

University spin-offs in Japan

From university-industry collaboration to university-industry crossover

Masayuki Kondo

Universities are sources of knowledge. In recent times, some of them have started making efforts to transfer their knowledge through spin-offs, technological consulting and patent licensing. In 2001, the Japanese Government had launched a plan to create 1,000 university spin-offs in the next three years. This article throws light on the current situation, on the basis of the first survey on university spin-offs in Japan.



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Introduction

Universities are great sources of knowledge. In this age of knowledge, they need to possess public service functions in addition to education and independent research.¹

Earlier, knowledge transfer, especially technology transfer, took place through consultancy, joint R&D, contract R&D and patent licensing; in short, university-industry collaboration. Now, in addition to these forms of university-industry collaboration, university-industry crossover is also observed. Universities have started engaging in technology commercialization activities to transfer their knowledge. Traditionally, such activities belonged to the industry sector. One form of university-industry crossover activities is "university spin-off". Observers point out that universities are becoming entrepreneur-

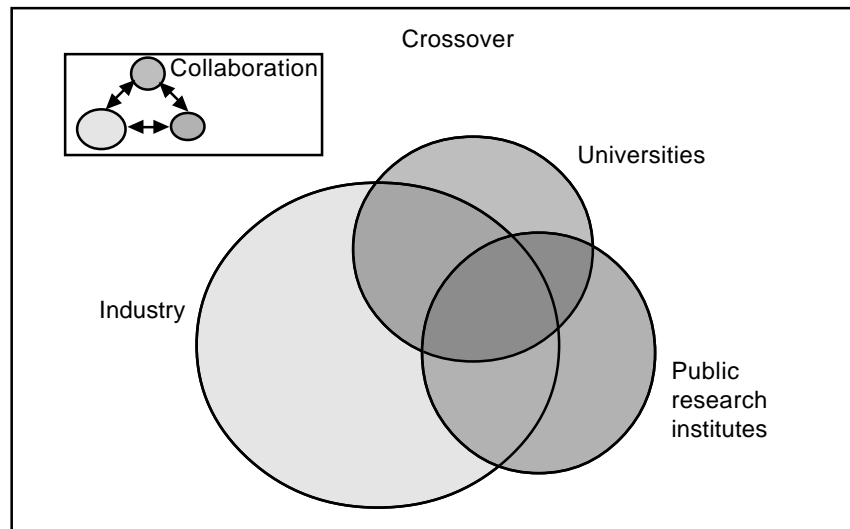
ial, that technology transfer from universities to industry is pervasive in the USA and that university spin-offs are increasing in Europe, including the UK.² The relation between the university sector and the industry sector has moved from university-industry collaboration to university-industry crossover (Figure 1).

This article, after explaining the need for, and defining, university spin-offs in Japan, clarifies some characteristics of Japanese university spin-offs based on the first survey on university spin-offs in Japan.¹ It analyzes:

- The relation between university spin-offs and their mother universities;
- Founder profiles;
- The profiles of university spin-offs;
- Difficulties at the time of start-up and current difficulties; and
- Assistance received from mother universities and public authorities,

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Figure 1: University-industry collaboration to university-industry crossover



and so on, compared with university spin-offs in Germany. Comparing the Nippon-Rheinland model with the Anglo-Saxon model, one could conclude that Japan and Germany have some common features in their economic-industrial structures, such as a close relation between large industrial companies and large banks.

The need for university spin-offs

Many expect that university spin-offs will lead Japanese high-tech in the 21st century. The Government launched a plan in 2001 to create 1,000 university spin-offs in the next three years, and has taken various policy measures since then to promote spinning off from universities. As will be seen later, the number of university spin-offs is increasing rapidly as a result.

There exist several reasons why university spin-offs are needed in Japan.

First, universities are the source of advanced technologies as is the case in many developing countries as well as in developed countries. In Japan, university researchers comprise 27 per cent of all researchers. On the demand side, strategic changes have taken place in corporate R&D activities. Japanese companies concentrate their R&D resources in target areas to compete in the global market. However, they need to widen the range of their R&D activities because of technology fusion and accelerated new technological developments.

Especially in the fields of Pasteur-type research,² where basic research results can be readily applicable to commercial use, university researchers are expected to play a major role. Biotechnology is one such field. More than 80 per cent of researchers of health science, which includes medicine and pharmaceutical science, are university researchers in Japan.³ Within the university sector, more than one half of university researchers in natural science and engineering belong to health science.

Second, university technological achievements need to be commercialized quickly to compete in the global market. Time is an important competitive factor.⁴ Technology transfer needs to take place in a short time. From the earliest stage of technology development, there needs to be collaboration between university researchers and company researchers. Since technology transfer is done in the form of verbal and non-verbal communication or human transfer rather than in the form of documents in Japan, university spin-offs are among the fastest ways to transfer university technology to industry.

Third, the technology frontier is long, and key next-generation technologies are not foreseen. Existing companies cannot investigate all the possibilities and, in addition, are downsizing corporate laboratories to shift their resources to more near-future projects. Thus, university spin-offs are expected to pursue various technology fron-

tiers to enhance the possibility of Japan's technological competitiveness in the next generation through university research results. Universities conduct more than a half of the basic research in Japan.⁵

In universities, Bohr-type research, which pursues truth, is conducted perversely. Needless to say, such research should indeed be conducted in universities. The important point is that some university researchers who conduct Pasteur-type research engage in technology transfer activities, including spinning off. Such activities should be encouraged or at least should not be blocked. Actually, the ratio of the university faculty who are interested in starting up a company is not high. In Germany only 3-4 per cent of university faculty have any intention of starting up a company; in the USA only 5-15 per cent of university faculty are interested in starting up a company.⁶

The areas where university spin-offs possess advantages are those where intellectual property rights can be well protected in the form of patent rights or other forms. Otherwise, existing companies have competitive advantages over university spin-offs. They have capabilities of marketing, producing, and creating patents to circumvent existing patents. Areas where university spin-offs have special advantages are those where a small number of patents can protect their business and these patents possess high value. A material patent is a good example. The related industry to material patents is chemical industry, including the pharmaceutical industry. In the chemical industry, creating a patent requires a longer time and more R&D funding than other industries such as the machinery industry,⁴ and patenting is most highly regarded as a means to appropriate inventions both in Japan and the USA.⁵ Biotechnology is one of the fields where university spin-offs have the possibility of competitive advantages, because genes whose functions are clarified can be patented like material patents and these patents could have high values.

Definition and types

In this article a university spin-off is defined as a newly founded company

that has received some management resources from a university or universities. That is, a new company has received human resources, technology or capital from a university or universities at the time of foundation.⁷

University spin-offs under our definition have one or more of three relationships with their mother universities:

- Technology-related - where a new start-up company is founded based on research results of universities or a technology acquired at universities;
- Human-resource-related - where faculty members, technical staff or students⁸ establish a new start-up company or are deeply involved at the founding stage; and
- Capital-related - where universities or university-related organizations provide initial capital or play an intermediary role between founders and investors.⁹

An example of the first type of relationship is seen in AUTM (Association of University Technology Mangers), USA.¹¹ An example of the second type is seen in the ATHENE Project, Germany.¹⁰ Our own definition of a university spin-off is wider than these.

Mass media tend to focus on fast-growing university spin-offs aiming at quick initial public offerings. However, wider roles are expected for university spin-offs and there are several types according to their profit orientation.

Four types are considered (Table 1).¹² The first is a fast-growth type. A university spin-off of this type targets a major market. It usually receives capital from venture capitalists and hires professional managers. The second is a steady-growth type. A university spin-off of this type targets a niche market. It usually collects funds from founders, their family members, their friends and so on. It is managed by founders for a fairly long time. As it grows slowly, founders have time to learn how to manage a larger organization. The third is a research/education promotion type. A university spin-off of this type is founded to conduct applied research that is difficult on campus, to efficiently supply research materials to campus researchers, to provide an alternative research opportunity to students, or to provide both an applied research opportunity and financial assistance to

Table 1: Types of university spin-offs

Profit-oriented ↑ ↓ Non-profit-oriented	<ul style="list-style-type: none"> ● Fast growth type (targeting a major market) ● Steady growth type (targeting a niche market) ● Research/education promotion type ● Social purpose type
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doctoral students. The fourth is a social purpose type. A university spin-off of this type aims to contribute to society through bringing university research results to the market. Its products are usually not commercially profitable. Some examples are seen in the area of environment technologies.

Upsurge of university spin-offs

University spin-off activities have become very active in Japan. The number of university spin-offs increased rapidly around the end of the 1990s, according to the first comprehensive survey on university spin-offs in Japan.¹³ In the 2000's more than 100 university spin-offs were created each year (Figure 2). This shows a marked difference from the situation in 1997, when Japan created only 17 university spin-offs, while Germany created 635 and the USA created 258.¹⁴

A look at the number of university spin-offs by decade after World War II clearly reveals a drastic change. In the 1950's only three university spin-offs came into being, in the 1960s four, in the 1970's five, and in the 1980's twelve; but, in the 1990's 121 were founded. University spin-offs are really a new phenomenon in Japan.

Mass media attention increased more recently. The number of articles on university spin-offs that appeared in Japanese business newspapers increased only after 2000 (Figure 3). Only one or two articles per year were found up to 2000. In 2001, 84 were found. In 2002, 354 were found, that is, almost one article per day.

University role

Fostering entrepreneurship

To create university spin-offs, the role of universities is important. Some universities provide lectures and courses to provide knowledge on start-ups to students and faculty members; to pre-

pare them for start-up if they have concrete plans; or to nurture entrepreneurship for future start-ups.

National universities are most active (Table 2). They are directly influenced by the policies of the Ministry of Education, Culture, Sports, Science and Technology.¹⁵ Lectures on start-ups are provided in 57 per cent of national universities, as against only 20 per cent of private universities and only 13 per cent of public universities.¹⁶

At the stage of physical start-up, it is always helpful to receive consultancy on business planning, financing, marketing, company registration and so on, since faculty members and students do not have such experience or knowledge. Here again, national universities are most active (Table 2). Start-up consultancy organizations exist in 47 per cent of national universities, as against only 11 per cent of private universities and only 8 per cent of public universities.

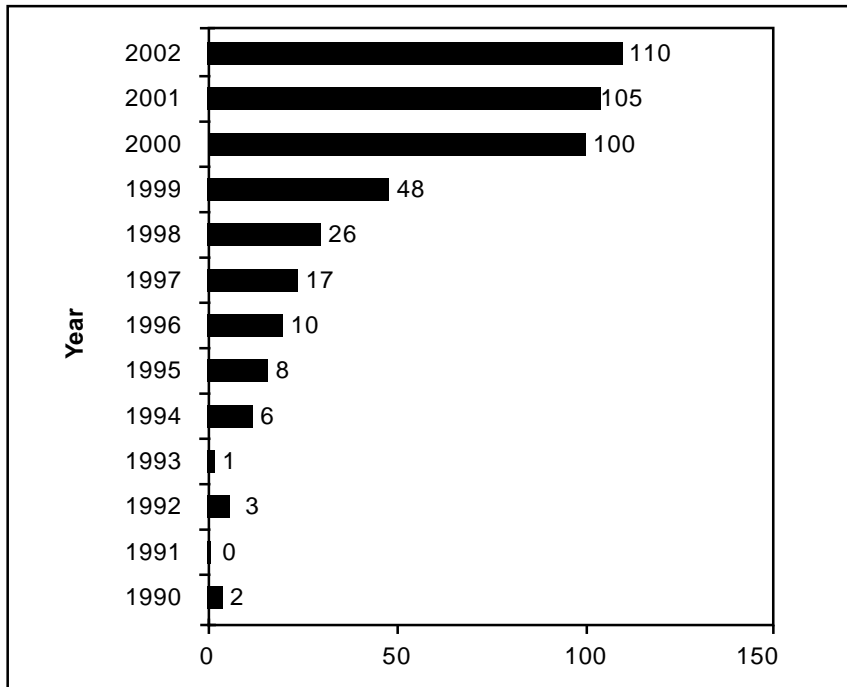
Regarding venture capital funds, national universities are also most active. There are venture capital funds related to five national universities but to only two private universities.

As a result, many university spin-offs have been created from national or public universities. While about a third have been founded from private universities, about two thirds have been founded from national or public universities.

Relationship with mother universities

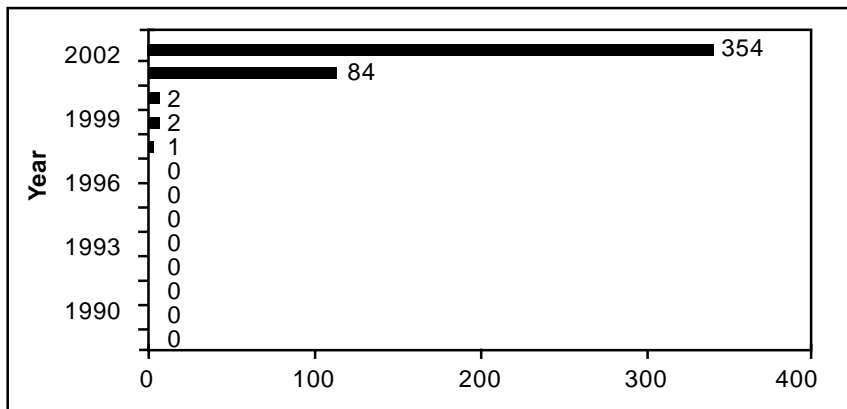
Most university spin-offs in Japan have technological and/or human relationships with their mother universities. More than 70 per cent of university spin-offs are human-resource-related and 63 per cent of them are technology-related¹⁷ (Table 3). More than a third (36 per cent) of them have both technological and human relationships. The percentage of university spin-offs that have all three types of relationships - technological, human and capital -

Figure 2: University spin-offs in Japan



Note: The number in 2002 is estimated based on the number of university spin-offs created up to August.

Figure 3: Articles on university spin-offs



Note: The number of articles were counted by searching the NIKKEI Newspaper and the other three sister newspapers with the key word "university spin-offs".

with their mother universities is about 19 per cent.

As university spin-offs have some relationship with their mother universities before they are founded, they receive some assistance from their mother universities at the time of start-up. Nearly half (44 per cent) of them received some assistance, from psychological support to the availability of facilities, introduction of customers, intermediation of loans and so on, from

their mother universities at the time of start-up. After the establishment of the companies, a larger percentage (61 per cent) of them have received some assistance from their mother universities.

The deepest relationships that university spin-offs keep with their mother universities is mainly technological. Joint research is most common and 32 per cent of university spin-offs conduct joint research with their mother universities (Table 4). The second most com-

mon relationship is through technology guidance from mother universities (20 per cent). While two per cent of university spin-offs conduct contract research from their mother universities, eight per cent of them contract out research to their mother universities. However, direct business relationships are limited. Only seven per cent of them provide goods or/and services to their mother universities.

The royalty system is not widely practiced. Only four per cent of university spin-offs pay royalties to their mother universities. This is because, in national universities, patent rights belong to individual faculty members unless special equipment is used or especially large funding is received to create inventions; and in private universities, only a small number of them have been managing intellectual property rights.

Human relationships are also found between university spin-offs and their mother universities. Among university spin-offs, seven per cent of key members work as regular faculty staff and another seven per cent work as part-time faculty staff. University spin-offs, moreover, accept students from their mother universities as interns or trainees (9 per cent).

Profiles

Profiles of founders

Observation of those heavily involved in the human-resource-related cases of university spin-offs in Japan reveals that half of these are faculty members and 36 per cent are professors (Table 5). Students are nearly half (47 per cent) of those involved, and of them again nearly half are master course students.

This situation is quite different from that in Germany, where many university spin-offs are founded by young entrepreneurs in their early thirties with doctoral degrees. As much as 65 per cent of academic spin-offs¹⁸ in technology entrepreneur centres in the former West Germany are founded by students.¹⁹ These founders are mostly 30 or 31 years old. At least one of the founders possesses a doctoral degree in 32 per cent of academic spin-offs.²⁰

Considering the number of university researchers, the potential to cre-

ate university spin-offs is quite high in Japan. Japan has nearly 2.5 times as many as university researchers as Germany (Table 6). Even the USA has fewer than Japan.

The motives to found university spin-offs vary. The most common motive is commercializing developed technology (34 per cent, Table 7). This is followed by the motives of contributing to society (27 per cent), commercializing business ideas (18 per cent) and developing self-competence (11 per cent). Making a fortune is mentioned by only a few founders as a primary motive (5 per cent). A similar tendency is found in the motivation to start up any company.⁷ The most common motive is to challenge one's own life.

For a new company, its initial public offering (IPO) is a typical milestone of success. University spin-offs in Japan are not exceptions. Those who aim at IPO within 5 years from their foundation comprise 30 per cent and those who aim at IPO within 10 years from their foundation comprise another 33 per cent. In total, about two thirds (63 per cent) of university spin-offs in Japan aim at IPO within 10 years from start, while a lower percentage, 40 per cent, of German counterparts aim as high.²¹

University spin-offs

The size of employees is not large at the time of a spin-off's founding. In nearly two thirds of university spin-offs (63 per cent) the number of employees is one to four. The weighted average is 5.2 employees per university spin-off. The situation is similar in Germany. According to Baranovsky (1999), the average academic spin-off in technology entrepreneur centres in Germany starts with three to four employees.⁸

The size of initial capital is fairly large. One half of university spin-offs starts with ¥ 10-30 million²² (Table 8). The weighted average is ¥ 77 million. This large initial capital reflects the facts that 82 per cent of university spin-offs in Japan are incorporated as stock companies, whose required minimum capital is ¥ 10 million. In Germany,⁸ the average initial capital is DM 115,000.²³ In Germany, the most common form of an academic spin-off is a limited liability company (GmbH), whose required

Table 2: University spin-off education and supports (%)

	Lectures on start-up	Consulting office for start-up
National universities	57	47
Public universities	13	8
Private universities	20	11

Table 3: Relations to mother universities at the time of foundation

Relations	Ratios (%)
Human resource (a+b+c+d)	70.3
a. Human resource only	32.8
b. Human resource and technology	17.2
c. Human resource and capital	1.6
d. human resource, technology and capital	18.8
Technology (b+d+e+f)	62.5
e. technology only	25.0
f. technology and capital	1.6
Capital (c+d+f+g)	22.7
g. capital only	0.8
No answers (h)	2.3
Total (a+b+c+d+e+f+g+h)	100.0

Table 4: Current relations to mother universities (multiple answers)

Relations	Ratios (%)
Joint research	32
Receiving technical guidance	20
Accepting student internship	9
Contracting research	8
Supplying goods/services	7
Some staff being regular faculty members	7
Some staff being part-time faculty members	7
Paying royalties	4
Receiving contract research	2

Table 5: Profiles of founders

Founders	Ratios (%)
Faculty	50.0
of which professors	36.2
Students	43.1
of which doctor course students	12.1
of which master course students	20.7
of which undergraduate students	10.3
Researchers/technicians	6.9
	100

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Table 6: University researchers

Nation	University researchers (thousand)
Japan (2001)	167
Germany (1999)	67
United States (1995)	134

Source: Ministry of Education, Science and Technology, FY2002 Kagakugijutu Youran (Science and Technology Summary Book).

Table 7: Motives

Motives	Ratios (%)
Practical use of technology	34
Contribution to society	27
Commercialization of business ideas	18
Developing self competence	11
Making a fortune	5
Others	6

Table 8: Initial capital

Initial capital (million ¥)	Ratios (%)
Less than 3	8.3
3-5	15.3
5-10	6.9
10-30	50.0
30-50	2.8
50-100	6.9
100-1000	8.3
1000 or more	1.4

minimum capital is DM 5,000, and a registered legal entity (Gbr), which requires no minimum capital, is fairly common.

In Japan most of the initial capital is provided by founders, even though the size of the initial capital is fairly large. The university spin-offs, more than three quarters of whose initial capital are financed by founders, occupy two thirds (64 per cent)²⁴

Regarding the industry sector, most university spin-offs in Japan belong to manufacturing (45 per cent). Another five per cent engage in R&D. Thus, their businesses look fairly solid, though the IT sector is also popular among university spin-offs in Japan (37 per cent).

Difficulties

Though university spin-offs possess technology or other knowledge assets, in general they lack other management resources, and hence face various difficulties.

At start-up, the greatest difficulty they face is finance (25 per cent, Table 9). Though several policy measures have been taken in Japan, the main issues of financing assistance appear to relate to speed of reimbursement, simplicity of procedures and flexibility of usage.

More than 10 per cent of university spin-offs in Japan face problems in staff recruitment (16 per cent), sales (14 per cent), locating offices and laboratories (12 per cent), and accounting and financial management (12 per cent).

Only a few (2 per cent) face patent disputes at the time of start-up.

Current difficulties that university spin-offs face are different from those at the time of start-up. Staff recruitment is the most serious difficulty (31 per cent), which surpasses financing (29 per cent). Staff recruitment for small start-ups is difficult because of the low mobility of qualified workers, who prefer large companies, and the large-company preference of students and their families. True, the situation is changing and is gradually becoming more entrepreneurial, but this process will take some time.

The third most serious difficulty at the time of start-up is sales (13 per cent), and the fourth, though not the time of start-up, is patent disputes (9 per cent). The issue of patent disputes emerges as a company operates for a while and its activities become visible in the business community.

The changes of difficulty types from the time of start-up to now can be understood by looking at the per cent changes (Table 9). Though the issue of financing has increased a little, the issues of staff recruiting and patent disputes have increased significantly. Conversely, the issues of locations of offices and laboratories and of accounting and financial management have decreased in significance. The issue of sales has remained almost the same.

Where do university spin-offs go to receive assistance at the time of start-up? In Japan public organizations play an important role. Fewer than half (45 per cent) of would-be founders go to public organizations to seek advice and assistance, while a sixth (17 per cent) go to private organizations. The remaining 52 per cent do not go to either type of organization.

Some public assistance measures are very helpful to university spin-offs at the time of start-up. Public finance and incubators are most highly appreciated. These two policy measures are pointed out as useful by 18 per cent of founders.

Conclusion

This millennium has seen university spin-offs being created in Japan as in other developed countries. However, judging from the number of researchers in the Japanese universities, one could conclude that the full potential has nowhere been realized.

Though the university spin-off is a relatively new phenomenon in Japan, more university spin-offs should be created with proper innovation policies. The author hopes that university spin-offs will advance innovation in Japan and will contribute to society as well as to industry, as their second most important motive shows.

This new movement of university spin-offs in an age of university-industry crossover can also be adopted in developing countries. For example, China is very successful in creating university spin-offs. The author hopes that university spin-offs will bridge the university sector and the industry sector and will contribute to the development of developing countries.

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Table 9: Difficulties

Difficulties at the time start-up (%)	Current difficulties (%)	Changes of (% points)
1. Finance - 25	2. Finance - 29	4
2. Staff - 16	1. Staff - 31	15
3. Sales - 14	3. Sales - 13	-1
4. Office/lab. - 12	6. Office/lab. - 4	-8
5. Accounting/financial management - 12	5. Management - 7	-5
6. Legal issues - 8	—	—
7. University regulation - 6	—	—
8. Procurement - 3	7. Procurement - 3	0
9. Patent disputes - 2	4. Patent disputes - 9	7
10. Others - 2	8. Others - 0	-2

Note: The numbers before the names of difficulties show the ranking of difficulties.

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