company
25 Dec. 2001	Niigata TLO Co., Ltd.	Niigata University, etc.	16 Nov. 2001	Joint-stock company
17 Jan. 2002	Hamamatsu Foundation for Science and Technology	Shizuoka University, etc.	10 May 1999	Foundation
1 April 2002	Kita-Kyushu Foundation for the Advancement of Industry, Science and Technology	Kyushu Institute of Technology, etc.	1 March 2001	Foundation
16 April 2002	MIE TLO Co., Ltd.	Mie University, etc.	7 Feb. 2002	Joint-stock company
Authorized TLOs				
Date of authorization	Name of TLO	Related institutions	Date of establishment	Mode of establishment
13 April 2001	AIST Innovations, Japan Industrial Technology Association	National Institute of Advanced Industrial Science and Technology	30 July 1969	Foundation

Note: Approved and authorized TLOs are technology licensing organizations which have had their business plans approved or authorized under the Law Promoting Technology Transfer from Universities to Industry. Approved TLOs are those TLOs handling patents, etc., held by university staff or by private universities, etc., while authorized TLOs are those TLOs handling state-held patents created by research institutes within national universities or government experimental research institutes, or patents held by independent administrative institutions.
Source: METI

[10] "Implementation permissions" here refers to the number of cases where contracts were formed for the conveyance of patent rights (including those under application) by approved TLOs to private

As conditions are set in place, the number of patent applications from universities is increasing, as well as the number of cases of implementation of joint research with companies. However, the results of academia-industry cooperation in Japan have yet to exert the major socioeconomic impact seen in the United States. To strengthen this trend and stimulate academia-industry cooperation in Japan, it will be vital for universities and industry to each play their respective roles and also to take responsibility for self-reform. It will also be important that the government continues to pursue systemic reform in support of the activities of individuals and organizations seeking academia-industry cooperation, and creates fair and transparent rules on issues emerging in the development of these partnerships[11].

(c) Promising activities by university-initiated ventures

In the United States, universities also serve as the core of regional economic networks, creating new business as main innovation entities. Many venture companies in the United States are developed based on technology "seeds" from universities, and many of these companies have now grown into large world-leading companies (Fig. 4.3.12). In FY2000, at least 368 university-initiated ventures emerged[12]. By contrast, METI research indicates that 68 university-initiated ventures were created in Japan in 2000[13].

Figure 4.3.12 Examples of major university-initiated ventures in the US

Company	Year of establishment	Outline
Hewlett Packard	1939	Students at Stanford University, Hewlett and Packard were helped by professor Fred Terman to set up their company, developing chemical scientific measuring instruments.
Digital Equipment	1957	Set up by MIT engineer Ken Olsen and associates, developing mini-computers.
Genentech	1976	Set up by University of California professor Herbert Boyer and associates, develops pharmaceuticals using genetic engineering technology.
Biogen	1980	Set up by MIT's Dr. Phillip Sharp and Harvard's Dr. Walter Gilbert, developing pharmaceuticals using GMO technology.
Sun Micro Systems	1982	Stanford university students develop UNIX-based workstations. Their supervisors act as consultants.
Silicon Graphics	1984	Stanford University professor Jim Clark and his students establish the company to develop graphic workstations.
Cisco Systems	1985	Established by Stanford University husband-and-wife team Sandy Lerner and Len Bosack; develops routers.
Qualcomm	1985	Established by Dr. Irwin Mark Jacobs from the University of California, San Diego; develops telecommunications equipment (spinout from military development company).
Netscape	1994	Established with capital from Jim Clark, based on the Mosaic Internet browser developed by Mark Anderson and other Illinois University students.
Inktomi	1996	Established by assistant professor Eric Brewer and computer science graduate student Paul Gauthier from the University of California, Berkeley; develops Internet search engines.

Source: Nishio (2000) .

companies, as well as the number of contracts formed to establish dedicated implementation rights.

[11] For example, conflicts of interest and conflicts of responsibility.

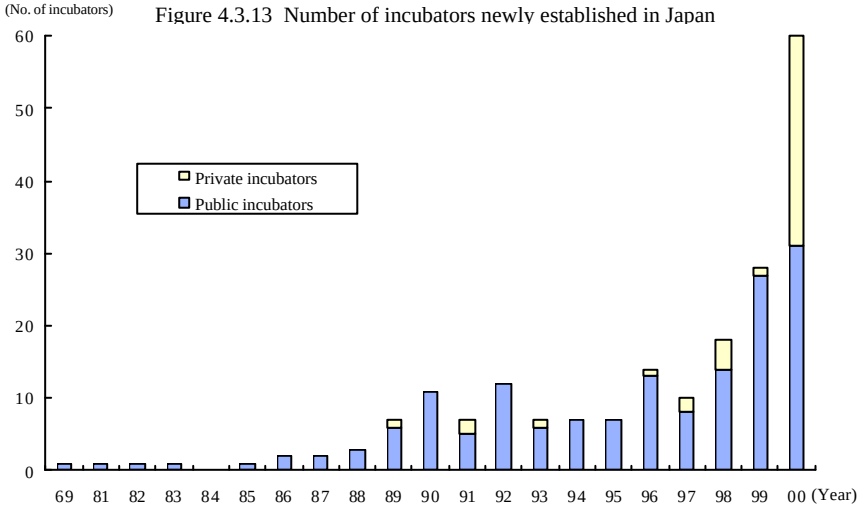
[12] *AUTM Licensing Survey 2000.*

[13] There have also been cases in Japan where university knowledge and technology has been the starting point for world-leading companies. Looking back in history, these include Hakunetsu-sha & Co., Ltd. (one of Toshiba' predecessors), in which Dr. Ichisuke Fujioka participated, and Ajinomoto, which grew out of the commercialization of so-called "Umami" by Dr. Kikunae Ikeda.

In the establishment of university-initiated ventures in the United States, TLOs and business incubators have functioned as the core of technology transfer. In regard to the latter, business incubators really took off in the United States in the late 1980s following formulation of the Bayh-Dole Act and the resulting momentum given to academia-industry cooperation, as well as the growing drive to establish new industries and stimulate the economy based on local initiative. Not only have incubators since expanded numerically, but they have also developed in terms of quality, including the upgrading of expert functions within incubators, the development of stronger ties with external human resources and support institutions, and the comprehensive provision of the diverse and specialist support services needed for start-ups. This wide-ranging incubator assistance has prompted the creation of a succession of university-initiated ventures.

In Japan too, the number of business incubators has skyrocketed since the 1990s. Private-sector incubators grew particularly rapidly in 2000 (Fig. 4.3.13). The incubation situation in Japan is therefore improving in terms of quantity, but from a quality perspective, business support services and ties with external support resources are still said to be lacking compared to the United States. This may reflect the short history of incubation in Japan and the limited number of personnel and institutions supporting start-ups.

Figure 4.3.13 Number of incubators newly established in Japan



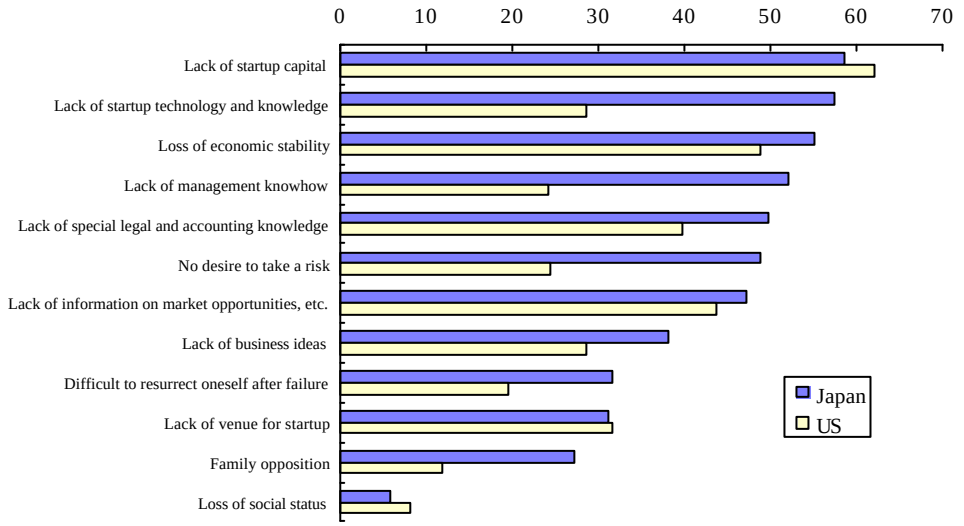
Source: *Abstract of Business Incubators in Japan* (Japan Association of New Business Incubation Organizations; 2001)

A questionnaire survey on factors impeding start-ups identified marked uncertainty in regard to knowledge and knowhow in Japan compared to the United States, with key responses including “lack of start-up technology and knowledge”, “lack of management knowhow”, “lack of special legal and accounting knowhow” and “lack of information on market opportunities” (Fig. 4.3.14). Such obstructions will need to be removed if Japan is to encourage university-

initiated ventures and other start-ups. This will mean improving entrepreneur education and boosting the ability of entrepreneurs to start their own businesses, to which end it will be important to strengthen ties with personnel who can supplement these gaps in the knowledge and knowhow of budding entrepreneurs, as well as with the various support institutions necessary in setting up and then running a business (Appended Note 4.3.1).

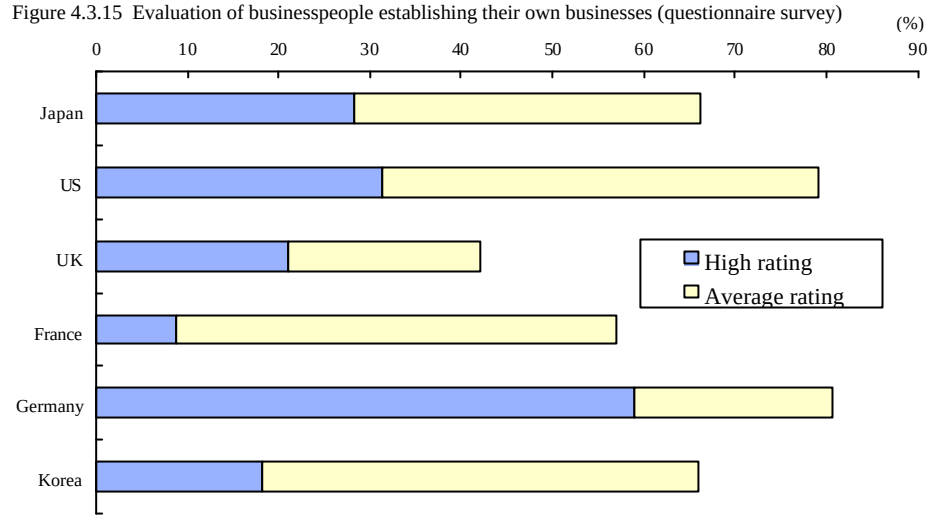
In promoting start-ups from universities, it will also be vital to nurture the kind of society in which, even if they fail once, individuals and companies can learn from their mistakes and try again. In the questionnaire survey presented in Figure 4.3.14, the Japanese emerge as having a stronger risk avoidance tendency than in the United States, as evidenced in responses such as "no desire to take a risk" and "difficult to resurrect oneself after failure". Some see this inclination toward risk avoidance as a difference in national temperament. Certainly, the US has a culture which rates and supports those taking a risk in setting up their own companies (Fig. 4.3.15). However, this is supplemented by mechanisms to ensure that risk does not focus on the entrepreneur, including comprehensive start-up support networks such as venture capital, strong capital flows centered around risk money and the presence of direct finance markets, the use of an expeditious bankruptcy system from an early stage, and a culture and systems which are tolerant of failure and facilitate further challenges, and these have played a key role in stimulating a vigorous cycle of exits and start-ups. To stimulate new business, Japan too needs to create comprehensive networks to support start-up activities and build a society which empowers its citizens to try again in the event of failure.

Figure 4.3.14 Comparison of factors obstructing startups in Japan and the US (questionnaire survey) (%)



Source: *Comparative Survey on Attitudes to Startups in Developed Countries and Startup Capacity in Prefectures and Towns* (Japan Small and Medium Enterprise Corporation)

Figure 4.3.15 Evaluation of businesspeople establishing their own businesses (questionnaire survey)



Source: *Comparative Survey on Attitudes to Startups in Developed Countries and Startup Capacity in Prefectures and Towns* (Japan Small and Medium Enterprise Corporation)

(3) Issues in urban revitalization

To create attractive economic agglomerations, the conditions need to be set in place to bring forth potential urban dynamism and upgrade the functions of urban amenities to draw creative human resources.

Cities have great potential attractiveness. Firstly, many companies and industries are concentrated there, a basic condition in the creation of new industries. Industries with high growth potential benefit enormously from the merits of regional agglomerations, including not only existing industries but also population and start-up support institutions, infrastructure and universities. In Japan, these urban functions tend to concentrate in Tokyo and Osaka. However, many of Japan's regional cities have great potential, including, for example, the presence of numerous universities. The self-sustaining development of local regions will depend on taking advantage of the potential of cities and, from a wider-ranging perspective, seeking forms of development whereby the merits of agglomeration spill over into peripheral areas, while also fostering key cities to form the core of regional economies.

To support the development of internationally attractive cities, the functions of international airports and ports need to be upgraded to allow these to become international exchange and distribution hubs, while more liquidity needs to be injected into the land market, and under-utilized or unutilized land such as former factory sites needs to be reorganized and concentrated in order to adjust to changes in industrial and urban structures. Japan has been advancing preparations toward revision and amendment of the various laws related to urban development, including the May 2000 revision of the City Planning Law. For example, in March 2002, the

Urban Renaissance Special Measure Law was formulated to put some weight behind urban revitalization, while the Urban Renewal Law has been revised and deliberations are underway on revision of the Building Standard Law and the formulation of a law to facilitate the reconstruction of apartment buildings. Deliberations are also moving in the direction of abolishing the Act concerning the Industry Restriction[14], which was formulated 1955-1965 to prevent excessive concentration of industries and populations in metropolitan areas or their environs.

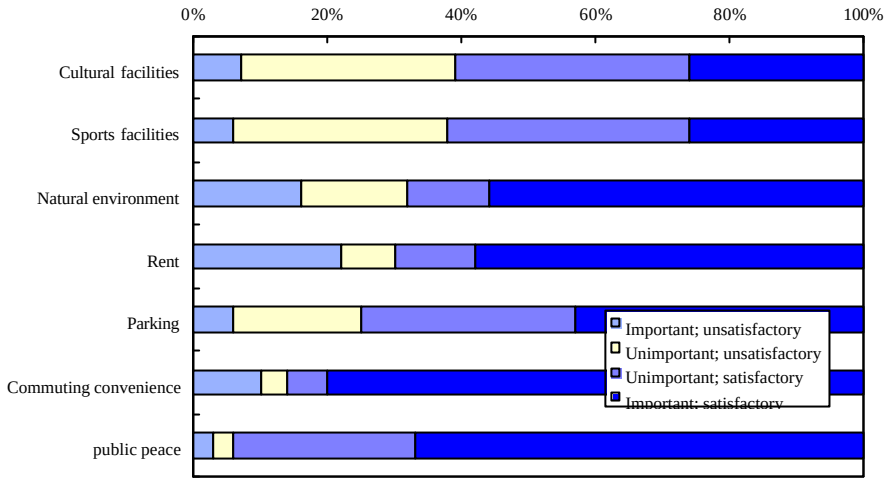
Living environment issues also need to be resolved such as long commutes and traffic jams, taking advantage of the cultural resources and amusements built up in cities and improving amenities. The new media industry agglomeration in Silicon Alley was created by human resources attracted by the available amenities. Improving amenities also contributes to the introduction of foreign capital. In terms of the living environment in Japan's capital, foreign businessmen are generally satisfied with the state of civil order and commuting convenience, but are dissatisfied with cultural facilities, sports facilities and the natural environment (Fig. 4.3.16)[15]. For example, there are major disparities between Tokyo and other major cities of the world in terms of park development (Fig. 4.3.17). Japan will need to work to improve these points.

Private-sector dynamism must also be used to the greatest extent possible to promote urban revitalization, and the conditions need to be set in place to exploit that dynamism.

[14] Namely the Act concerning the Industry Restriction in the Built-up Area of the National Capital Region(formulated in 1959) and the Act concerning the Industry Restriction in the Built-up Areas of the Kinki Region (formulated in 1964). These laws banned in principle any new construction of factories and universities larger than the standard measurement in limited areas within metropolitan areas and their environs. (However, new construction was permitted in exceptional cases based on special permits from prefectural governors and mayors of cities designated by government ordinance, restricted to instances meeting two criteria: (1) that the population in the restricted area does not increase as a result and (2) that the construction of said facilities contributes to the development or improvement of the urban environment.

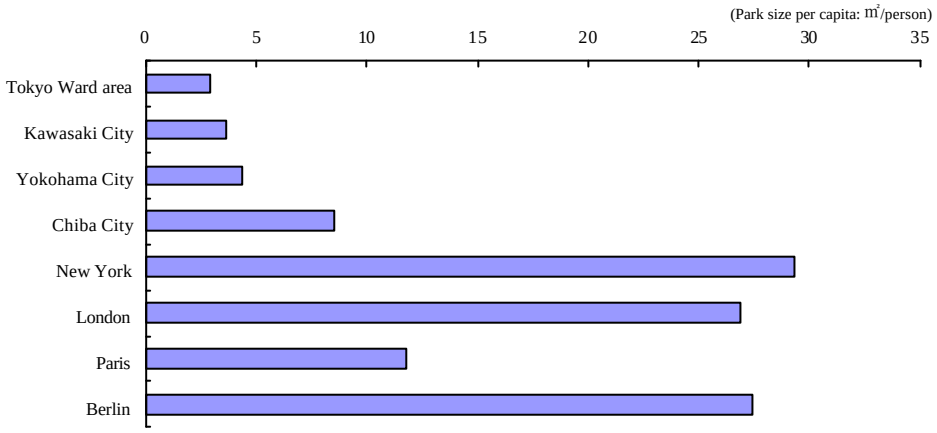
[15] According to a questionnaire survey by the Ministry of Land, Infrastructure and Transport targeting foreign businessmen working in foreign companies in Tokyo, children's education was the second greatest priority following the business environment, with around a quarter of families with children expressing dissatisfaction. (Ministry of Land, Infrastructure and Transport, 2001).

Figure 4.3.16 Tokyo living environment from the perspective of foreign businessmen (questionnaire survey)



Source: Ministry of Land, Infrastructure and Transport(2001)

Figure 4.3.17 Status of municipal park development in main cities



Note: Data for the various Japanese cities as at 31 March 2000. Dates for other cities surveyed were as follows: New York, FY1997; London, FY1997; Paris, FY1994; Berlin, FY1995.
Source: Ministry of Land, Infrastructure and Transport (2001)

(4) Industrial Cluster Plan (Regional Revitalization and Industrial Agglomeration Plan)

To support self-sustaining regional development, METI is engaged in the Industrial Cluster Plan (Regional Revitalization and Industrial Agglomeration Plan). The plan is designed to ensure the comprehensive and efficient institution of regional measures and consists of 19 projects nationwide aimed at forming wide-ranging personal networks among academia, industry and government, including around 180 universities and around 3,400 medium-ranked and small and medium enterprises looking to world markets. The policy comprises three basic planks: formation of wide-ranging human networks among academia, industry and government; promotion of technology development taking advantage of regional characteristics; and development of entrepreneur training facilities. It is expected to underpin regional economies

and promote the formation of new business agglomerations of a world standard.

(5) Efforts to create attractive economic agglomerations in Japan

Finally, TAMA, Kyoto City and Kobe City provide examples of efforts to form economic agglomerations to be matrices for innovation in Japan based on the three elements discussed to date, namely (1) knowledge-intensive networks centered around universities, (2) urban amenities, and (3) technology and industries exploiting regional characteristics.

(a) TAMA

One front-running project where a Regional Bureau of Economy, Trade and Industry (formerly a Regional Bureau of International Trade and Industry), a METI regional branch, has served as a nodal point in forming a regional knowledge-intensive network is the TAMA project conducted by the Kanto Bureau of Economy, Trade and Industry to stimulate regional industry.

The Kanto Bureau of Economy, Trade and Industry (Kanto Bureau) responded to the intensification of global-scale competition and changes in industrial structure in the 1990s by conducting various studies in the wider Kanto area between 1994 and 1997 in search of a new direction for regional economic development. Recognizing agglomerations as the source of Japan's economic dynamism and the possibility of also achieving regional economic development through the stimulation of agglomerations, the Kanto Bureau became increasingly interested in the wider Tama region (TAMA[16]).

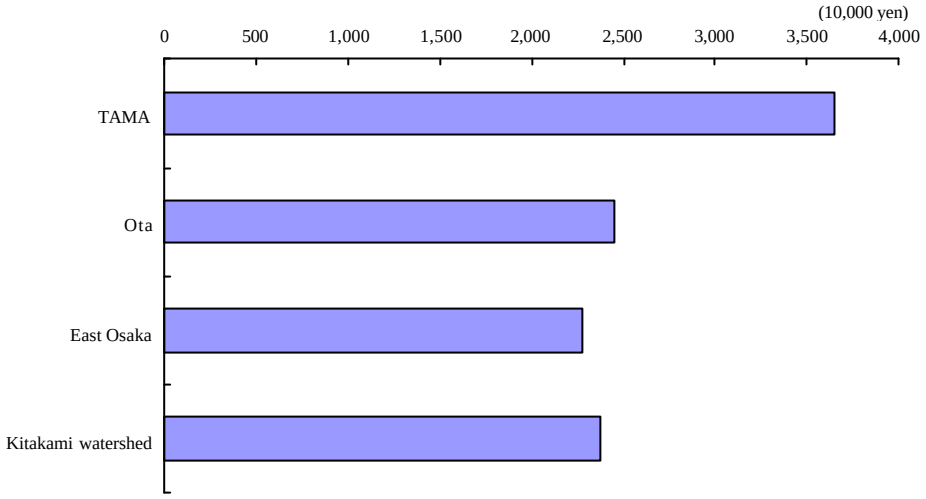
TAMA spreads from the Tokyo Tama region across southwest Saitama and central Kanagawa. The region is situated on the outskirts of the wide-ranging network agglomeration in the Tokyo metropolitan area, and embraces a number of agglomerations based on regional cities (Hachioji, Sagamihara, Machida, etc.) and on "corporate towns" (Sayama, etc.).

The area has absorbed many factories transferred out of Tokyo by large companies, with new businesses emerging as spin-offs, and as a consequence, electrical machinery and electronics, transport machinery and precision machinery agglomerations have formed. Further, because large companies with their R&D and trial manufacturing facilities in the Tokyo area have expected sophisticated technology from regional companies in the TAMA area, many product development companies have emerged with their own planning and development capacity. It should also be noted that private enterprises and universities[17] have also located

[16] TAMA: Technology Advanced Metropolitan Area.
[17] Around 40 of these have science and engineering departments.

themselves in the area, forming one of Japan's leading "brains agglomerations". Also underpinned by strong technological foundations, the per capita value of manufactured shipments is high compared to other regions (Fig. 4.3.18).

Figure 4.3.18 Regional comparison of value of manufacture shipment per employee (Census of Manufactures 1998)



Source: Kanto Bureau of Economy, Trade and Industry, METI (2001)

However, because TAMA's agglomerations have developed only since the high-growth period, orders have been received within a rigid hierarchical pyramid with large companies at the pinnacle, and factories are widely dispersed with little agglomerative density. As a result, TAMA's horizontal linkage has been rather weak. The area therefore lacked the diverse basic technology and the capacity for a flexible response in terms of both quantity and quality which has been achieved in Tokyo's Jonan Ward and East Osaka.

To supplement these shortfalls and form more sophisticated agglomerations, a number of entities, including regional companies, economic groups, local authorities and the Kanto Bureau, joined forces to promote the development of regional networks. In April 1998, the TAMA Industrial Revitalization Council[18] was launched to serve as the primary promotion body. The Council has held meetings for exchange among academia, industry and government, promoted internships, and considered the establishment of TLOs. In addition to these tripartite partnership programs, the Council has also organized R&D promotion programs, programs supporting new business, information network programs, various types of seminars and exchange meetings. In terms of academia-industry cooperation in particular, Tama TLO Co., Ltd., was established in July 2000, and is expected to serve as a regional technology licensing promotion institution.

[18] The Council was reorganized into the Greater Tokyo Initiative in April 2001.

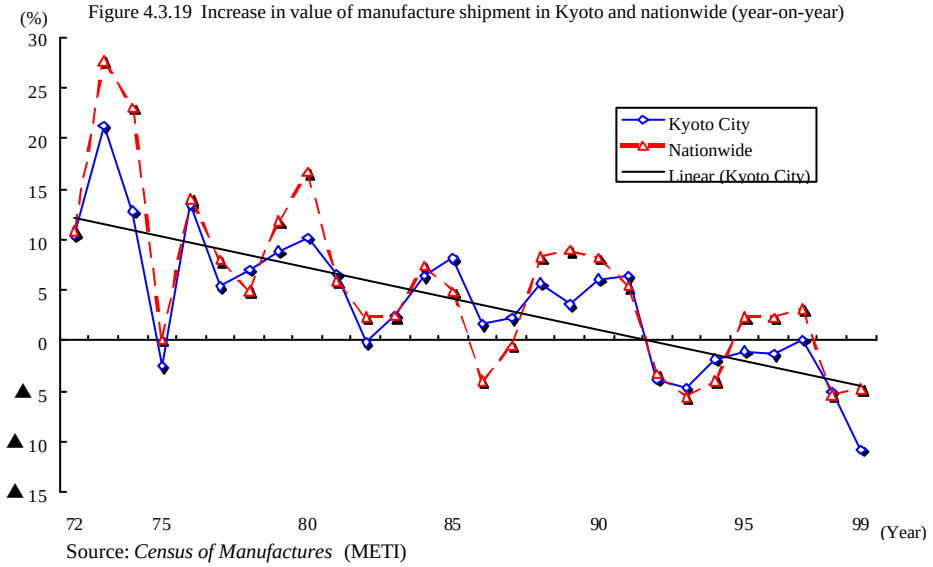
Program activities will be developed further over the coming years, including small groups of researchers established around the various railway lines within the region and the dispatch of experts to respond to company problems. It is hoped that the program will stimulate numerous talented human resources full of entrepreneurial spirit to create new business in technology and other areas, with TAMA demonstrating its full potential as an agglomerative area.

(2) Kyoto's efforts as the "venture capital"

Kyoto, former capital of Japan and home to 1,200 years of history and culture, is also known as the "venture capital" in view of the many venture companies the area has spawned. The accumulation of traditional industry, strong spirit of independence and respect for tradition counterbalanced by progressiveness have made Kyoto home to many companies which have subsequently grown into world-leading companies. Kyoto's many universities have also played a major role in the development of the region. Many of the companies which have departed from the region have actively absorbed technology and research results from universities and research institutions, bounding ahead on the strength of academia-industry cooperation.

However, growing conflict among universities has led to a decline in academia-industry cooperation, while constraints on development designed to protect cultural property have led companies and university campuses to shift out of the prefecture. As a result, economic conditions have deteriorated in recent years (Fig. 4.3.19).

Figure 4.3.19 Increase in value of manufacture shipment in Kyoto and nationwide (year-on-year)



Source: *Census of Manufactures* (METI)

Efforts have now begun to create new knowledge-intensive networks in order to stimulate

Kyoto's economy. The Kyoto City Industrial Development Vision, created by Kyoto City in 1995, comprised three pillars: (1) creating a future industry city, (2) creating and developing new Kyoto brands, and (3) developing support infrastructure for Kyoto as a manufacturing base. The Kyoto City Industrial Development Vision Promotion Council, established the following year, spearheaded considerations in regard to prompting venture companies, resulting in concrete action which included the establishment of a Venture Company Assessment Council, opening of the Kyoto Entrepreneurs School, and the establishment of the Venture Business Incubation Factory. Kyoto also established the Kansai TLO as the first such organization in Japan, and is advancing efforts to foster venture companies through partnership among academia, industry and government.

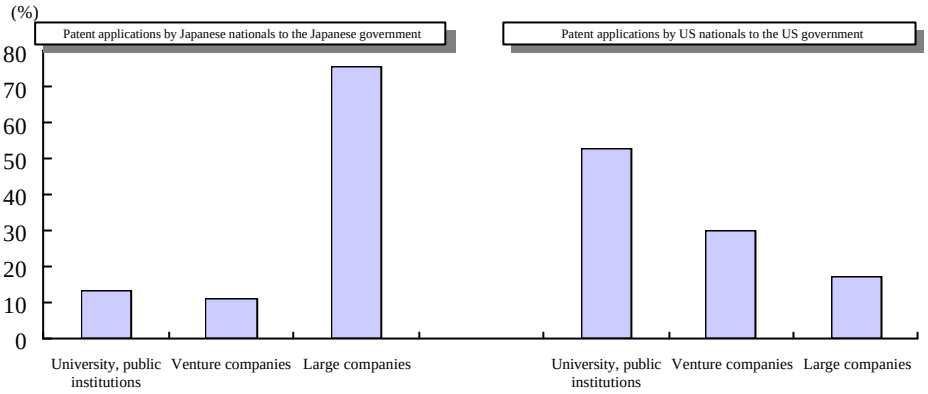
(3) Formation of a biotechnology industry agglomeration: Kobe Medical Industry Development (MID) Project

One industry on which countries all over the world are focusing as a strategic industry with high growth potential is the biotechnology industry. Because the exorbitant R&D costs cannot be shouldered by single companies, in the United States, for example, companies are developing partnerships with universities, research institutes and venture companies. Looking at applications for patents for key technologies in biotechnology[19], where the majority in Japan are made by large companies, the bulk in the US are received from universities, public institutions and venture companies, with universities playing a relatively important role (Fig. 4.3.20). Biotechnology industry agglomerations are beginning to form with universities as regional cores[20]. Further, when building knowledge-intensive networks, exchange with different disciplines such as medicine, engineering, biology and information technology is extremely significant for the biotechnology industry.

[19] Key technologies in biotechnology consist of the six core technologies: genetic modification technology, gene sequencing technology, developmental engineering technology, protein engineering technology, glycoscience technology and bio-informatics.

[20] On the east coast, government research institutes are clustered around Boston, which is home to Harvard University and the Massachusetts Institute of Technology (MIT), as well as the outskirts of Washington DC (the National Institute of Health, for example). The area between Philadelphia and New Jersey State hosts numerous pharmaceutical majors, and the "Research Triangle" agglomeration is evolving in central North Carolina State. On the west coast, the San Diego area and the San Francisco area known as "Biotech Bay" are well-known as bio-technology industry agglomerations.

Figure 4.3.20 Composition of Japanese/US applicants in key biotechnologies



Note: Applications to the Japanese government were researched using PATLIS to examine patent applications 1990-1997.
Applications to the US government were researched using WPINDEX (STN) to examine patent applications 1990-1997.
Source: Japan Patent Office (2002)

In Japan too, some regions are pursuing efforts to create agglomerations with a priority on the biotechnology industry. For example, Kobe City created the Kobe Medical Industry Development (MID) Project in 1998 as a means of developing new industries and upgrading existing industries toward a full recovery from the Great Hanshin-Awaji Earthquake, as well as to build a medical care and welfare services supply system geared to Japan's inverting age pyramid. Under the MID, efforts are going ahead to develop a medical industry agglomeration centered around the Institute of Biochemical Research and Innovation (IBRA), the Translational Research Informatics Center (tentative name; a clinical research information hub), and bio-technology-related facilities to support entrepreneurs. The agglomeration will tie in with the Port Island 2nd Stage and approached in collaboration with the Institute of Physical and Chemical Research's RIKEN Center for Development Biology. Partnership with the Kobe City General Hospital and other local medical institutions, domestic and foreign research institutions, and companies working in the medical field is an important part of the scheme, with views also exchanged among the various members at the Kobe MID Project Study Group. Kobe City is also devoting considerable energy to attracting foreign companies, actively engaging in presentations abroad. The Kobe International Business Center has also been established to provide cheap, highly-convenient offices and R&D lab space[21].

[21] Kobe City website (http://www.city.kobe.jp/)