

# Technological Innovation and the Origins of R&D Venture Bussinesses in Japan

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出版者	法政大学産業情報センター
journal or publication title	グノーシス : 法政大学産業情報センター紀要
volume	3
page range	58-69
year	1994-03-31
URL	<a href="http://hdl.handle.net/10114/00020870">http://hdl.handle.net/10114/00020870</a>

# Technological Innovation and the Origins of R&D Venture Businesses \* in Japan

**Tadao Kiyonari**

## **A. R&D Characteristics of Japan**

### **(1) R&D Patterns Characteristic of Late Comers**

Research and Development in Japan has followed patterns characteristic of late comers. In the beginning, Japan could not afford to promote R&D and depended on imported advanced technology products. Next came the "import-substitution stage" when imported products were replaced by domestic products, which were imitations of those from advanced countries. While imitation may play a role in innovation, it is still difficult to catch up with mainstream economies that way.

Improvement followed imitation. Japan was not content with imitation and improved its production technology while, at the same time, refining the overall quality of its products. Through these efforts, it increased exports while meeting domestic demand. After a long series of small improvements at the production level, Japan increased its competitiveness. In reality, Japan took advantage of being in a position to learn from the mistakes of pioneers.

Improvements stimulate product development technology through applications of existing technologies. In the 1970s, Japan entered this next stage when new products are developed to meet consumer demand.

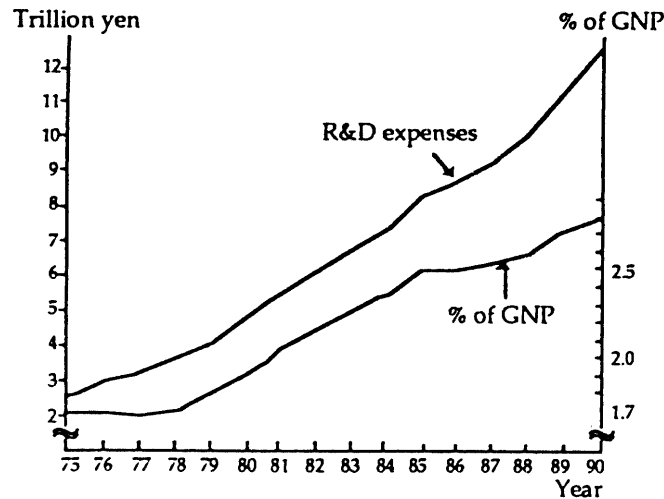
In the 1980s, Japan's R&D sector became active resulting in new developments in technology. Research institutes rapidly increased in number during this period.

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\* The term "venture business" is defined as "knowledge-intensive and innovative small business." It is a "Japanized" English word.

Figure 1 shows the changes in R&D expenditures since 1975. Note its dramatic rise. The ratio of R&D expenditures to GNP has also increased every year, from 1.72% in 1975 to 2.73% in 1990.

**Figure 1 Changes in R&D Expenditures in Japan (Natural Sciences only)**



Source : *Management and Coordination Agency, "Report on the Survey of Research and Development"*

Another characteristic of Japan is that companies account for an extremely large proportion of research expenditures. This has increased constantly from 64.3% in 1975 to 76.7% in 1990.

Recently, Japan surpassed countries such as Germany, the U.S., France and the U.K. in the ratio of research expenditures to GNP. Japan, a late comer, has reached the point where it exceeds the standards of other advanced countries on this point.

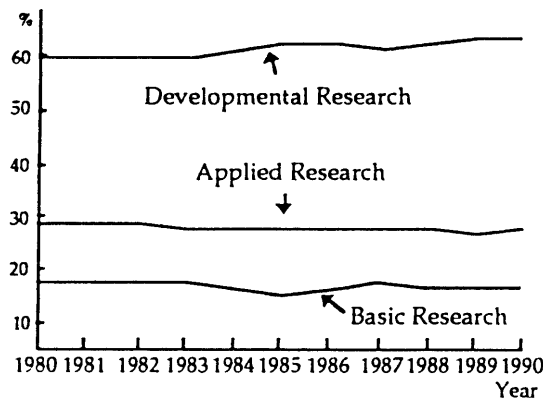
## (2) Advantages of Japanese R&D

Research and development in the West is characterized by a linear process of basic research → applied research → development. By comparison, development is the central concern in Japan, and its R&D process sometimes move the other way, starting from development and ending up with basic research. Such basic research is known as results-oriented basic research. In other words, R&D patterns in Japan are characterized by a non-linear process. It is the civilian sector that has carried out major R&D activities and, consequently, research is conducted to meet specific needs, thereby producing greater efficiency. This can be a substantial advantage for a "late comer."

In Figure 2 research expenditures in Japan are shown by category, where it can be seen that proportions changed little in the 1980s. Developmental research has consistently accounted for a little more than 60% of expenditures, while basic research has stayed around

13%. This is similar to the U.S., where the image is one of greater emphasis on basic research, accounting for 13.4% in 1981 and 15.5% even in 1991. The U.S. Federal Government funds more than 50% of the national research cost, while industry accounts for less than 10 percent. Additionally, more than 70% of the U.S. Government's total budget for scientific development goes into defense and space development. As a result, there is little input of research expenditures into the civilian sector in the U.S.

**Figure 2 Changes in Research Expenditures in Japan by Category**



Source: *Management and Coordination Agency, "Report on the Survey of Research and Development"*

We can conclude that R&D activities in Japan were mainly "catch-up" in style as practiced by the civilian sector, and that this has proven to be fairly efficient.

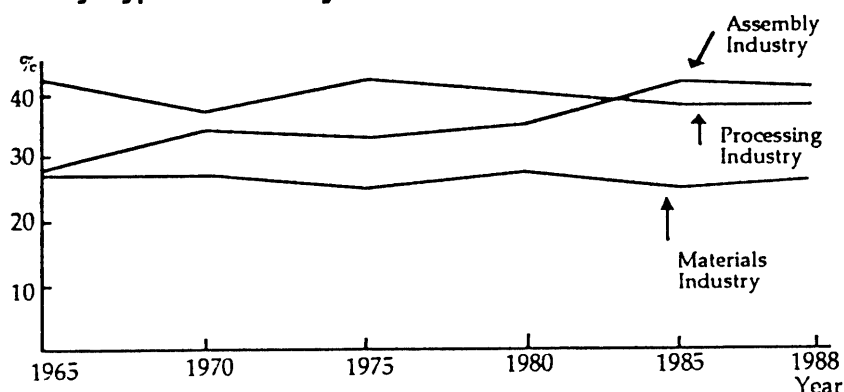
## B. Changes in Industrial Structure and Emergence of Venture Businesses

### (1) Changes in Japan's Industrial Structure

Japan's industrial structure changed rapidly in the 1970s due to rapid economic growth.

In the manufacturing sector, materials industries reached maturity while assembly industries grew. Figure 3 shows the changes in the proportions of value-added amounts in the manufacturing industry according to the types of industries. It shows that materials industries have gradually decreased in importance. Assembly industries, by contrast, have increased their share, reaching 40.3% in 1985, the largest share of any industry type within the manufacturing sector. Growth was especially high in high-tech industries such as electronics and computers. Among processing industries, growth was especially notable in the fashion industries. Thus, it can be shown that R&D and design development are more important than ever. The rise in production costs has forced businesses to increase productivity through innovative efforts.

**Figure 3 Changes in the Proportions of Value-Added Amounts in the Manufacturing Sector by Type of Industry**

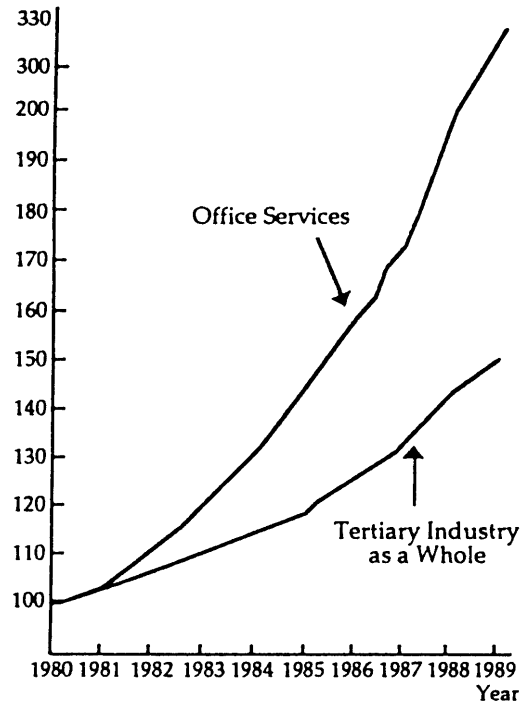


Source : *Ministry of International Trade and Industry, "Tables of Industrial Statistics"*

As R&D and design of development increased in importance, the economy became more oriented towards service. Even within the secondary industries, service jobs increased, while service industries showed remarkable growth. The proportion of tertiary industry within the GDP (real term) has shown a steady increase, from 40.8% in 1970, to 48.1% in 1975, 50.6% in 1980, 50.8% in 1985 and 53.9% in 1989.

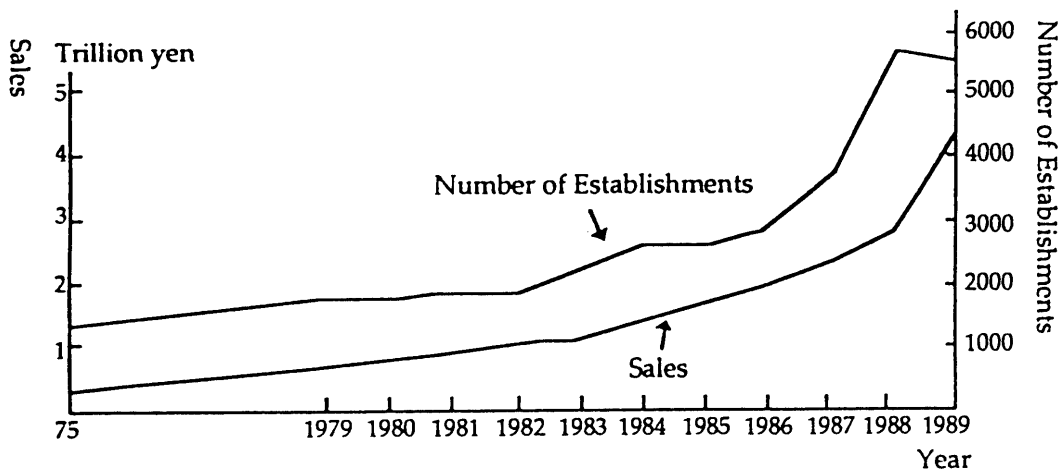
Figure 4 shows the changes in the activity index of tertiary industries. This data reveals that office services have experienced especially high growth. The use of external companies to provide service jobs is increasing in popularity. This may, in part, reflect the advancement of computerization. Regarding this point, Figure 5 shows changes in the number of information service companies and their annual sales. Both the number of companies and their sales greatly increased in the latter half of the 1980s.

**Figure 4 Changes in the Activity Index of Tertiary Industries**



Source : *Ministry of International Trade and Industry, "Activity Index of Tertiary Industries"*

**Figure 5 Changes in the Number of Companies in the Information Service Industry and Their Annual Sales**



Source : *Ministry of International Trade and Industry, "A Report on the Survey of the Present Conditions of Specific Service Industries"*

With the rapid rise of the yen after September 1985, industrial costs increased, and, as a result, imports and direct foreign investments have also increased. And, only those companies that held down rising costs through increased productivity were able to continue their businesses. This is the reason R&D and design development are crucial to business success in Japan.

## (2) Emergence of Venture Businesses

These changes in industrial structure were most likely advantageous to small and mid-sized companies. Furthermore, in the 1970s, various aspects of assembly-line technology accumulated, and it enabled the application of existing technology to product development in a short period. In fact, during this period, small and mid-sized companies started their businesses to meet market demands through the development of new products.

Table 1 is from "A Report on the Survey of Scientific Technology Research" (The Prime Minister's Office), and it shows the R&D trends of small and mid-sized companies (less than 300 employees). The number of companies that conducted R&D activities was 10,370 in 1975, which accounted for only 4.2% of all companies. The figure was 6.1% for the manufacturing industry. Within the manufacturing industry, a significant proportion of electrical and precision machinery businesses were involved with research and development. However, the number of workers engaged in R&D was just 3.8 per company, while R&D expenditure was only ¥12,533,000. R&D expenditure accounted for only 2% of total sales.

**Table 1 R&D Trends of Small and Mid-sized companies(1975)**

	R&D companies	R&D workers	R&D expenditure (million yen)
All Industries	10,370 (4.2)	39,136	129,968
Manufacturing Industry	9,935 (6.1)	36,589	120,366
General Machinery	1,168 (7.5)	5,272	23,117
Electrical Machinery	1,791 (18.0)	4,794	16,968
Electrical Machinery/Appliances	1,245 (25.3)	1,979	7,087
Communication/Electronics/ Electrical Measuring Instruments	546 (10.8)	2,815	9,881
Transport Equipment	206 (3.3)	453	1,648
Precision Machinery	475 (12.7)	1,753	5,572

Source : *Management and Coordination Agency, "Report on the Survey of Research and Development"*

It should be noted, however, that small and mid-sized companies were more active in R&D than the above numbers suggest. At the actual production level, developments were made constantly, and many companies may not have allocated specific R&D expenditures within the budget.

It may be inferred that small and mid-sized companies were fairly active in R&D in 1975. Also, around this time, new types of R&D businesses were emerging. A survey of newly started enterprises conducted by the People's Finance Corporation in 1974-1975 revealed that new innovative small and mid-sized companies began operations in the Tokyo and Kinki areas. These enterprises became known as "venture businesses."

In what way were venture businesses new? Entrepreneurship has been active in Japan since the early stages of industrialization. Many small companies were established after World War II, and many small companies grew to medium-size.

However, they were businesses that accumulated their managerial expertise through experience—the managers were not always highly educated. Another type of enterprise expanded during the time of rapid economic growth beginning in the late 1950s. These medium-sized businesses pursued economies of scale through innovation and creativity.

Venture businesses were the result of a further intensification of intellectually creative work. Thus, venture businesses are characterized by knowledge-intensive innovation such as R&D. They concentrate their efforts in intellectual activities rather than experience. As a result, managers of venture businesses are, in general, highly educated. An additional new phenomenon is that many managers have held positions in large or "backbone" companies, but started their own companies to better utilize their talents.

However, as a matter of course, venture businesses are risky. Accordingly, risk capital is needed, but no such funding mechanism existed at the time. As a consequence, businesses were started mainly through funds "on hand." The only system that supported them was a loan system of the People's Finance Corporation.

This gap in the supply-and-demand in risk capital discouraged the start-up of venture businesses, and led to the establishment of venture capital companies. As a result, eight venture capital companies were established in 1972 and 1973.

Venture businesses did not grow very much at this stage due to the strict requirements for going public and a lack of investment knowledge.

## **C. Changes in Venture Businesses**

### **(1) Increase in Venture Businesses**

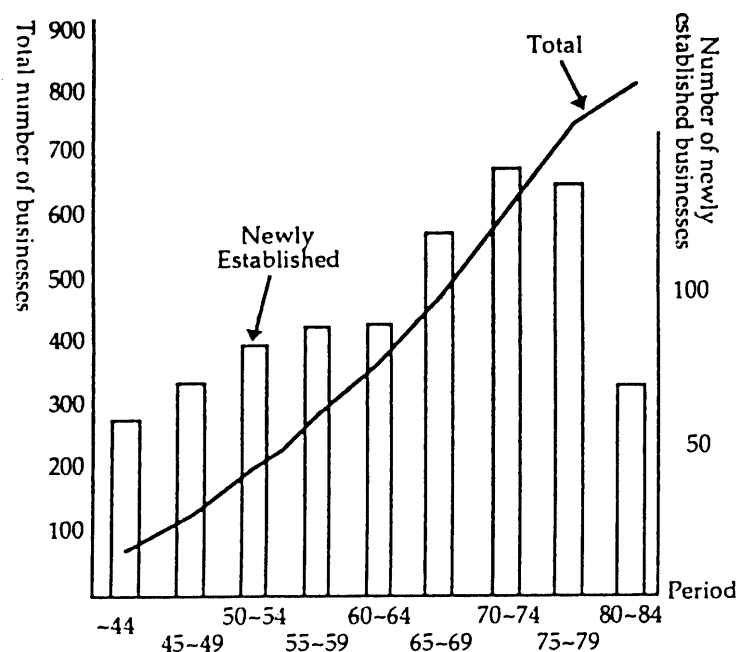
In the 1970s and 1980s, venture businesses steadily increased in number. The general impression is there were two "booms" in venture business establishment, the first around 1970 and the second around 1980. But such "booms" are mostly the creation of journalists. In actual fact, the increase in the number of venture businesses was constant.



It is true, however, that there were two booms in the establishment of venture capital companies. The first boom came in 1972–1973, and there was a second boom in 1982–1983. The requirements for going public in the over-the-counter market were relaxed in 1983, and it resulted in the successive establishment of venture capital companies. Eight were established in 1982, 11 in 1983, and 5 in 1984. Establishment has continued even after 1984. At the same time, in 1986, investment competition intensified, and over-investment without sufficient knowledge caused large-scale bankruptcies.

No exact statistics are available on the establishment of venture businesses. Figure 6 is taken from "Information on Venture Businesses" (1985 edition) (*Nihon Keizai Shimbun*, November 1984), which shows establishment in the manufacturing and information service and software industries. *Nihon Keizai Shimbun's* criteria for identifying venture businesses are not entirely clear, but it is safe to assume that only businesses that achieve a certain amount of sales within a specified period grab the attention of a newspaper.

**Figure 6 Establishment of Venture Businesses**



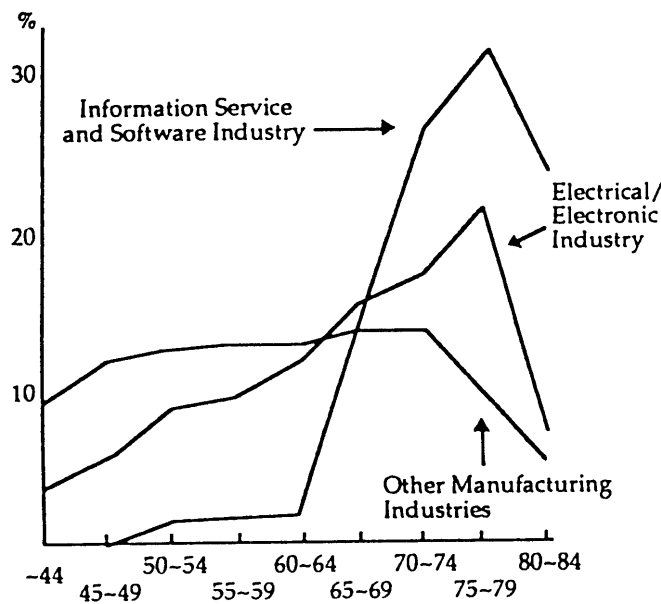
Source : *Nihon Keizai Shimbun, Inc., "Information on Venture Businesses" (1985 Edition) (November 1984)*

Figure 6 shows that 1970–1974 was the peak for establishment of venture businesses. The number of newly established businesses after 1980 is small since many had not as yet come to the attention of the *Nihon Keizai Shimbun*. In fact, in spite of the recession after the oil crisis, establishment of venture businesses continued. This is evident from their establishment according to the type of business, shown in Figure 7. In terms of educational background, the electrical/electronic and especially information service software industries

contain significant numbers of companies established by people who were not highly educated. Venture businesses were established first in machine industries, followed by electronic/computer hardware and finally computer software. In the 1980s, the number in computer software increased significantly. Nikkei's *Yearbook of Venture Businesses (1992 Edition)* shows that computer software companies, established after 1974 accounted for as much as 60% of the total of 176 businesses, with those established between 1980 and 1984 accounting for the largest share. Among the 371 electrical/electronic (hardware) companies, 72(19.4%) were established between 1975 and 1979, accounting for the largest share. The rate of establishment for venture businesses was constant.

Investment in information businesses accelerated the development of an advanced industrial structure, which brought about a variety of changes not only on the production lines of manufacturing but also in distribution and service. These changes led to increased business opportunities for small and mid-sized companies, and the success of information-related venture businesses encouraged further investment in information businesses.

**Figure 7 Changes in the Establishment of Venture Businesses by Type of Industry**

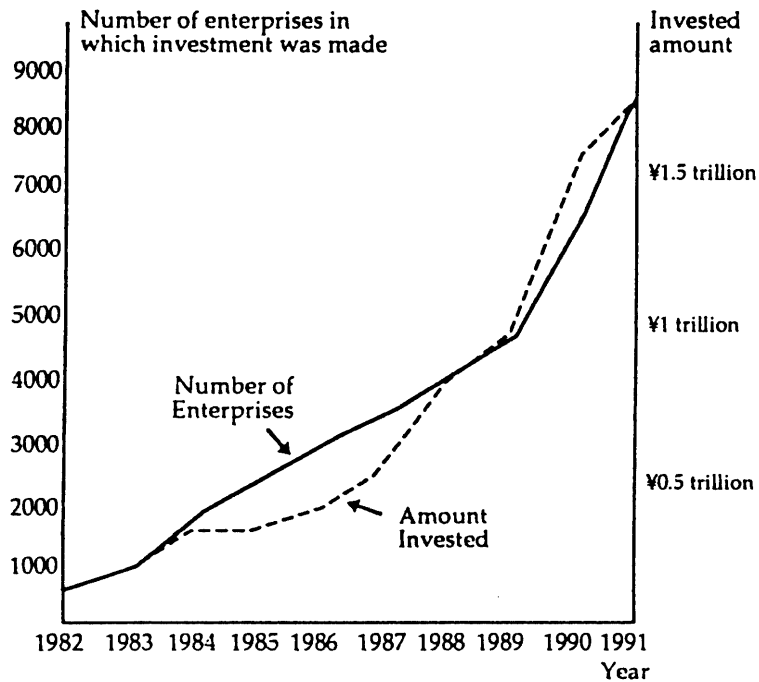


Under these circumstances, some venture businesses grew to be "mid-sized" enterprises. Investment by venture capitalists also increased considerably in the 1980s. Figure 8 shows the changes in their investment and loan balance. It indicates that both the number and the amount of investment increased rapidly. Investments, however, were made in vastly diverse sectors. R&D companies probably accounted for less than one-third. This reflects the fact that the growth rate is usually higher in non-technological businesses.

Furthermore, as clearly seen in Figure 9, the number of companies that went public in

the over-the-counter market also increased yearly in the latter half of the 1980s, reaching a peak of 95 in 1991. However, R&D companies were not numerous here either. More growth took place in non-technological fields. And, with the bursting of the "bubble" economy and the decline in stock prices, the number of companies going public decreased rapidly to only 15 in 1992.

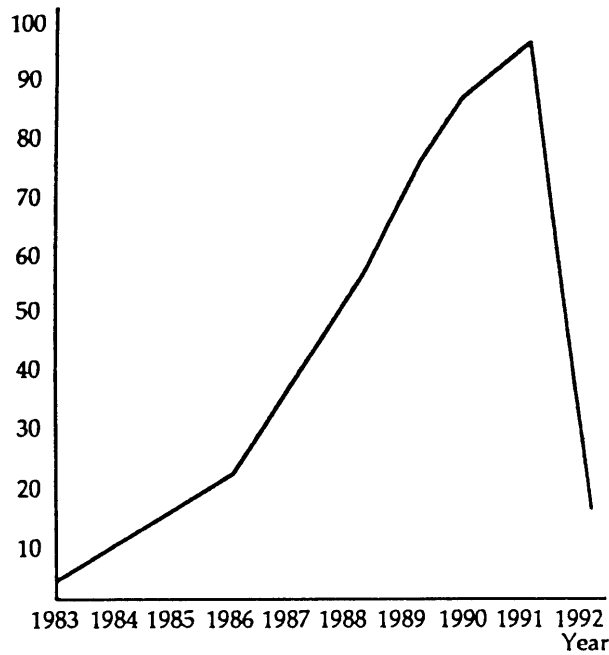
**Figure 8 Changes in the Investment and Loan Balance of Venture Capital Companies**



Source : *Ministry of International Trade and Industry*

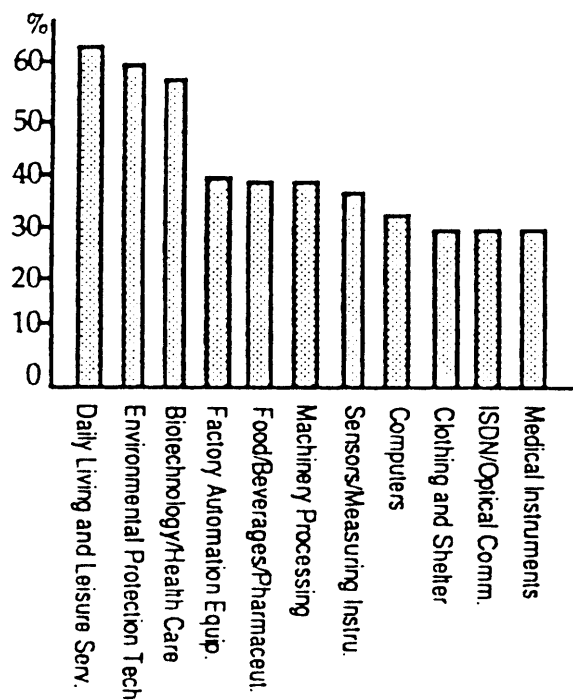
Notes : *Figures are as of December 31 of each year.*

**Figure 9 Changes in the Number of Companies Entering the Over-the-Counter Market**



Nevertheless, according to "1992 Nikkei's Survey of Venture Capital Companies," R&D industries are targeted for future investment by an increasing number of venture capitalists, as shown in Figure 10. Though daily life and leisure-related services top the list, the businesses that follow are R&D-intensive.

**Figure 10 Businesses Ripe for Increased Investment**  
(Proportions of venture capitals, multiple answers)



## **(2) Remaining Issues for Venture Businesses**

Venture businesses have increased remarkably in Japan, yet they fall far behind those in America both in quality and in quantity. This is caused not by any lack of ability on the part of the entrepreneurs but on social circumstances in Japan. Establishing a venture business is not easy because of difficulties in securing sufficient risk capital. In addition, even after the business is established, it is often difficult to secure enough human resources due to the low mobility rate of workers in Japan. This is in contrast to the American situation where the higher the quality of venture business the more people it attracts. These conditions inevitably hinder growth of venture businesses in Japan. Of the companies that entered the over-the-counter market in 1991, it took an average of 29 years from establishment to going public. Under such circumstances, venture capitalists are more reluctant to invest at the time of start up and are more or less forced to manage the bridge financing before going public. Thus, the supply-and-demand gap of establishment expenses is created.

Therefore, the establishment of venture businesses in Japan is usually accompanied by both a lack of personnel and funding. Venture businesses have increased, but not at the expected pace. The growth rate of venture businesses is also much lower than in the U.S. Furthermore, increased start-up costs have magnified the difficulties inherent in establishing a venture business.

Increases in venture businesses will contribute to the strengthening of the economy. We are awaiting an effective policy to solve the issues pointed out above.