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Japan's Innovative Capacity and Policies for Commercializing New Technologies: Using Carve-Outs to Create New Industries

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Contents

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Summary

1. While China is making rapid economic strides and the United States is undergoing a dynamic transformation, Japan faces the prospect of dwindling birth rates and a graying population; hence it will not be easy for the country to achieve ongoing growth by enhancing its innovative capacity and commercializing potential technologies. In this connection Professor Clayton Christensen of Harvard University observes that small, autonomous organizations independent of existing firms are effective in making a break with the successes of the past -- the innovator's dilemma -- and nurturing new innovations and markets.

2. There are a number of indicators that can be used to gauge Japan's innovative capacity and level of international competitiveness. Examining these to determine Japan's position internationally reveals that it languishes in the middle of the OECD nations by such measures as investment in knowledge creation, R&D by medium and small business, venture capital investment as a percentage of GDP, and technical trade balance. In an opinion survey about the technology gap with the US and China, 36% of respondents who saw the US as having the edge said they expected the gap to grow in the future. As for China, while 79% of respondents answered that Japan still has the edge, 85% of those respondents said that the gap is shrinking. Thus Japan's technology gap with the US is widening even as China surges up from behind.

3. Ever since the Young Report appeared in 1985, the US has been pursuing ambitious innovation policies in line with it and later the Nanotechnology Initiative and the Palmisano report. Japan too is beginning to take the required policy steps, including crafting its own version of the Bayh-Dole Act, formulating an industrial cluster plan, and cutting taxes on research and development.

4. On the path from invention to commercialization lies what has been described as either the "Valley of Death" or the "Darwinian Sea," where market failure occurs due to, among other things, asymmetry of information between entrepreneur and investor. Successfully navigating such difficulties and completing the process of commercializing technological "seeds" requires: (1) management of technology (MOT), (2) technology transfers, (3) evaluation and circulation of technology, (4) mentoring of technology, and (5) technology financing.

5. With TLOs being established at universities, the infrastructure is now being put in place to facilitate technology transfers. But the most important thing is to adopt a "needs"-oriented approach, rooted in the viewpoint of the corporate user that is the customer, rather than a "seeds"-oriented approach that gives priority to the university's wants. Germany's Steinbeis Foundation serves as an instructive model in this regard.

6. Japan too is beginning to witness the emergence of businesses active in the field of evaluation and circulation of technology. These can be broadly classified into: (1) evaluative agencies primarily involved in distribution and trading of technology in an auction-type format; (2) evaluative agencies that perform evaluations by tapping a network of technology evaluators with expertise in specific fields; and (3) evaluative agencies that appraise the value of technology using real option theory or the like.

7. As for the issue of financing technology, the US has a generous funding system in place: the ATP, SBIR, and STTR programs all provide R&D funding. Germany for its part makes available abundant risk money through public financial institutions such as the tbg and KfW.

8. The creation of new venture-type businesses by big corporations and middle-tier firms is generally referred to as corporate venturing. These ventures can be broadly divided into such categories as in-house venture programs, spin-outs, spin-offs, and carve-outs. Inspired by the venture boom of a few years ago, many companies have established their own in-house venture programs, but true entrepreneurship has failed to flourish. Such ventures often end up being regarded by the outside world as mere subsidiaries, so that sales to the outside fail to take off as expected.

9. A spin-out is where technologists leave a company to set up their own independent business, and in many cases the venture maintains no ties whatsoever with the parent company. In the US, such spin-outs have played a major role in the formation of industrial clusters in the true sense of the term. However, when promoting spin-outs in Japan, the first priority should be to set up some kind of shelter, such as an NPO-type agency to facilitate mobility among technologists.

10. A carve-out is a type of venture in which management "carves out" a portion of the company's business as a management strategy and invites third-party evaluation and investment. This type of arrangement is well suited to commercializing R&D and endowing it with corporate value under conditions such as Japan's, where relatively large manufacturers engage in R&D, possess the seeds of new technologies, and have skilled technologists on staff. Independent ventures alone will not be enough to trigger the emergence of robust new industries in Japan; also needed is a flurry of carve-outs by big corporations and middle-tier firms that conduct extensive R&D and have large numbers of elite engineers on staff. That would reinvigorate Japan's big corporations and middle-tier firms, which easily get trapped by the "innovator's dilemma" because of their successes in the past, and by extension greatly help to economically reinvigorate Japan as an innovator nation.

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I Japan's Innovative Capacity[1]

1. Modern Innovation Theory and the State of Innovation Today

With China catching up from behind and the United States resurgent, it goes without saying that Japan's only option is to become a breakthrough innovator. But, while China is making rapid economic strides and the US is undergoing a dynamic transformation, Japan faces the prospect of dwindling birth rates and a graying population; hence it will not be easy for the country to achieve ongoing growth by enhancing its innovative capacity and commercializing potential technologies. First let us analyze, from several angles, what innovation means and the state of Japan's innovative capacity.

1.1. What Is Innovation?

Schumpeter defined the capitalist economy as a dynamic development process driven by entrepreneurial innovations in technology. The essence of capitalism is the process of "creative destruction," which constantly shatters the old and gives birth to the new, thereby revolutionizing economic structure. The key player in this process of creative destruction is the entrepreneur. The innovations in technology referred to here constitute, to use Schumpeter's exact terminology, "new combinations." A new combination refers to a change in the way that materials and energy are combined, whether in a product or in a method of production. In other words, it means an alteration in production function in the broad sense of the term. New combinations, Schumpeter argued, occur as a result of:

1. The production of a new good
2. A new method of production or a new commercial technique
3. The opening of a new market
4. The acquisition of a new source of supply for raw materials or components
5. The emergence of a new organization (either the achievement of monopoly status or the overthrow of a monopoly)[2]

Schumpeter focused on changes in technology and company organization, which had until then been taken as givens in a static economy. These, he contended, are the main factors driving economic development, for, unlike cyclical movements and motion processes that tend to equilibrium, they alter the course of cycles and cause shifts in equilibrium. The chief player in this process of economic development is the entrepreneur, as Schumpeter called him, who pursues new combinations (i.e., innovations). Schumpeter postulated a principle of dynamic markets that can be schematized thus: equilibrium → new combination → equilibrium → new combination. The creation of credit by banks, he explained, performs the function of facilitating the transition from state of equilibrium to new combination; hence the banker is the true capitalist in that he is indispensable to making new combinations possible. However, it might better suit the present state of the Japanese economy to talk of "providers of risk money" or "venture capitalists" rather than bankers, given the country's predicament: financial institutions have their hands full disposing of bad debt, and they are unable to move beyond the practice of only providing loans that are backed up by real estate and thus guaranteed to be repaid.

1.2. The Innovator's Dilemma

When *The Innovator's Dilemma*[3] by Clayton Christensen of the Harvard Business School appeared in 1997, it immediately became a nationwide bestseller in the US. This work is a highly thought-provoking read for anyone interested in the question of modern innovation strategies. Christensen uses the term "the innovators dilemma" to describe the phenomenon whereby great firms that were once industry leaders have, on account of their very success, failed miserably in their attempts to defend their position upon coming face to face with certain types of changes in markets or technology. Success today can be

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[1] This chapter incorporates the results of an analysis of the international competitiveness and innovative capacity of Japan and the US conducted by the author in 2002 and 2003 as a guest researcher at Harvard University (see Yutaka Kijima, *Industrial Competitiveness Policy and Innovation Strategy in the United States and Japan*, Harvard University USJP Occasional Paper, 2003).

[2] See J. A. Schumpeter's *The Theory of Economic Development* (1934) and other works.

[3] Clayton M. Christensen, *The Innovator's Dilemma* (Harvard Business School Press, 1997).

the cause of failure tomorrow: if a successful business model is structured simply to ride the tide of the times, the company in question could end up on the losing side should the tide shift. So Christensen demonstrates, citing such cases as how those firms that made a successful business of vacuum tubes lagged behind when it came to developing transistors, while companies that achieved success with transistor technology fell behind in developing semiconductors. He classifies new technologies into "sustaining technologies" and "disruptive technologies."[4] Sustaining technologies are technologies that improve performance along the dimensions of performance that mainstream customers in major market have historically valued. But occasionally disruptive technologies emerge, which bring with them a very different value proposition from that available previously. It is these disruptive technologies that precipitate the failure of great firms that have been successful in existing markets. In the short term, disruptive technologies result in worse product performance, at least in mainstream markets, and they offer features that a few fringe, and generally new, customers value; hence they do not dovetail with the growth needs of large firms and do not appeal to mainstream customers. And because no market exists for them, they defy analysis and render existing organizational capacity ineffective. And so they cause even outstanding companies to stumble.

Professor Fujio Masuoka of Tohoku University, the developer of flash memory, sued his old company, Toshiba, for one billion yen as compensation for surrendering his patent. As one commentator has noted, "The difficulty of evaluating disruptive technology, and the fact that [Masuoka] left Toshiba on the grounds that the company, being wary about commercialization, lacked the insight to recognize future potential: that is what lies at the root of the case. DRAM formed the mainstay of Toshiba's semiconductor business at the time, and disruptive technology can render existing technologies obsolete; hence the company hesitated to commercialize the new technology, allowing Intel to surge ahead."[5]

Christensen identifies the following strategies for successfully handling disruptive technologies:

(1) If managers align a disruptive innovation with the "right" customers, customer demand will ensure that the innovation gets the resources it needs.
(2) Leave development of disruptive technologies to organizations small enough to get excited about small wins.
(3) Develop markets for disruptive technologies through repeated trial and error.
(4) Do not apply the processes and value standards of mainstream organizations to disruptive technology projects.
(5) When commercializing disruptive technologies, find new markets that value the attributes of the disruptive products.

As the speed of innovation picks up, such disruptive technologies will emerge with proportionately greater frequency, making it more vital than ever to come to grips with them. As will be examined in greater detail in Chapter III, "spin-offs" and "carve-outs" from large corporations have been growing in importance of late in Japan as elsewhere, demonstrating the soundness of Christensen's argument.

1.3. What Constitutes a Productive Environment for Innovation?[6]

The above account provides a general idea of what innovation means and its nature in the modern economy. But does there exist a set of conditions that determines what constitutes a productive environment for innovation? If not, then innovation should be able to take place anywhere, as long as there are abundant research funds available, along with researchers and entrepreneurs to boot. One scholar who has attempted to answer this question is Professor Michael Porter, also of the Harvard Business

[4] Christensen presents a wealth of examples: mainframe computers vs. minicomputers, copy center copiers vs. desktop copiers, silver film vs. digital photos, power utilities vs. distributed power sources, general securities firms vs. online brokers, central processing units vs. microprocessors, etc.

[5] See *Nihon Keizai Shimbun*, Mar. 4, 2004, "Kison jigyo obiyakasu shingijutsu no hyoka" (Evaluating new technologies that threaten existing business).

[6] See Yutaka Kijima, Wataru Kurosawa, Yasuhisa Yamaguchi and Norihisa Shimozawa, *Kakkoku no Sangyo Kurasuta no Genkyo to Keisei Shien Saku* (State of Industrial Clusters in Different Countries and Policies to Support Their Formation). DBJ Industry Report, Vol. 12, 2003.

School.

Michael Porter's theory of clusters originally grew out of his work on developing a theoretical framework on corporate competitive strategy. In his 1980 book *Competitive Strategy*, which is something of a business classic, Porter identified five factors determining corporate competitiveness:

(1) New entrants
(2) Substitute products
(3) Bargaining power of buyers
(4) Bargaining power of suppliers
(5) Rivalry among firms

Porter argued that formulating a strategy for achieving preeminence in these five areas was crucial to profitability and competitive strategy. Later, in *The Competitive Advantage of Nations* (1990), he came to stress the overriding importance of the environment in which firms operate, which provides a dynamic stimulus both through competition, as comprised of the above five factors, and through the support mechanisms available there. He hinted at the importance of focusing on the interaction of four determinants:[7]

(1) Firm strategy, structure, and rivalry
(2) Factor conditions
(3) Demand conditions
(4) Related and supporting industries

It was in this book that the concept of "clusters" also first appeared, as a way of characterizing the immediate environment in which firms operate.[8] Later, in *On Competition* (1999), Porter contended that in modern society more than ever, with globalization of the economy progressing and information and communications networks spreading, geographical conditions and the immediate external environment in which companies operate, paradoxically, hold the key to innovation and competitive success. He identified the following effects that clusters exert on competition. First, they boost the productivity of companies headquartered in the region in question. Second, they have an impact on the direction and pace of innovation. That underpins future gains in productivity. Third, they stimulate the emergence of new enterprises, a process that in turn strengthens the clusters themselves. Thus clusters enable the companies and organizations that form part of them to enjoy the kinds of advantages (external economies) that they could otherwise only obtain if they were larger in size or concluded formal alliances with other firms.

1.4. Conditions Determining Innovative Capacity

Based on the above analysis, we can now summarize the key factors for creating and commercializing innovations as follows:

(1) Research and development activities that unleash creative destruction
(2) Risk money to fund those activities
(3) Implementation of management of technology and formation of small, autonomous organizations, both for the purpose of commercializing innovations
(4) Network and coordination functions along the lines of industrial clusters

The organic integration of these factors is what produces innovation. The next section will examine Japan's innovative capacity and competitiveness from a variety of angles.

2. Japan's International Competitiveness and Blind Spots in its Innovative Capacity

2.1. Definition of International Competitiveness

The term international competitiveness is defined in many different ways depending on who is using it.[9] The focus of present debate on international competitiveness can be summed up in three questions:

(1) Who are the actors that determine a country's international competitiveness? (Are they defined by nationality, in which case even companies operating abroad would be counted, or are they defined by national borders, in which case all companies operating within a country would be counted,

[7] Porter formulated a model of how the four determinants affect one another, which he schematized in the form of a diamond (this being his so-called diamond theory).

[8] Clusters are the manifestation of the diamond theory in practice. Proximity -- the presence of companies, customers, and suppliers in the same region -- ratchets up the pressure to innovate and improve, according to Porter.

[9] The OECD defines competitiveness as "the degree to which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the long term."

regardless of nationality)?

(2) What are the indicators of international competitiveness? (RCA index, export share, trade balance, RIC coefficient [=(value of exports - value of imports)/value of production], international competitiveness coefficient [=(value of exports - value of imports)/(value of exports + value of imports)], labor productivity, unit labor costs, total factor productivity, etc.)

(3) What is international competitiveness?

With regard to the last question, Paul Krugman of Princeton University points out that thinking in terms of national competitiveness has risks, for it can result in mistaken policies that, among other things, waste government funds, lead to protectionism, and reduce the quality of public policy. He asserts that, as far as people's standard of living is concerned, the important thing is not international competitiveness but rather, in the first place, (a) raising productivity, as well as (b) income distribution, and (c) unemployment. On the other hand, Professor Michael Porter of Harvard University defines international competitiveness as anything that leads to improvements in productivity. He observes that enhancing national productivity requires individual companies to keep improving themselves by, for example, raising the quality of their products and boosting efficiency. The kind of desirable trade mix that results from competition and pressure from overseas rivals as a consequence of international trade, as well as from shifting production to more productive industries, can make a major contribution in this regard, according to Porter. Thus he recognizes to some degree the importance of international competitiveness.[10]

With these points of view in mind, let us turn now to analyzing blind spots in Japan's innovative capacity and assessing its international competitiveness.

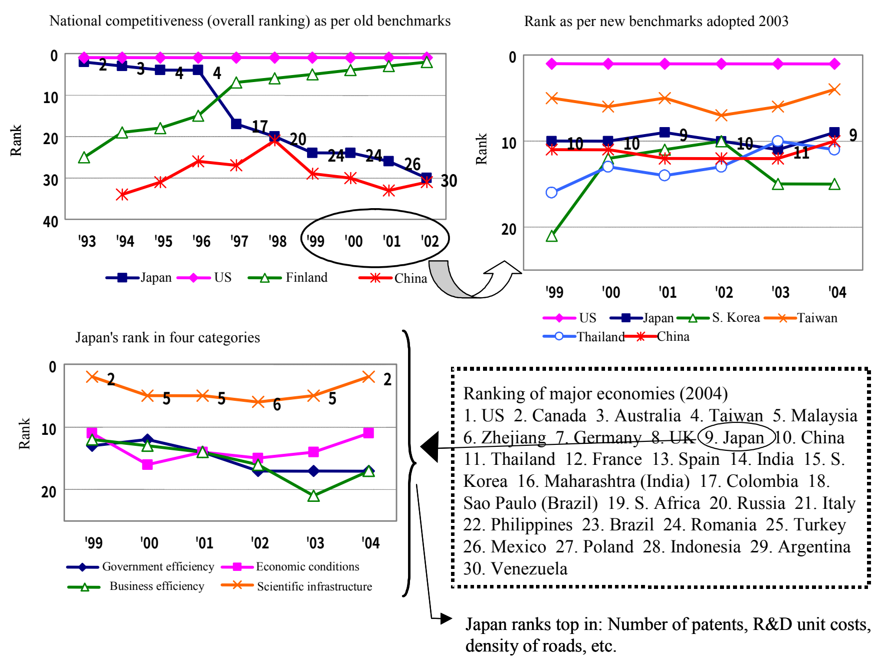
2.2. Japan's International Competitiveness and Blind Spots in its Innovative Capacity

When the subject of national competitiveness comes up, one well-known indicator that is frequently cited is the World Competitiveness Yearbook issued by the Swiss business school IMD. In the 2003 survey, which ranks countries and regions separately depending on whether their population is over or under twenty million, Japan places eleventh overall among the thirty countries and regions with a population of over twenty million. In the 2004 edition it places ninth. But one need not be overly pessimistic: overall ranking is determined based on a potpourri combining statistical data with questionnaire-type data, and the way in which the indicators are measured is somewhat arbitrary. In terms of scientific infrastructure, which is closely related to innovative capacity, Japan ranks second after the US (see Figure 1-1). That relates in large part to the fact that the country ranks No. 1 in the world in R&D expenditures as a percentage of GDP, the percentage of the population engaged in R&D activities, and the number of domestically registered patents. Is it fair to conclude on that basis that Japan's innovative capacity and competitiveness are, for the time being, fine? Or are there blind spots? That is the question to which we turn next.

2.3. Investment in Knowledge Creation

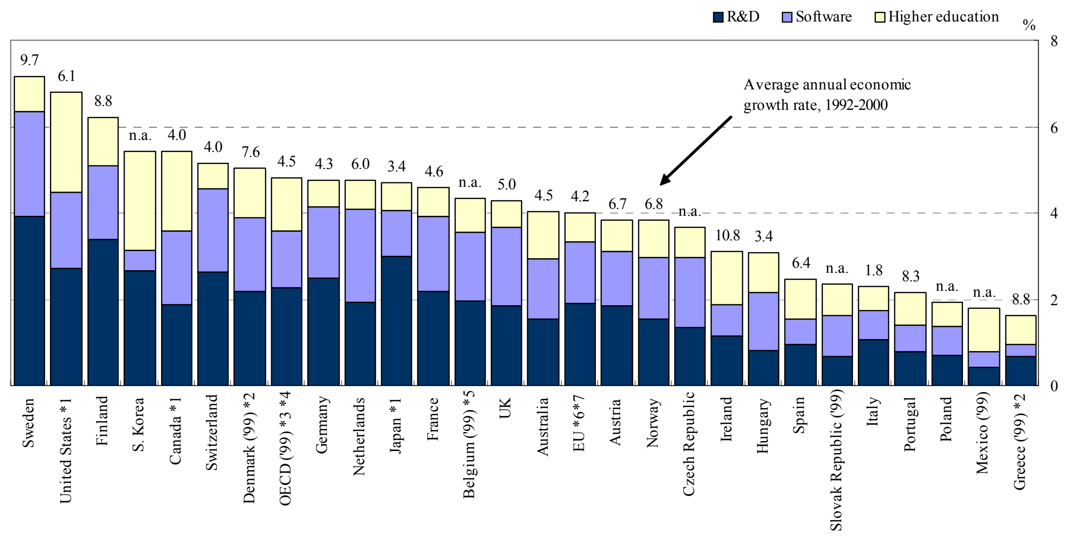
Comparing figures on research expenditures between countries is not an easy task, since the nature of the statistics and the survey methods used differ from country to country. One indicator often used to determine general trends is the ratio of research expenditures to gross domestic product (GDP). Japan is in the top rank globally in terms of R&D expenditures as a percentage of GDP, as the FY 2003 *White Paper on Science and Technology* also shows. This is a reliable indicator for estimating Japan's potential innovative capacity. R&D investment in the future generates innovations and drives up a country's GDP through the process of commercialization and product development. However, when considering knowledge creation, it is misleading to look at R&D investment alone. One also needs to take into account expenditures on higher education and software. As Figure 1-2 shows, Japan is a big spender on R&D, in which it invests over 3% of GDP, but it is stingy when it comes to expenditures on higher education and software. Overall

[10] See Yutaka Kijima and Daisuke Asaoka, U.S. Competitiveness Policy since the Young Report and its Implications for the Hollowing out of Japan's Manufacturing Industry, DBJ Industry Report Vol. 3, 2001.



Source: Compiled from "IMD 2004."

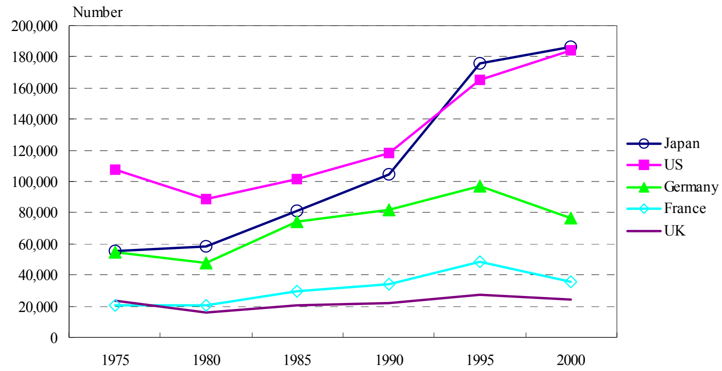
Figure 1-1. Present Level of Japan's National Competitiveness (IMD analysis)



Notes:
1. Higher education includes programs at technical colleges upon completion of secondary education.
2. Average annual economic growth rate is for 1992-99.
3. Excluding Hungary, Poland, and the Slovak Republic.
4. Average annual economic growth rate is for 1992-99 except in the case of Belgium, the Czech Republic, Hungary, S. Korea, Mexico, Poland, and the Slovak Republic.
5. Expenditure on higher education includes direct public spending only.
6. Excluding Belgium, Denmark, and Greece.
7. Average annual economic growth rate is for 1992-99 except in the case of Belgium.

Source: Compiled from OECD, "Science, Technology and Industry Scoreboard 2003."

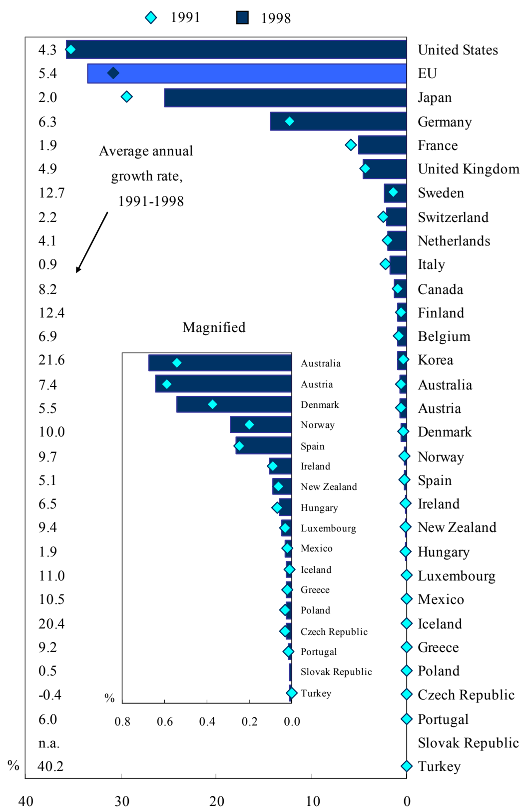
Figure 1-2. National Expenditures on R&D, Software, and Higher Education, as a Percentage of GDP (2000)



Notes: 1. Figures for 1975-1995 are taken from Source (1), those for 2000 from Source (2).
2. The figures in (2) include designated patents applied for under the Patent Cooperation Treaty (PCT) and in Europe.

Sources: (1) WIPO, "Industrial Property Statistics."
(2) Japan Patent Office, "Japan Patent Office Annual Report 2003."

Figure 1-3. International Comparison of Number of New Patents Registered (by nationality of patent holder)



Notes: 1. The figures next to the name of each country represent average annual economic growth rate, 1991-98.
2. All percentages are estimates calculated by grouping together patents registered in the US (USPTO), Japan (JPO), and the EU (EPO).

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-4. Share of Patent Families by Country, and Fluctuation Therein (1991-1998)

it falls beneath the OECD average, a fact best kept in mind.

2.4. Patent Trends

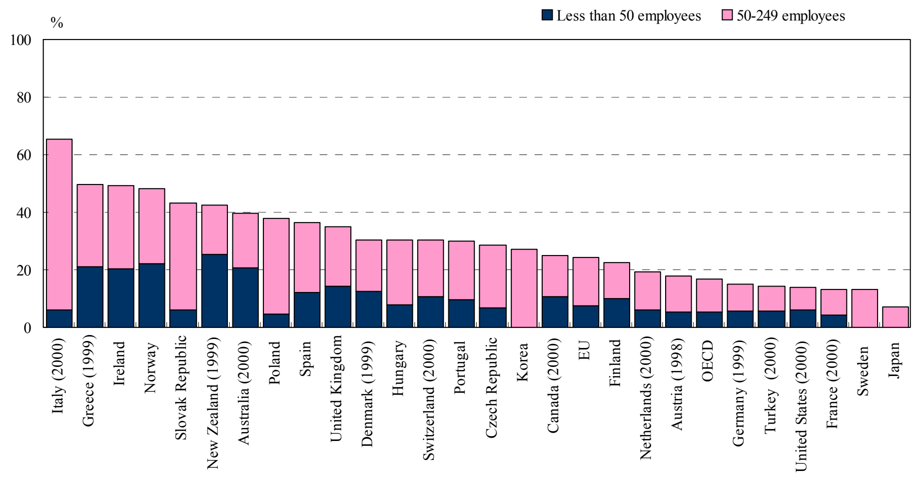
One key measure of a country's innovative capacity is the number of new patents registered. Figure 1-3 shows trends in number of patents among the major economies. Japan overtook the US in the early 1990s to take the No. 1 spot worldwide, and by 2000 it held some 190,000 patents. However, 60.3% of its patents are registered domestically, and world patent applications account for a lower percentage than in the case of other countries.

The OECD statistics given in Figure 1-4 are for patent families (a set of patents filed in several countries for a single invention). This comparison more accurately reflects the real situation. As the chart shows, Japan holds the second largest number of patents after the US, but its share declined between 1991 and 1998.

One thing should be noted here: this comparison takes absolutely no account of the quality of the patents. Japan has a reputation for owning many peripheral patents but relatively few core patents. In order to take due account of this factor, patents would need to be grouped and then compared on that basis. That involves some difficult questions. How exactly should they be grouped? How should peripheral patents be handled? Still, accurately assessing developments with respect to the "seeds" of technology will definitely require analyzing trends in basic patents and patent families.

2.5. R&D by Medium and Small Business

As Figure 1-5 shows, Japan ranks at the bottom of the OECD in percentage of private-sector R&D expenditures accounted for by medium and small business. In Italy, Greece, and Ireland, medium and small business is the locomotive of R&D-driven innovation. By contrast, while Japan is at the top of the global rankings in percentage of private-sector R&D expenditures, the chart suggests that virtually all that spending is by big corporations. Medium and small business's low level of R&D explains why not many medium- and small-sized firms have emerged in the technology sector, and why research and development by venture businesses is not that vigorous. In the past in Japan medium- and small-sized firms could get away with just obe-



Notes: 1. Data are for the year next to the name of the country, if indicated; otherwise they are for 2001.
2. For the Netherlands and Norway, the categories are less than 50 employees and less than 200 employees. For New Zealand, the categories are less than 50 employees and less than 100 employees. For Japan and S. Korea, a single category, less than 300 employees, is used.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-5. Percentage of Private-Sector R&D Expenditures Accounted for by Medium and Small Business, by Country (2001)

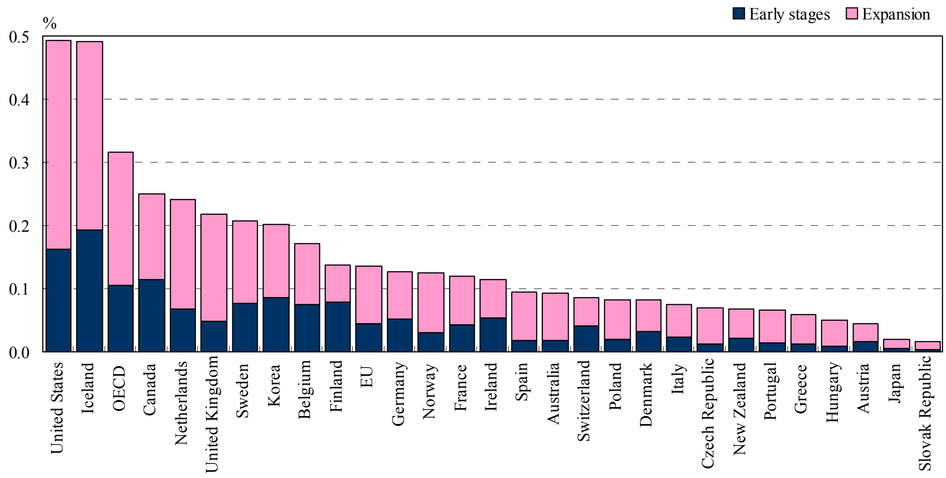
diently manufacturing whatever they were told to on subcontract from a major corporation, but now the order of the day is aggressive research and development, including development of new products. The implication of this is that medium- and small-sized firms do not currently have much of a stock of technological "seeds." With the sole exception of R&D ventures, it is perhaps going to take time for Japan's numerous medium- and small-sized firms to eliminate their reliance on subcontract work from big corporations and find products unique to themselves. To put it the other way round, this could end up being Japan's Achilles' heel now that the speed of innovation is picking up, for, as Christensen described in *The Innovator's Dilemma*, small organizations are the best breeding grounds for disruptive technologies.

2.6. Venture Capital Investment as a Percentage of GDP

The benchmark illustrated in Figure 1-6 is also a vital measure of a country's innovative capacity. Annual venture capital investment in Japan represents less than 0.1% of GDP, placing the country near the bottom of the OECD heap. In light of that fact, and of medium- and small-sized firms' low share of R&D spending, it would be fair to describe Japan as something of a global laggard when it comes to venture-driven innovation. As will be examined in greater detail below, the availability of risk money is of vital importance to innovation, yet it is always in short supply. Hence in the US the federal government taps public funds for risk money, and public financial institutions at the state level dish it out as well. Similarly, in Germany both the federal and state governments supply public risk money. The justification for such policy measures is the thesis that the supply of risk money to fund innovation is a case in point of "market failure," since innovation will not get the funds it requires if left solely to the market -- say Wall Street or the City. The correctness of this thesis will need to be further verified, but at any rate the wellsprings of future innovation will gradually dry up unless Japan hikes the amount of risk money it spends, as a percentage of GDP, to a level comparable with that of the other developed economies.

2.7. International Comparison of Technology Trade Balances

The size of a country's technology trade surplus or deficit is also useful in determining its innovative capacity. Royalty income from the supply of technology to other countries climbs in proportion to the number of cutting-edge innovations that are commercialized, resulting in a surplus. Conversely, if a country is dependent on other countries for basic technologies, it will in many cases find itself stuck in the red as far as royalty payments go, even if it enjoys a surplus in trade in goods. In that sense the technology trade balance is a useful measure of the outcomes of in-



Note: Average level of annual investment for 1998-2001, shown as a percentage of GDP.
Source: OECD, "Science, Technology and Industry Scoreboard 2003."

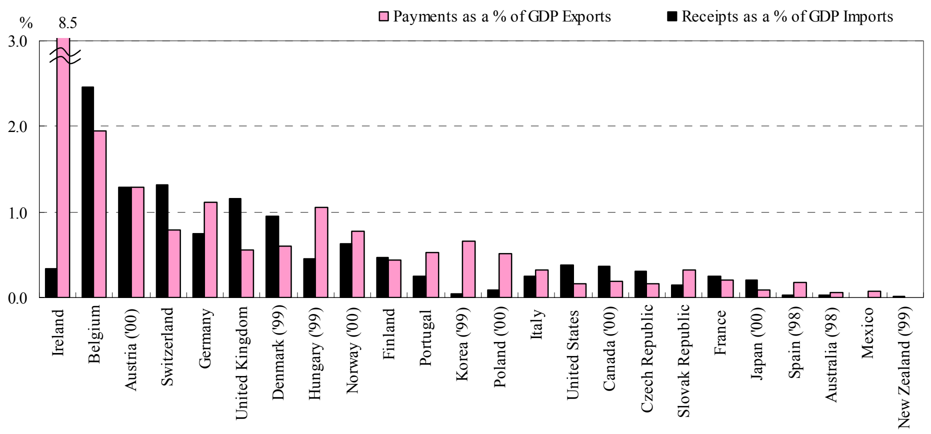
Figure 1-6. Annual Venture Capital Investment as a Percentage of GDP

novative capacity. However, it should be kept in mind that, when companies shift their production hubs overseas, they will often charge those hubs for operational know-how, which amount is included in the technology trade surplus. Much of Japan's surplus, characteristically, is from transactions between parent companies and subsidiaries in the automobile industry, and the amount of pure royalty income in the biotechnology and similar sectors is small.

As the international comparison in Figure 1-7 shows, Japan ranks near the bottom of the OECD by this measure. For all its reputation as a high-technology giant, Japan's volume of technology trade as a percentage of GDP is extremely low, though it does enjoy a surplus.

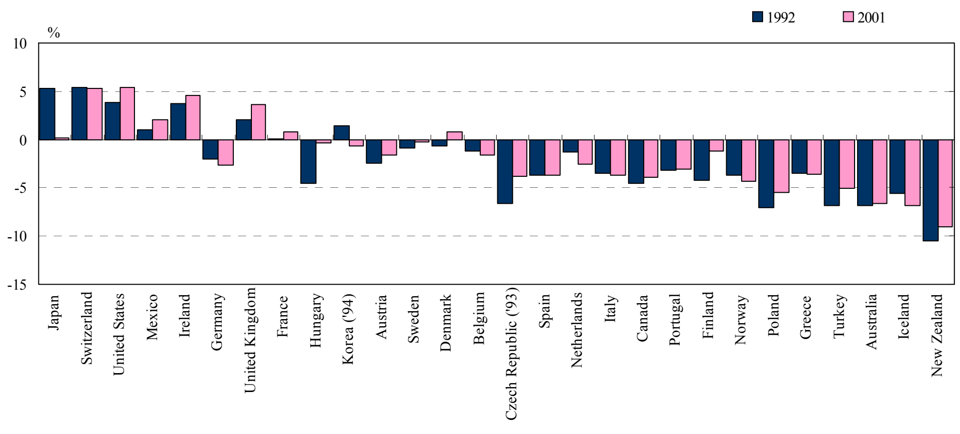
2.8. Change in Contribution of High-Technology Industries to the Trade Balance

Figure 1-8 illustrates trends in competitiveness among high-technology industries, which is one



Note: Data are for the year next to the name of the country, if indicated; otherwise they are for 2001.
Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-7. Value of Technology Exports and Imports as a Percentage of GDP (2001)



Notes:
1. Data are for the year next to the name of the country, if indicated, and for 2001; otherwise they are for 1992 and 2001.
2. Amount contributed by sector = sectoral trade balance - overall manufacturing trade balance X total value of imports and exports in sector / total value of imports and exports, manufacturing industry overall.
3. Contribution (%) = amount contributed by sector / overall manufacturing trade balance.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

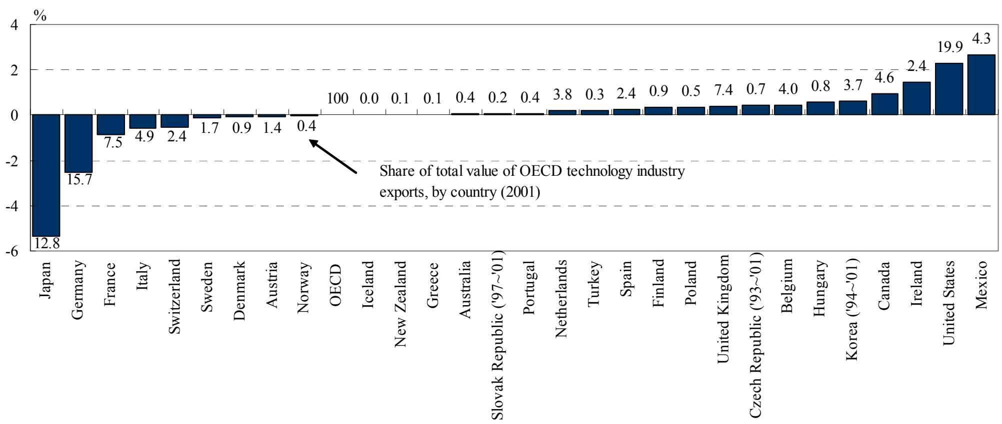
Figure 1-8. Contribution of High-Technology Industries to Overall Manufacturing Trade Balance

of the outcomes of innovation and is directly linked to it. The OECD classifies high-technology industries into five categories: aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, television and communication equipment; and medical, precision and optical instruments. Compare the contribution of those high-technology industries to the overall manufacturing trade balance in 1992 with the same benchmark for 2001, and one can see how the high-technology sector has weakened considerably in Japan. By contrast, in the US, Ireland, and the UK it has grown more robust. That fact suggests that the international competitiveness of Japan's innovation-spawning industries has declined rapidly over the past decade. Electrical machinery and motor vehicles are classified as medium-high-technology industries, and a different classification might lead to a different conclusion; nonetheless, the situation is cause for concern.

Figure 1-9 shows the percentage by which each country's share of the total value of OECD technology industry exports increased or decreased between 1992 and 2001. The term technology industry here refers to the five high-technology industries listed above, plus the medium-high-technology industries of electrical machinery and apparatus; motor vehicles; chemicals excluding pharmaceuticals; transport equipment; and machinery and equipment. Note how Japan has experienced the largest decline in share, followed by Germany, France, and Italy. Japan's high-tech industries, which as of 1992 were among the most competitive in the OECD, have rapidly lost their dominance as the US, the European countries, Mexico, Canada, and South Korea have closed the gap.

2.9. Import Penetration and Export Ratio

Next we turn to discussion of the international competitiveness of individual industries. A wide range of possible indicators are available for gauging the international competitiveness of an industry, among the most straightforward of which are import penetration in the industry, and the industry's export ratio; these are also relatively easy to quantify. Figures 1-10, 1-11, and 1-12 rank industries in Japan, the US, and the EU respectively in descending order of level of import penetration. As can be seen, Japan generally excels in manufacturing but has a weak primary commodities sector. The sectors with the lowest level of import penetration and the highest export ratio, which can be assumed to be the most internationally competitive, are, in the case of Japan, such industries as electrical machinery, machinery and equipment, motor vehicles, and

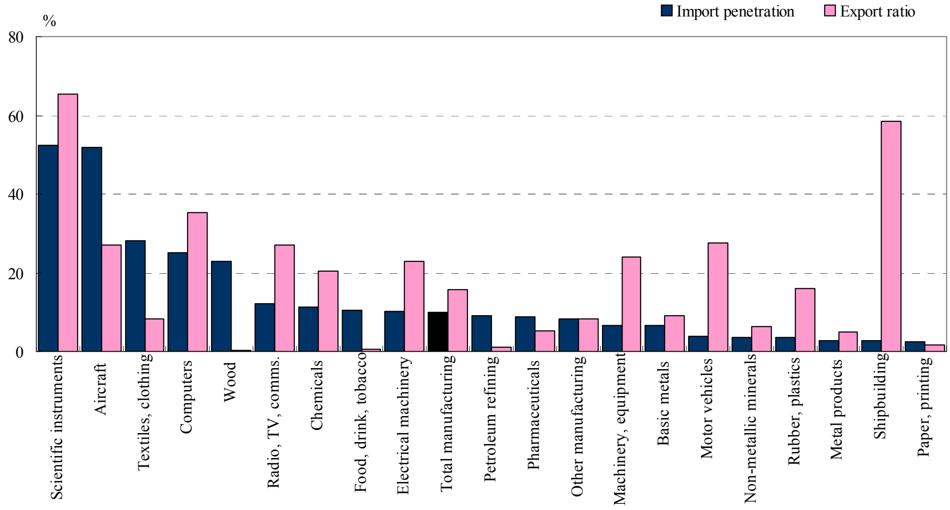


Notes: 1. The increase/decrease is for the period next to the name of the country, if specified; otherwise it is for 1992-2001.
2. OECD totals exclude the Czech Republic, South Korea, and the Slovak Republic.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-9. Increase or Decrease in Share of Total Value of OECD Technology Industry Exports

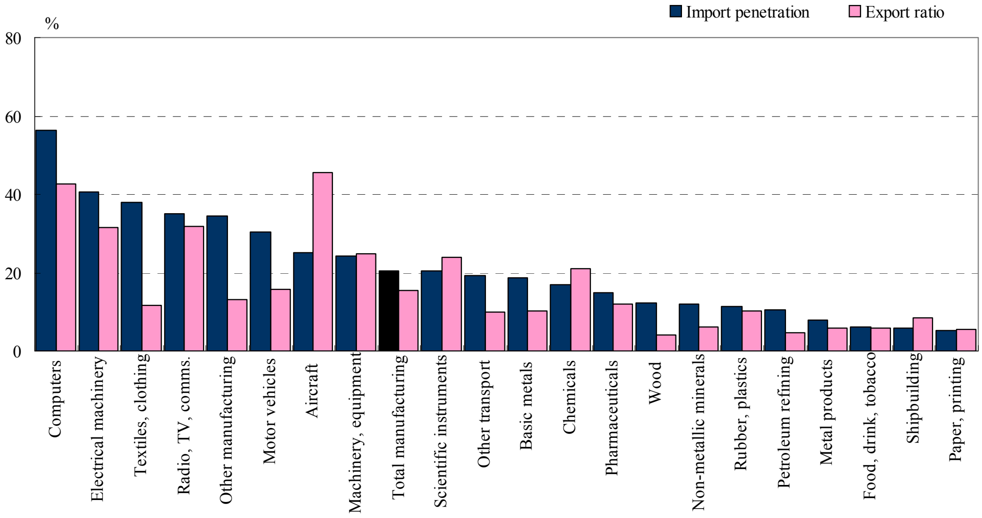
shipbuilding, as shown in Figure 1-10. But examine this chart more closely in conjunction with Figures 1-11 and 1-12, and it is striking how much weaker the Japanese aircraft industry is compared to its US and EU counterparts -- a fact that can be attributed to the industry's connection banned. Note too how marked the gap is between strong industries, like motor vehicles and shipbuilding, and weak industries, like foodstuffs and pharmaceuticals. Japan also stands out among the advanced countries for the diffuse distribution of its strongest industrial sectors.



Notes: 1. Data are for 1999.
2. Export ratio = value of exports (X) / GDP (Y)
3. Import penetration = value of imports (M) / (GDP (Y) - value of exports (X) + value of imports (M))
4. In Japan, "automobiles" includes other transport equipment.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-10. Import Penetration and Export Ratio by Industry (Japan)



Note: Data are for 1999.

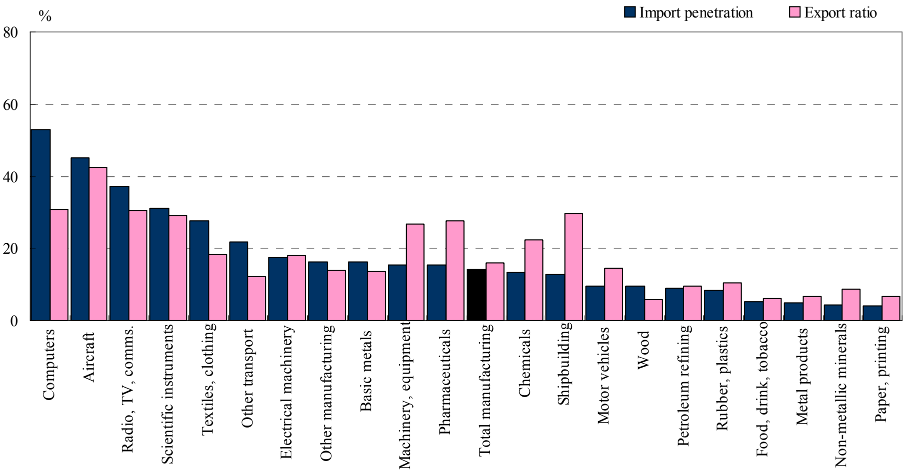
Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-11. Import Penetration and Export Ratio by Industry (US)

Figure 1-13 plots export ratio minus import penetration in each industrial sector in the order Japan, the US, and the EU. The chart highlights the strengths and weaknesses of each economy in such sectors as shipbuilding, motor vehicles, computers, pharmaceuticals, and aircraft.

2.10. True State of the Technology Gap with China

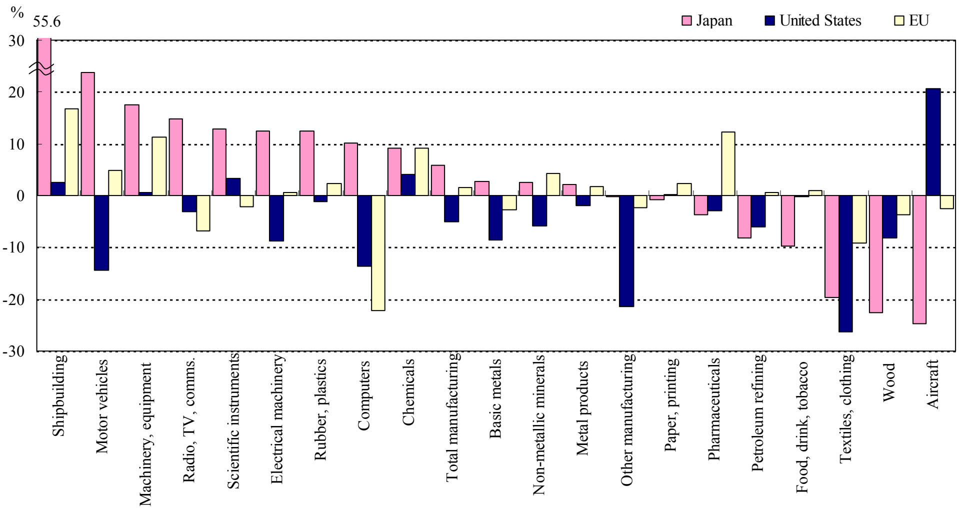
The Chinese manufacturing industry devotes itself primarily to assembly, the lowest part of the so-called "smile curve" representing value added (see Figure 1-14). That has led many economists to argue that China is beginning to catch up to



Notes: 1. Data are for 1999.
2. Percentages represent overall totals for Austria, Denmark, Finland, Germany, Ireland, Italy, Portugal, Spain, Sweden, and the UK.
3. Intra-EU trade is excluded.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

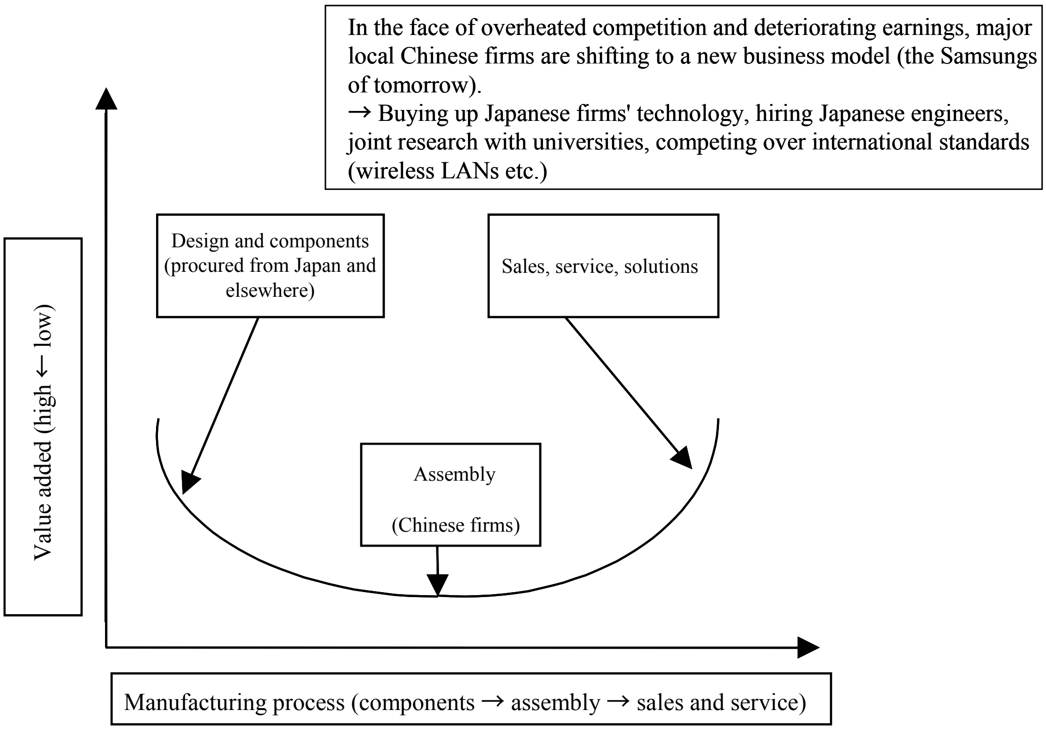
Figure 1-12. Import Penetration and Export Ratio by Industry (EU)



Note: All data (Japan, US, EU) are for 1999.

Source: OECD, "Science, Technology and Industry Scoreboard 2003."

Figure 1-13. Export Ratio Minus Import Penetration, by Sector: Japan, the US, and the EU



Source: Compiled by the author.

Figure 1-14. The Value-Added "Smile Curve"

Japan on the high-technology front only because it copies Japan and infringes intellectual property rights; control intellectual property rights more rigorously, therefore, and Japan's technological lead will be unassailable. Noting how Japanese manufacturers have been flocking home from abroad of late, newspapers and magazines, too, feature frequent commentary to the effect that the Japanese manufacturing industry has made a full comeback and has nothing to fear from the Chinese. But is such confidence really justified? In the face of overheated competition and deteriorating earnings, major local Chinese firms are now trying to make the shift from the kind of business model illustrated below to a higher value added one. To that end they are making systematic moves: buying up Japanese firms with the goal of acquiring their technology, hiring Japanese engineers, collaborating with China's leading universities such as Tsinghua University, and competing over international standards for wireless LANs and the like. They are poised to become the Samsungs of tomorrow.

Figure 1-15 summarizes information gleaned from a series of interviews on the current state of China's high-tech industries that I conducted with the Shanghai Semiconductor Industry Association and others in February 2004. One got a real sense of how the semiconductor industry, traditionally one of Japan's fortes, is growing by leaps and bounds in China. The talk of how China has only managed to produce low-tech, labor-intensive industries is completely off the mark.

As Figure 1-16 on the next page shows, the Chinese government has, in its Tenth Five-Year Plan, committed itself to nurturing the high-tech and semiconductor industries, and those sectors are steadily growing. In today's China even high-value-added, cutting-edge industries grow in the wink of an eye the instant they get an infusion of advanced technology. The upper echelons of these advanced industries are almost completely dominated by managers with a background in Silicon Valley or an American or European MBA. Once they acquire technology from, say, Alcatel, NEC, or Philips, China's corporate managers, recently back from studies

- The Mecca of the Chinese semiconductor industry (location, concentration, water supply, demand)
- Shanghai Semiconductor Industry Association (270 firms)
  Fablesses (1,000), many launched by returnees from studies abroad, Material manufacturers (54), Wafer production (9)
  - NEC Huahong (China's first 8-inch chip, Jiang Zemin project, foundry setup, NEC's newest plant, one of the seven managers from NEC)
  - Shanghai Belling (makes ICs for Shanghai Telecom, locally affiliated, uses Alcatel technology)
  - Advanced Semiconductor Manufacturing Corporation of Shanghai (38% owned by Philips, analog foundry, air bag drive systems etc., 40% profit rate)
  - SMIC, GSMC, Shin Shin, Huahong Group, etc.

  113 foreign-owned independent corporations, 80 local firms, 47 cooperatives, 24 privately run firms
  Total investment $14.4 bn, 63,000 employees incl. 23,000 engineers

Source: Compiled from documentation of the Shanghai Semiconductor Industry Association et al.

Figure 1-15. The Rise of the Shanghai Semiconductor Industry

- Tenth Five-Year Plan (2001-2005)
  - Communications industry: Business revenues of ¥13.8 tr, growth of 23.4% p.a.
  - Mobile communications: 290 m users, 40 m computers linked to Internet (200 m users)
  - Electronic information product manufacturing: Business revenues of ¥37.5 tr, growth of 20% p.a.
  - 20 bn IC wafers, 18 m PCs, 100 m mobile phones
  - Software industry: Business revenues of ¥3.75 tr
- Forecast growth in the Chinese semiconductor market
  - 2000: ¥1.7 tr 2005: ¥5 tr 2010: ¥13 tr (of which 4 tr made domestically)

→ "Grafted" industries are growing rapidly in China, even in high-value-added sectors

Source: Compiled based in interviews with the Chinese government et al.

Figure 1-16. Outlook for the Chinese IT Industry

abroad and far more flexible and far-sighted than their Japanese counterparts, work frantically to join the top ranks of global industry, and they are one step ahead of the rest of the world in the way they do business. In the past a graft from a Japanese apple tree crossed over to China to produce what is now a thriving industry. If outstanding technology can be grafted in the same fashion at the incubation stage, there is a good chance that high-value-added, cutting-edge industries will quickly blossom in China. As the example of the automobile's internal-combustion engine shows, high-value-added industries take time to mature technology and integrate it with artitecture; hence they are hardly able to grow into world-class players overnight. But "grafted" industries such as just described may be able to become competitive with the world's best in almost an instant, as long as there is technology available to be grafted and outstanding management to oversee it.

The following chapters examine the question of what action Japan should take to remedy these blind spots in its innovative capacity and deal with its changing level of international competitiveness.

II Strategies for Commercializing Technology

1. Policies and Strategies for Successfully Navigating the "Darwinian Sea"

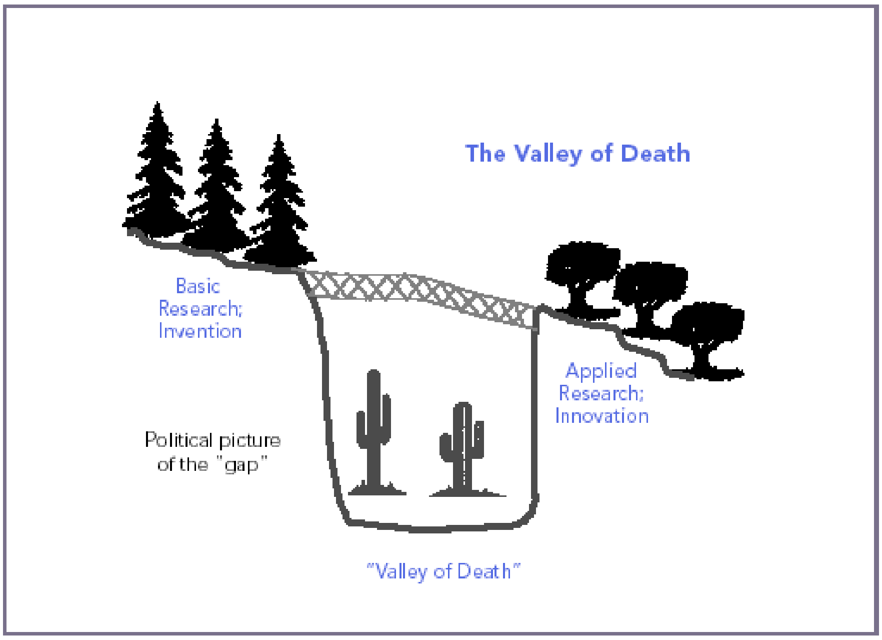
1.1. Innovation and the "Darwinian Sea"

In the Ministry of Economy, Trade and Industry (METI) and the Council for Science and Technology Policy, there has been much interest of late in the concept of the "Valley of Death," which we now examine. The Valley of Death is the well-known idea propounded by American Congressman Vern Ehlers to describe the valley through which entrepreneurs must pass on the journey from invention to innovation. This valley is conceived of as barren territory, as illustrated in Figure 2-1.

However, the diagram in Figure 2-2 on the following page, illustrating the difficulty of raising money, strikes more of a chord in Japan. This image appeared in a report unveiled in February 2002 by U.S. Secretary of Commerce Don Evans, which proclaimed the need for an ATP program and mapped out the direction of reform.[11]

The "Valley of Death," as the Department of Commerce uses the term, refers to the time period prior to the demonstration of the economic and technical feasibility of a new technological concept, being the stage when the risks are highest due to uncertainty and complexity. Transcending the valley in the shortest time is the key to success in exploiting the new technology in the marketplace. The ATP program reduces this lead time by at least half, according to the Commerce Department.

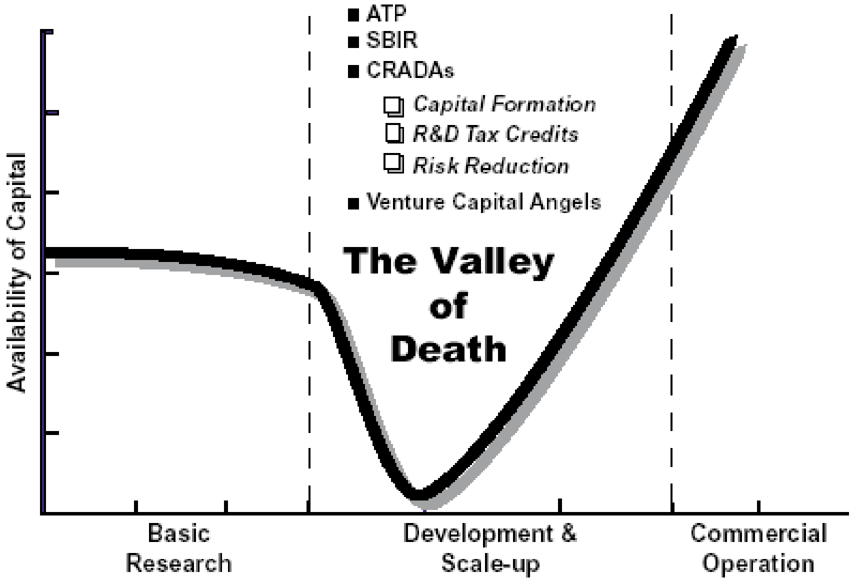
Lewis Branscomb, Professor Emeritus at Harvard University, has, with a colleague, recently argued that a more accurate metaphor exists for the innovation process than the Valley of Death, namely the "Darwinian Sea." Research findings wade into this "Darwinian Sea," which teems with numerous life forms struggling to survive, but only those ideas that, in the course of evolution, prove strong enough to fight off



Source: US Department of Commerce, "The advanced technology program: Reform with a purpose (February 2002)."

Figure 2-1. The "Valley of Death" Image I

[11] US Department of Commerce, The advanced technology program: Reform with a purpose (February 2002).



Source: US Department of Commerce, "The advanced technology program: Reform with a purpose (February 2002)."

Figure 2-2. The "Valley of Death" Image II

sharks and other deadly enemies and withstand the raging storms (i.e., technical hurdles and risks of commercialization) reach the opposite shore, where innovation and new business thrive. This Darwinian Sea is illustrated in Figure 2-3 on the next page.[12]

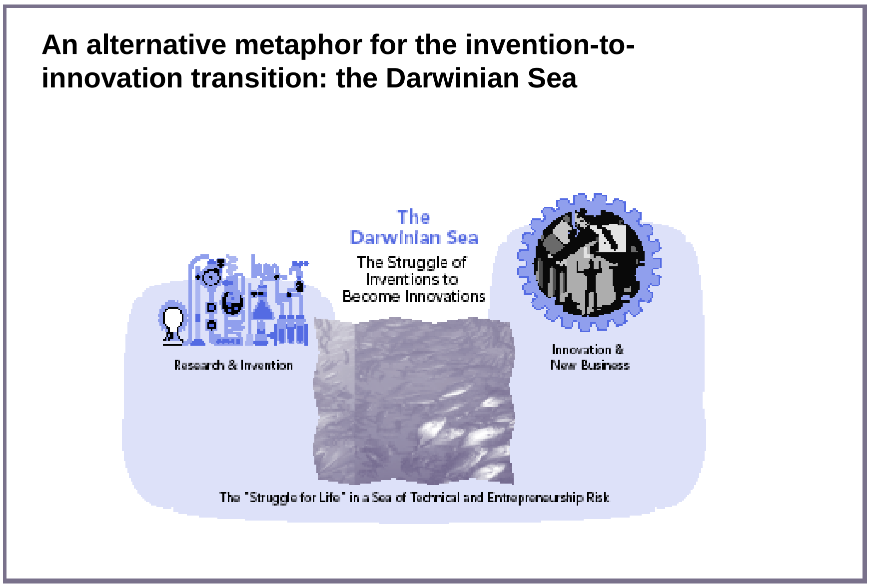
This image more aptly portrays the journey from invention to innovation than does that of the "Valley of Death." Between one safe shore where research and invention take place and the opposite shore where innovation and new business can proceed in security lies an ocean, where a struggle to survive unfolds among ideas and commercial opportunities. The "Valley of Death" and the "Darwinian Sea" are both of course metaphors, but the "Darwinian Sea" surely better captures the way in which fertile waters nurture in abundance the evolution of technologies and inventions, with those that triumph in the struggle to survive eventually thriving in the form of new products and businesses.[13]

There are three major obstacles in the Darwinian Sea. The first obstacle is insufficient incentives for scientists. Not many scientists are willing to spend time and effort on the verification work needed to commercialize an invention that has emerged from their academic research. The second obstacle is the disjuncture between technologist and business manager. Success is difficult unless both sides can communicate effectively. The third obstacle lies in raising funds and securing human resources. It is easy to find funding at the basic research and development stage and again at the stage where a valid business model is already in place. In between, however, there are few sources of funding available. There also tends to be a shortage of human resources capable of providing the required technical support for commercialization.

1.2. Policies for Successfully Navigating the Darwinian Sea

Harvard's Professor Branscomb contends that, in order to help businesses that are struggling in the Darwinian Sea, steps are needed to (1) reduce technical risk, (2) identify markets that do not yet exist, and (3) match up people and money from disparate sources. To help firms on the "research and invention" shore, meanwhile, there is also a

[12] Lewis Branscomb and Philip Auerwald, *Between Invention and Innovation*. USA: NIST, 2002A.
[13] In Japan both the Valley of Death and the Darwinian Sea are often described as barriers. Similar characterizations are found in accounts of the ATP program in the EU and elsewhere.



Source: Lewis Branscomb and Philip Auerwald, "Between Invention and Innovation." USA: NIST, 2002A.

Figure 2-3. The Image of the "Darwinian Sea"

need for (4) technology push policies. And to those already on the other bank, where new businesses and industries are born, policymakers should provide (5) incentives for risk taking.[14]

1.3. Market Failure

Even in the US, market failure is an acknowledged threat at the early stage of the journey from invention to commercialization. Upon completing basic research, entrepreneurs find it difficult to scrape together enough money to create a viable business model, yet as of 2002 over $70 billion remained undisbursed from venture funds. Memories are still fresh of how several American venture capital firms prematurely returned money to investors to reduce the size of their funds. The reason for this state of affairs is that, when the time comes to allot risk money to early-stage technology ventures, the financial markets per se fall victim to market failure. After all, investors lack the basic ability to conduct a fair assessment of the return on their investment at the early stage. Another reason lies in asymmetry of information between investor and entrepreneur. At the early stage, not only are the risks great; so too are the technological uncertainties, and investors have no effective means of dealing with these. Some of today's new technologies have the potential to engender whole new product categories, but by the same token they can cause discontinuities in commodity markets and aggravate market uncertainty. In the high tech world with its increasingly complex technologies and markets, it is becoming ever more difficult to provide documentation that meets the level of due diligence that investors require, complete with the data to back it up. Then there is the venture capital gap: there is a reluctance to cough up the $200,000-$2,000,000 in risk money required at the early stage, in part because "hands-on" investment involves a lot of work for a venture capital firm.

1.4. A Process for Supporting Commercialization of Technology

Innovation is generally said to pass through the following phases:

Phase I. Basic research, research based on an innovative idea

Phase II. Proof of technical concept (so-called invention)

[14] Lewis Branscomb and Philip Auerwald, *Between Invention and Innovation*. USA: NIST, 2002A.

Phase III. Early-stage technology development, establishment of markets and production methods, verification of business model

Phase IV. Product development (so-called innovation), initial production and marketing, procurement of necessary outside funds

Phase V. Full-scale production and marketing, recovery of investment begins

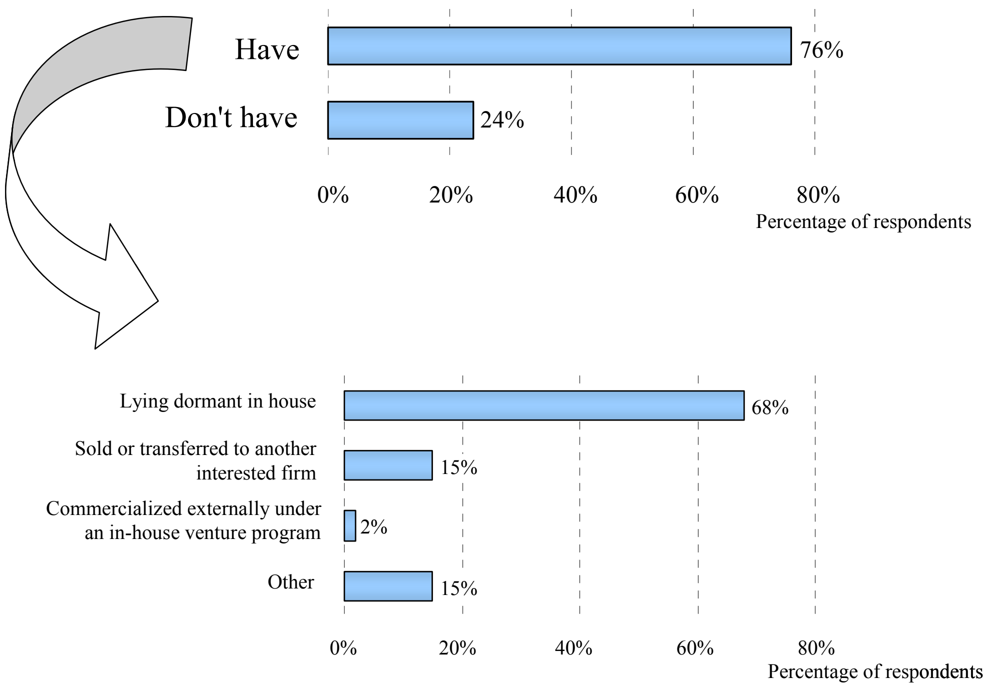
Of course, this is the classic linear innovation model; in many cases one or another step is skipped through M&As or purchase of technology. Plus in a growing number of instances the technology commercialization process itself skips stages or backtracks (marking the emergence of a nonlinear model). Nonetheless, it is self-evident that, in commercializing an innovation, one must pass through a number of steps fraught with difficulty.

The preceding analysis leads to the conclusion that the process of commercializing technological "seeds" cannot be successfully completed without proper implementation of all of following: (1) management of technology, (2) technology transfers, (3) evaluation and circulation of technology, (4) mentoring of technology, and (5) technology financing. The following sections examine these in order.

2. Management of Technology (MOT)

Management of technology (MOT) is receiving a lot of attention these days, for it is of growing importance to smooth implementation of innovation, including selecting R&D fields likely to produce seed technologies and deciding how much to spend on R&D.

As Figure 2-4 shows, in a questionnaire 76% of firms responded that they had R&D projects that they had never commercialized. When asked what had happened to that uncommercialized R&D, 68% of those firms replied that it was "Lying dormant in house." Effectively tapping such R&D is thus a task of the greatest urgency. However, consider the changes that took place in commercialization of R&D findings in the 1980s and 1990s as illustrated in Figure 2-5.



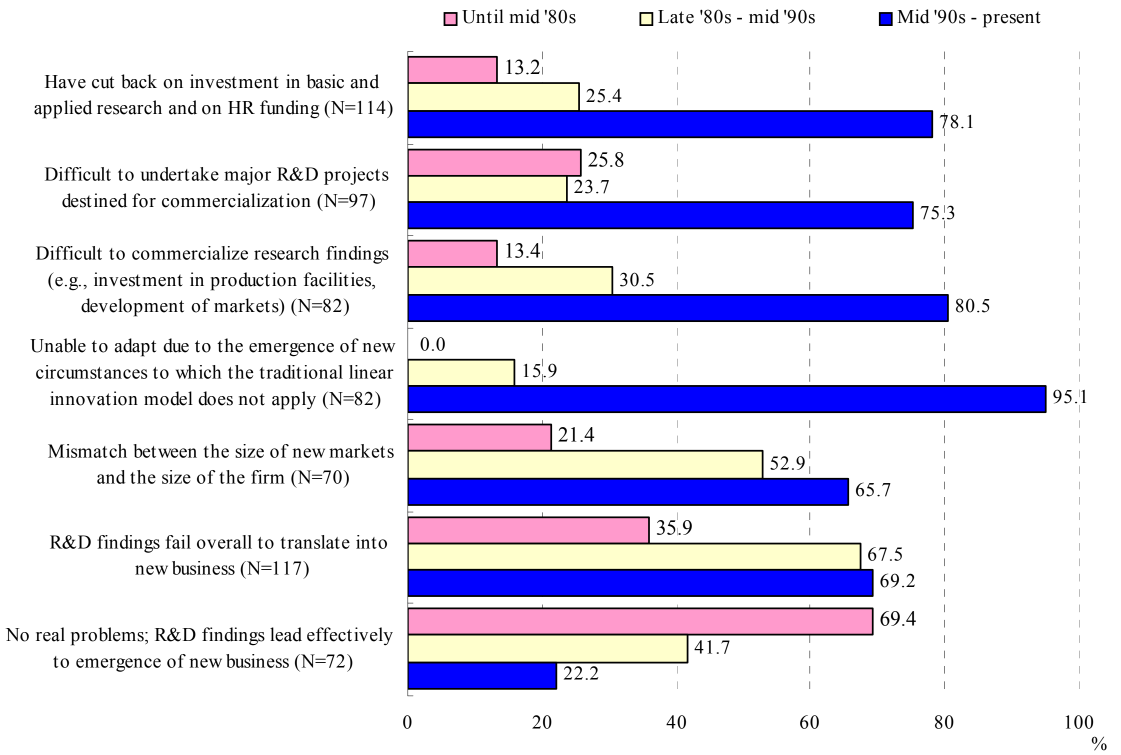
Source: Compiled based on Japan Research Industries Association, "Corporate Questionnaire on Technology Development Capacity, June 2001."

Figure 2-4. Uncommercialized R&D

Ninety-five percent of respondents admitted being "Unable to adapt due to the emergence of new circumstances to which the traditional linear innovation model does not apply"; 66% cited a "Mismatch between the size of new markets and the size of the firm." That means they are in the situation that Christensen described in *The Innovator's Dilemma*, as recounted in Chapter I. The key to success in extracting themselves from that predicament will be to use small organizations to manage technology flexibly.

Skilful management of technology requires that the people doing the managing have in mind a more or less concrete roadmap of the technology. But with "disruptive technological innovation" accounting for such a large share of innovation these days, it is extraordinarily difficult to formulate such a roadmap. Figure 2-6 lists companies' reasons for failing to commercialize R&D. Seventy-seven percent of respondents cited the reason "Anticipated results failed to materialize during research, and we realized that R&D would be more difficult than first thought"; 66% cited the reason "The prospects of commercialization vanished due to changes in user needs or other economic circumstances." It is becoming more difficult than ever to reform management of technology and implement it efficiently.

One approach that is emerging is getting another firm in the same group to screen which research projects to pursue: for instance, Mitsubishi Chemical Corporation spun off the core of its R&D arm in July 2003.[15] Innovative US firms hire "futurists" for top dollar to divine which way the winds of technology are blowing. The more innovative a company aspires to be, the more it

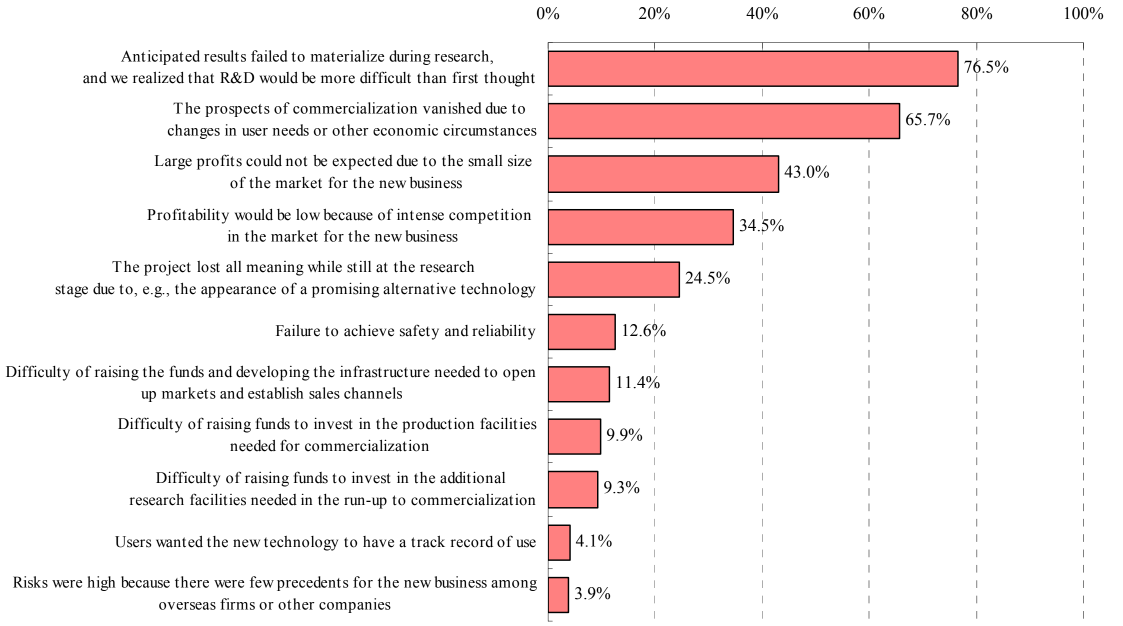


Note: The questionnaire was administered to 370 central and divisional research labs run by 161 firms, each a major R&D investor in its industry. The survey was conducted in August 2003; replies were received from 156 labs representing 113 firms.

Source: "Fact-finding Survey on Industrial Technology Development Capacity in Japan (FY 2003)," a survey conducted on behalf of METI.

Figure 2-5. Changes in Commercialization of R&D Findings in the 1980s and 1990s

[15] See *Nihon Keizai Shimbun*, Dec. 31, 2004.



Note: The questionnaire was administered to 2,310 companies, some listed on the First and Second Sections of the Tokyo Stock Exchange, others being OTC companies or unlisted firms. They include Japan's top fifty spenders on R&D. The survey was conducted in February 2003. Respondents were asked to select up to three answers from the choices provided.

Source: "Survey on State of Research and Development Activities in Japan (FY 2002)," a survey conducted on behalf of METI.

Figure 2-6. Reasons for Failing to Commercialize R&D

will need to take such steps.

Now is the time for the captains of Japanese industry to give serious thought to training world leaders in technology, who truly understand how to harness MOT in implementing innovative medium- to long-term technology strategies that boldly take risks. It is to them that the next generation of corporate leadership should be entrusted. MOT can make or break a company's competitiveness, and it is of great urgency to find and train the kind of people who can effectively oversee it. That means people capable of aggressively planning and deciding on investments in high-risk technologies, while making occasional use of alliances with carve-outs, spin-offs, and venture firms -- on which more below. The current practice of providing MOT training that is a mere extension of existing lectures and classroom instruction at the university and postgraduate level will not be good enough. More practical MOT training programs will need to be developed, which are more than a mere extension of academia as heretofore. Special instructors will have to be recruited and trained, and companies in completely new fields will need to enter the arena.

3. Technology Transfers: The Steinbeis Foundation's Pioneering Efforts

The most frequently debated topic when it comes to technology transfers is the question of how to transfer to industry the seeds of technologies incubated at universities and other institutions. When companies were asked in a questionnaire what wants they had vis-à-vis universities, many chose such answers as "Endow students with the ability to think," "Evaluate cognitive abilities from a wide range of angles," and "Give full consideration to actual ability at matriculation and graduation." TLOs are being established to facilitate technology transfers. But what is above all required is a shift in thinking away from a "seeds"-oriented approach, which focuses on licensing inventions made at universities and similar institutions, to a "needs"-oriented approach, which involves asking what needs exist and what research and development programs are required to meet them. The Steinbeis Foundation may be cited here as a pioneering example of an institution that performs needs-oriented technology transfers.[16]

The Steinbeis Foundation is an NPO that arranges partnerships between industry and academia in support of technology-based firms (TBFs). It was founded in 1971 to bridge the gap between the scientific and economic communities. In the 1970s Germany lagged behind in the shift to electronics that was sweeping across the globe; nonetheless, world-class high-tech firms like Daimler-Benz, Porsche, Carl Zeiss, and Bosch, which were based in the state, started implemented the shift to electronic technology on their own. However, many technology-based firms (TBFs) found themselves in a state of crisis because they had fallen behind as technological innovators. It was these circumstances that led to the creation of the Foundation as an agency designed to mobilize universities and research institutions in providing technical backing to technology-based firms (TBFs). The Foundation is named after Ferdinand von Steinbeis, who as trade representative in the mid nineteenth century promoted technology transfers and did much to bring about the industrialization of the Kingdom of Wurttemberg, as well as establishing a vocational training system combining theory and practice.

The Foundation, headquartered in Stuttgart, has about twenty full-time staff, some of them being generalists who act as project managers, while others administer personnel and accounts. The actual technology transfers are implemented by Steinbeis Transfer Centers (STCs), which operate in 470 locations throughout Germany, and by outside free-lance expert consultants and project managers. The Foundation handles some 20,000 projects a year.

[16] For details see Yutaka Kijima, *Nihon Keizai Kasseika no Tame no Risuku Mane Kyokyu to Inobeshon Jitsuyoka Hosaku* (Risk Money Supply and Innovation Commercialization Strategies for Invigorating the Japanese Economy), DBJ Industry Report, Vol. 7, 2002.

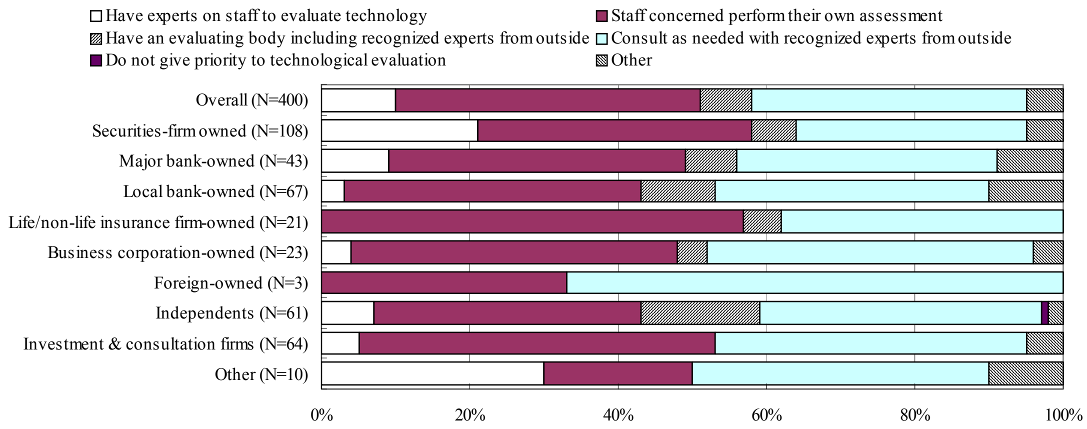
4. Evaluation and Circulation of Technology

Evaluating technology is another issue fraught with difficulty. As Figure 2-7 on the next page shows, when venture capital firms were asked about their methods of evaluating technology and its marketability, 10% said they "Have experts on staff to evaluate technology," and only 7% said they "Have an evaluating body including recognized experts from outside." It seems hardly likely that technology can be properly evaluated under such circumstances. No doubt all too many technologies that, given the chance, would achieve recognition on the market fail ever to see the light of day for lack of financing. Again, when asked about their investment screening criteria (see Figure 2-8), 89% of respondents cited "Background of CEO" and a whopping 92% cited "Character of CEO." A mere 24% cited "Joint research with a university, public agency, major corporation or the like." Certainly, a venture company's viability is ultimately determined by the enthusiasm and personal qualities of its CEO, but a more sophisticated investment screening process would be in order, one that involves a somewhat more in-depth assessment of the technology itself.

In this regard, Japan too is beginning to witness the emergence of businesses active in the field of evaluation and circulation of technology. Until the number of such businesses grows, and they become full-fledged in both qualitative and quantitative terms, little progress will be made in fostering evaluation and circulation of technology in the true sense of the term.

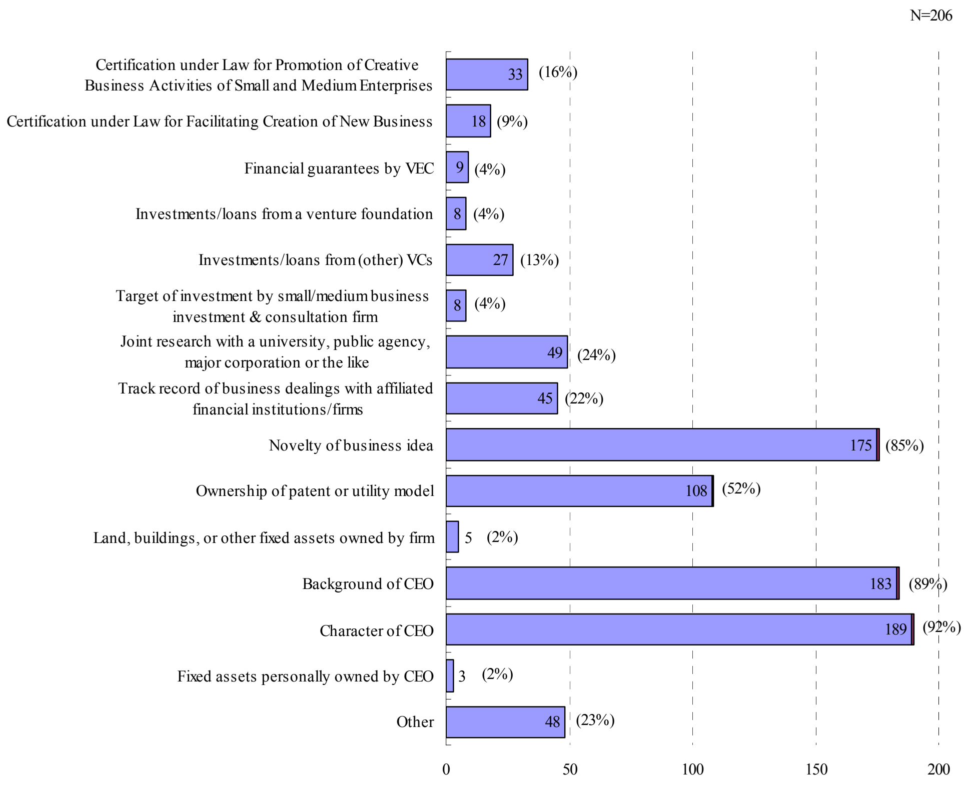
Organizations involved in evaluation and circulation of technology can be broadly classified into three categories. yet2.com is a brokerage site for buying and selling patents on the Internet. It was established in 1999 by Chris De Bleser, originally with Polaroid Co., and Ben du Pont of the Du Pont Family, and enjoys the backing of such global corporate heavyweights as 3M, Agfa, Arther D. Little, Asahi Glass, and BASF. The first category, then, comprises such evaluative agencies that are primarily involved in distribution and trading of technology in an auction-type format, such as over the Internet.

VentureLabo Inc. was established by Tadayoshi Yamanaka, a former bureaucrat with



Source: Japan Small and Medium Enterprise Corporation, "Survey of the Direct Finance (Investment) Environment for Venture Firms at Home and Abroad (FY 2001)."

Figure 2-7. Methods of Evaluating Technology and its Marketability



Source: Japan Small and Medium Enterprise Corporation, "Survey of the Direct Finance (Investment) Environment for Venture Firms at Home and Abroad (FY 2001)."

Figure 2-8. Investment Screening Criteria

METI. It consists of a network of over 200 individuals, including former employees from such major firms as Matsushita Electric, who assess the future potential of technologies in their respective fields of expertise using radar charts and the like. VentureLabo declares that, if it ranks a technology above a certain level, its affiliated venture capital firm is ready to fund it; in this manner it takes clear responsibility for its technology evaluation decisions. The second category, then, comprises organizations like this that perform evaluations by tapping a network of technology evaluators with expertise in specific fields.

The Patent & License Exchange (PL-X), which assesses patents and conducts market research, was established in 1999 under the leadership of Dr. Nir Kossovsky, then assistant professor at UCLA, with venture capital firm involvement.[17] PL-X also evaluates technology based on, among other criteria, real options and the share prices of companies with similar technology. This is certainly an interesting way of pricing patents, but using the same approach to assess the value of technology probably has its limits. The third category, then, comprises organizations that appraise the value of technology in line with a specific theory.

Each of these methods of evaluation has its advantages and drawbacks, and some organizations employ a combination of several. Objectively evaluating technology is an extraordinarily difficult enterprise, and further discussion will be needed on the issue.

5. Mentoring of Technology

Places like Silicon Valley are fully equipped with the infrastructure to support venture firms. Mechanisms are in place to back up venture entrepreneurs, with cadres of experts in such fields as marketing, accounting, and law playing the role of tutors. They propose business plans and parachute in CEOs or CFOs as needed. In Silicon Valley this approach is known as mentoring. Outstanding venture capitalists play the role of coordinator and dish out risk money as appropriate.

[17] The Japanese company pl-x changed its name to Intechstra, Inc. in April 2004.

Just as Japan has manufacturing hubs (industrial clusters) in areas such as Tokyo's Ota Ward, Silicon Valley is a hub for nurturing ventures. Israel is famous for producing large numbers of technological ventures, but because the Israeli market is so small, many entrepreneurs with technology will from the start formulate a business model that sets its sights on the US market, and move to Silicon Valley. In rapidly advancing fields like biotechnology, more and more Japanese too are relocating to Silicon Valley to launch businesses, taking just their R&D findings with them.

Social Capital

Silicon Valley's role as a hub as described above can be further clarified using the concept of "social capital." Its main proponent, Robert Putnam, sees social capital as contributing to the comfort and safety of the community. He stresses the importance to the formation of social capital of several factors: education, a lifestyle where people live near their workplace, building a community where mutual trust prevails, the Internet as a means of supporting face-to-face communication, hobbies and artistic and cultural activities, and greater decentralization in politics and government.[18] Putnam argues that social capital can only be built up gradually, over the course of a long history; it cannot be artificially created overnight.

In interviews, venture capital firms in Silicon Valley and along Route 128 in Boston spoke of a "five mile rule": they will only invest in businesses within a five-mile radius of themselves. This is because so-called "hands-on" investment, which involves sitting on the board of the company you are investing in and giving it marketing advice, is only feasible at such proximity. So-called angels are even more restrictive in the geographical scope of their investments than are venture capital firms, making them the best choice as the source of early-stage investment. The environment that exists in Silicon Valley and along Route 128, with local investors skillfully nurturing inventions and innovations, is the quintessential example of social capital. That

[18] Robert Putnam, *Making democracy work*. USA: Princeton University Press 1993.

environment is the key to the success of early-stage technology ventures. Not only is there an abundance of venture capital and "angels" (individual venture capitalists); generous support is normally also available from so-called corporate ventures and at the state level. Areas well stocked with social capital typically have a richer supply of "auxiliary infrastructure" than exists elsewhere: cumulative R&D, risk capital networks, legal and accounting firms specializing in the venture business. The industrial clusters referred to earlier too need to be understood in light of the concept of social capital.

Early-stage technology is, as mentioned above, vulnerable to market failure. In that regard national and local governments have a vital role to play. The US in general shows little enthusiasm for industrial policy, yet in this particular field the federal government's programs -- the ATP, SBIR, and STTR[19] -- are even more thoroughgoing than those of Japan. It is true that little support exists at the state level in Silicon Valley and along Route 128. But those regions have since the 1950s had the technological seeds, networks, and social capital required to drive innovation, in part thanks to spillover from military R&D.

In other states, meanwhile, frantic efforts are under way to create the right environment for innovation, with state officials themselves often taking the initiative.

6. Technology Financing

Finally we come to the question of what form technology financing should take. As already mentioned, availability of risk money is indispensable to commercializing inventions and technology, yet that money cannot be raised on free financial markets due to market failure. Realizing that, countries such as the US and Germany have set up special programs. The funding shortage is particularly severe at the early stage: even in the US the supply of cash is fairly limited at that point. American venture capital firms have a reputation for being more enthusiastic early-stage investors than their Japanese counterparts (see Figure 2-9); still, in absolute terms there is an undeniable cash shortfall. While precise statistics are hard to come by, the early stage is the one area where even venture capital firms are reluctant to commit themselves; the role of "angels" and governments is thus commensurately greater. According to the analysis by Harvard University's Professor Branscomb, funding to early-stage technologies totals some $5.4 bil-

		Japan	US
Company and personnel			
Company format		Financial institution subsidiary	Independent
Size	Amount of capital	Small (¥1 billion range)	Large ($1 billion range)
	Workforce	Large relative to amount of capital	Small relative to amount of capital
Management		Retirees from parent firm	Renowned figures + well-known capitalists
Professionals		Primarily on loan (approx. 3 yr. stint)	Business corporations + MBAs
Pay		Low + performance bonuses meager	High + performance bonuses hefty
Venture investments			
Regarded as		Peripheral to financial institution's operations	Major field of investment
Source of earnings		Liquidity gap between open and private markets (IRR declines as gap shrinks)	Gain in value of companies invested in
Investment format		Shotgun	Hands on
Size of investment		Small	Large
Expected return		Small (2-3 times)	Large (5-10 times)
Main investment target		Priority on potential for going public → Invests in pre-IPO low-tech firms	Priority on growth potential → Invests early in high-tech firms

Source: "Survey on State of Activities by Japanese Venture Capital Firms (FY 2002)," a survey conducted on behalf of METI.

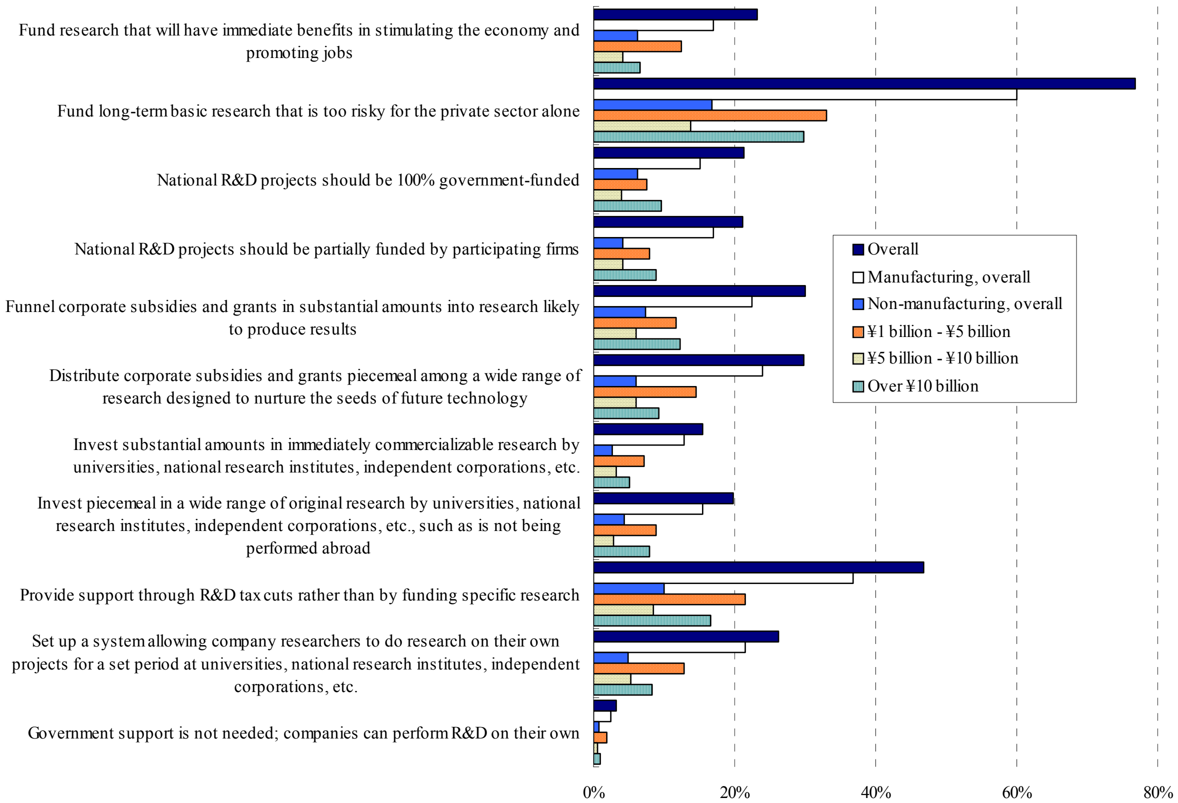
Figure 2-9. Venture Capital Firms and Venture Investments: Japan and the US Compared

19 See the next section for details.

lion on a conservative estimate; that amount breaks down into $1.4 billion from the federal government, $1.5 billion from angels, and $1.7 billion from business corporations, as opposed to a paltry $200 million from venture capital firms. Branscomb characterizes this state of affairs as a definite case of market failure.[20] The ATP, SBIR, and STTR programs described next are cases in point of the concrete role that the federal government plays in providing funding at the early stage, which accounts for 20% of the whole.

7. Promoting Commercialization of Technology

As the preceding account demonstrates, there are all kinds of obstacles to commercializing technology, and failure to clear any one of them dooms the commercialization process. Hence a comprehensive package of measures is needed. As Figure 2-10 shows, when private-sector firms were asked what forms of support they wanted from the government in the area of research and development, the list was topped by "Fund long-term basic research that is too risky for the private sector alone." The amount of venture capital that Japan invests is minuscule compared to the US and Germany. The analysis in the preceding pages suggests that further stimulating commercialization of technology in Japan will require carefully crafting policies in each of five areas: (1) management of technology, (2) technology transfers, (3) evaluation and circulation of technology, (4) mentoring of technology, and



Source: Ministry of Education, Culture, Sports, Science and Technology, “Survey Report on Research and Development by Private Firms (FY 2002).”

Figure 2-10. Government Support for Private-Sector R&D

[20] Lewis Branscomb and Philip Auerwald, *Between Invention and Innovation*. USA: NIST, 2002A.

(5) technology financing. Failure to fulfil any one of these five essential conditions will very likely derail any effort to commercialize a technology. Therefore efforts will be needed, both on the part of corporations and at the national and local government levels, to accurately determine which of these five essential conditions are not being well enough addressed and implement adequate measures in response.

III Using Carve-Outs to Create New Industries

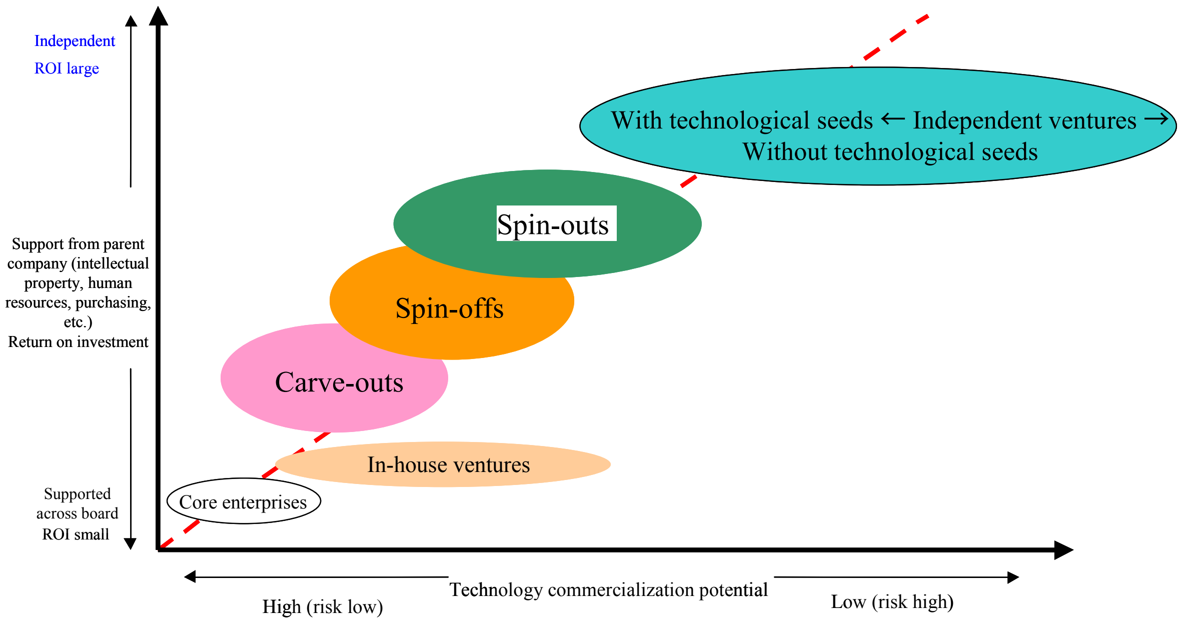
No one would dispute that providing support to venture firms that emerge out of the university environment or elsewhere is vital to creating new businesses and industries. However, in the case of Japan, it would be expecting a bit too much to vest the task of implementing bold economic structural reforms and creating new industries to ventures launched purely by individual entrepreneurs. Brilliant minds and outstanding technologies lie dormant in Japan's major corporations and middle-tier firms; spinning them off to fuel the emergence new industries would make a greater contribution to Japan's overall GDP.

Then there is the question of management of technology (MOT) discussed in the previous chapter. Today the tempo of innovation is constantly accelerating, and big corporations find themselves with less and less lead time to consider how best to distribute resources. The hierarchical structure of the big corporation is too often unable to keep up with the increasing sophistication and diversity of rapidly changing market needs. What is needed is a shift to a new model -- a network-type corporate grouping that enables specialization in specific fields. The logical conclusion is to utilize corporate venturing in the broad sense of the term, which includes setting up firms in house. The following pages examine forms of corporate venturing and how best to take advantage of them.

1. Corporate Venturing

The creation of new venture-type businesses and industries by big corporations and middle-tier firms is generally referred to as corporate venturing. Corporate venturing can be broadly divided into two categories: working with venture firms to establish new businesses and enterprises, and promotion by big corporations and middle-tier firms of in-house ventures, spin-outs, spin-offs, and carve-outs.

Figure 3-1 is a conceptual diagram of the relationship among types of corporate venturing. The horizontal axis indicates technology commercialization potential. The potential declines as one goes to the right, or, to put it another away, the risks of technology commercialization grow.



Source: Compiled by the author.

Figure 3-1. Conceptual Diagram of Relationship Among Types of Corporate Venturing

The vertical axis represents level of support from the parent company in the form of intellectual property, human resources, purchasing, investment, etc. Support from the parent company decreases and independence increases the higher one goes. The vertical axis also indicates return on investment (ROI), though this is not identical. A venture firm launched by an independent individual starts out from absolutely zero, so it can look forward to handsome returns as long as it receives investment from, say, a venture capital firm at the early stage and sticks it out until it can make its initial public offering (IPO). By contrast, if the enterprise is in the company's core business, it can tap into existing personnel, intellectual property, and organizational structures, and it will receive maximum input of resources from inside the company; hence its chances of success increase, but in many cases it will accomplish no more than pushing up the total value of the company's stock as a whole by, say, boosting existing sales. In that sense it is a low-risk, low-return proposition. Through the diagram runs a dotted line at a 45° angle; above this final returns are positive, regardless of whether the enterprise is high-risk, high-return or low-risk, low-return.

1.1. Core Enterprises

Core enterprises naturally have the best chance of success, since they receive intensive input of personnel, intellectual assets, brands, and funds from the parent firm. However, today, with the pace of innovation accelerating, a company's flagship division can end up becoming a poor revenue generator due to a slight turn of events. This casts the importance of management of technology (MOT) in a new light. For corporate managers, resting on the laurels of their flagship division is to endanger the company's very survival; it is vital to develop the seeds of new technologies and cultivate new fields, and there MOT holds the key. Moreover, in the US the 1990s witnessed a series of changes in the practice of conducting R&D and pursuing commercialization primarily at central research labs. Decentralization and multitracking are becoming increasingly the norm in conducting R&D and commercializing technology, making it more and more difficult to keep a firm hand on the tiller.

1.2. In-house Venture Programs

Inspired by the venture boom that started a decade ago, many big corporations have established in-house venture programs. However, in the case of many such programs run by big corporations, the parent firm looks after most of the funding, helps with marketing the product, and even guarantees employees' jobs should the venture fail. That is hardly the way to create true entrepreneurs willing to take risks and stake their livelihood on a business. A flurry of in-house ventures were launched during the fleeting boom, with people being recruited from the company's own ranks, but not many have proven successful. In many cases all that has ended up being accomplished is the establishment of a kind of firm within a firm. In some companies employees view in-house venture programs as a nice-sounding way of restructuring people. Interviews with several in-house ventures elicited views like: "Our parent company has put up virtually 100% of the funding, so we're regarded as a mere subsidiary and can't take orders freely." "Few of our staff show the backbone to fight like they've got their backs to the wall, since they're on loan and have few incentives." "Our parent company thinks of us as a subsidiary, so they tell us how to do every last thing." "When things don't go well we're left twisting in the wind, and when they do start going well the business wing tries to hog the new product."

Some companies are implementing reforms to better enable entrepreneurship to flourish. Matsushita Electric's Panasonic Spin Up Fund encourages selection and advice by outside institutions. Ricoh's Ricoh Challenge 21 requires that the proposer himself quit the company and put up his own money.

1.3. Independent Ventures

In the US, independent venture firms have become the driving force behind innovation, creating a major portion of new jobs. In Japan, too, the important role that ventures play in innovation hardly needs mention. But because they are high-risk, high-return, access to venture capital or some other form of risk money is vital. Nonetheless, in interviews, several venture capitalists expressed the view that investing in ventures that have solid technological seeds and can already bank to some extent on a market is rather a "middle-risk, high-return" proposition. The ability to accurately assess technologies and markets in this fashion will become crucial to ensuring that overall returns are positive.

1.4. Spin-Outs

A spin-out occurs when technologists performing, say, R&D work with a firm leave it to set up their own independent business. It involves a more decisive break than does a spin-off. In many spin-outs, the company that has split off and the original company cease to have any connection. Spin-outs are the norm in the US. When Silicon Valley was still in its early days, a group of eight individuals spun out from Shockley Semiconductor Laboratory to set up Fairchild, from which in turn Robert Noyce, the scientist who actually invented the IC, and Gordon Moore spun out in 1968 to found Intel.[21] Spin-outs are the driving force behind the formation of such industrial clusters in the true sense of the term. That applies not only to Silicon Valley but also to the bio-cluster in San Diego, California. San Diego is home to the University of California at San Diego (UCSD) as well as such Centers of Excellence (COEs) as The Scripps Research Institute and the Salk Institute. Venture firms have sprung up in the area in quick succession as researchers working at these institutions have spun out on their own. One of those firms is Hybritech, which has in turn generated more than fifty other companies through spin-outs by engineers. These companies, scattered throughout the San Diego area, form a true industrial cluster that breeds innovation through loose ties of cooperation and interchange of information.[22]

However, it would be dangerous to import the American spin-out model direct to Japan. Whether in Silicon Valley or San Diego, there are support mechanisms in place for technologists who want to go independent and set up their own business, with cadres of experts in marketing, accounting, management, and law ready to take aspiring entrepreneurs by the hand and mentor them. In the absence of such mentoring infrastructure, it would be brutal to push technologists to strike out on their own. The first step that should be taken in promoting spin-outs in Japan is setting up an NPO-type agency to facilitate mobility among technologists,[23] such as illustrated in Figure 3-2 on the next page. Once this infrastructure is in place, it has the potential to become a more powerful catalyst for innovation than the spin-offs and carve-outs to be described below, for it will enable entrepreneurship to blossom to the full.

Note that some scholars and economists use the term "spin-off" as a blanket term for both spin-outs and spin-offs, the latter of which will be examined below. In colloquial usage the two terms are synonymous, referring to quitting one's company to set up one's own business. According to Professor Ian MacMillan of The Wharton School of the University of Pennsylvania, a spin-out is where the parent company wants to have nothing more to do with the division that is being spun out and the people leaving with it; a spin-off is where the company wants to maintain some kind of a link. Among the disadvantages of a spin-out (in the narrow sense of the term) is the possibility of disputes over ownership of intellectual property and inventions made on the job; especially in Japan, it may also happen that the parent company prohibits all contact with the spin-out and thus obstructs its business.

1.5. Spin-Offs

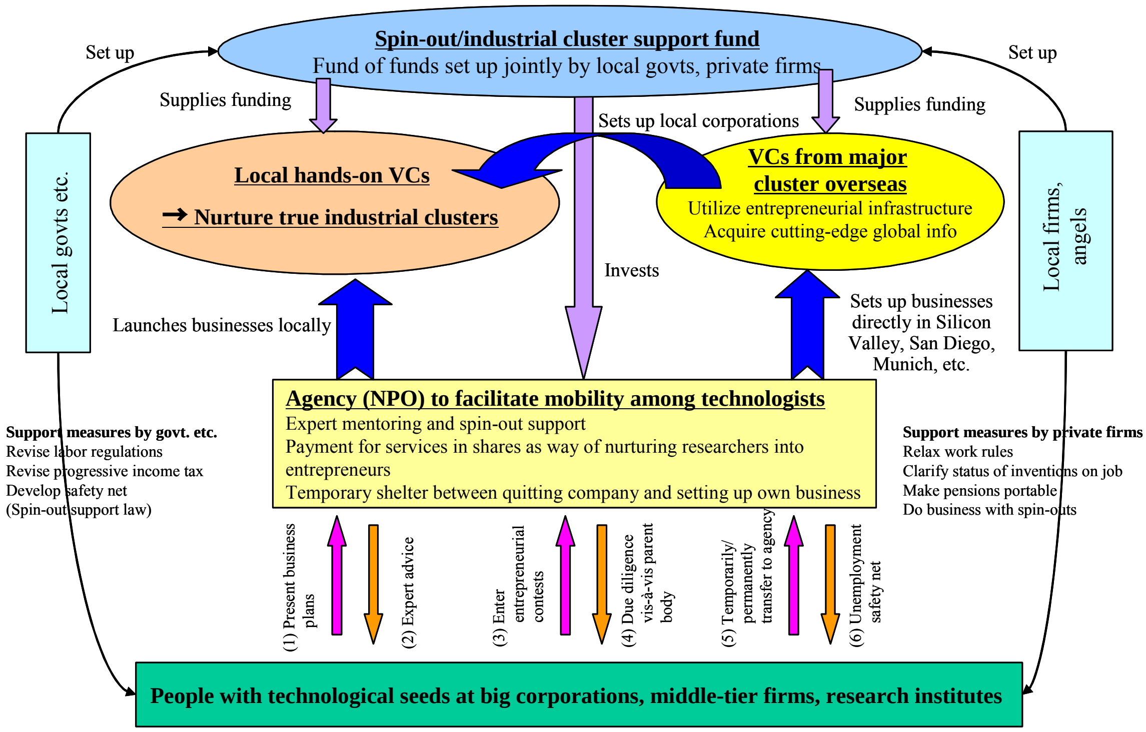
Like spin-outs, spin-offs involve quitting one's company to launch one's own business, but loose ties still tend to be maintained with the parent company despite the break.

In its report, METI's Spin-Off Study Team defines a spin-off as "neither a subsidiary under the control of the parent company nor an independent venture that has been spun out, but rather something between the two: technology,

[21] Hiroshi Toyoda, *Amerika Hatsu Bencha Tokuden* (Ventures: A Special Report from America), Toyo Keizai, 1996.

[22] See Yutaka Kijima, Wataru Kurosawa, Yasuhisa Yamaguchi and Norihisa Shimozawa, *Kakkoku no Sangyo Kurasuta no Genkyo to Keisei Shien Saku* (State of Industrial Clusters in Different Countries and Policies to Support Their Formation). DBJ Industry Report, Vol. 12.

[23] Yutaka Kijima, Yusuke Shoji and Hiroki Takemori, *Nihon Seizogyo no Fukkatsu no Senryaku* (Strategy for Reviving the Japanese Manufacturing Industry). JETRO Publishing, 2003.



Source: Compiled by the author.

Figure 3-2. Conceptual Diagram of a Support Mechanism for Spin-Outs

human resources, capital, and other business resources spun off by the parent company in the form of a venture. For a big corporation, a spin-off makes it possible to boost earnings ratio by focusing resources on the core business, and to develop new business domains by compensating for weaknesses, such as lack of mobility; for the spin-off venture itself, it makes it possible to run business in the autonomous fashion that is an essential characteristic of a venture company but with fewer start-up risks, since it is supported by the technical infrastructure that lies dormant within the larger corporation. The spin-off is a way of creating a new type of venture independent of the parent firm; these ventures have the potential to become the driving force behind groundbreaking innovation and new business creation, and could prove the key to stimulating the Japanese economy."[24] The conceptual diagram of the spin-off mechanism formulated by the Study Team is reproduced below. (Figure 3-3)

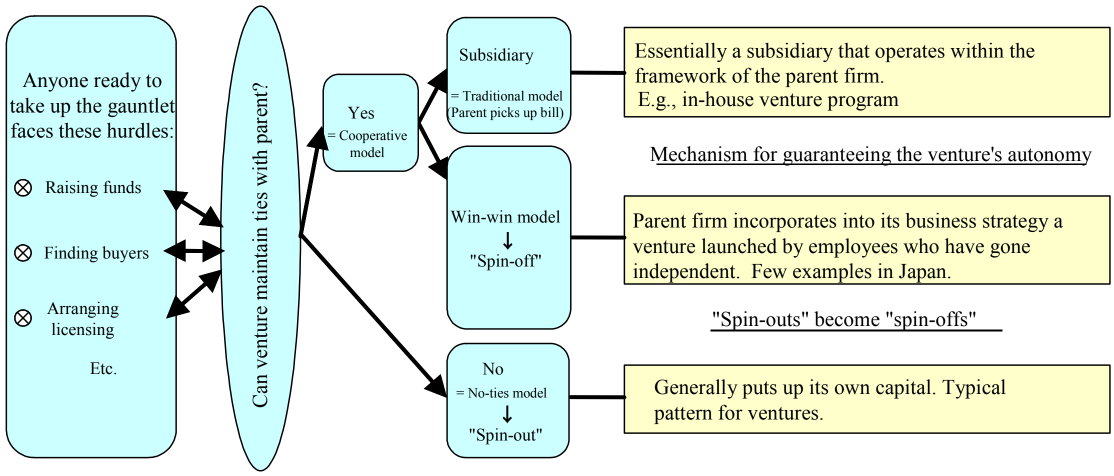
[24] Spin-Off Study Team, *Spin-Off Study Team Report*. April 2003.

The definition in Figure 3-3 covers both "carve-outs" (see below) and "spin-offs" (in the narrow sense) as the author defines those terms. The government and METI make no clear distinction between "spin-offs" and "carve-outs," treating the two as identical concepts. In the US, the term "tax-free spin-off" sometimes refers only to cases where the new company's shares are allocated to those of the parent firm.[25]

1.6. Carve-Outs

A carve-out is a type of venture by a large corporation or middle-tier firm, in which management "carves out" a portion of the company's business as a management strategy, with the venture receiving third-party input in the form of evaluation, investment, etc. The most salient feature of a carve-out is that it is made with strong support and collaboration from the parent company, including a certain amount of funding.

[25] In 1998, Collagen Corporation spun off the shares of its 100%-owned subsidiary Cohesion Technologies, transferring ownership without receiving payment. Such a spin-off constitutes a tax-free distribution of dividends.



Source: Spin-Off Study Team Report (April 2003)

Figure 3-3. Conceptual Diagram of the Spin-Off Mechanism Formulated by METI's Spin-Off Study Team

In many cases the aim is to get listed on the stock market, making outstanding enterprises a potential candidate. As a rule employees are permanently transferred to the new venture. This type of arrangement is well suited to commercializing R&D and endowing it with corporate value under conditions such as Japan's, where relatively large manufacturers actively engage in R&D, possess the seeds of new technologies, and have skilled technologists on staff.

Carve-outs have these and other advantages: (1) They have the potential to speed up the pace with which a new business evolves (e.g., commercializing what Christensen calls "disruptive technologies"). (2) They free one from the trammels of existing business (facilitating sales to outside customers). (3) They capitalize on business divisions and intellectual property (IP) that do not match the existing business portfolio (they are well suited to the IP licensing business and to enterprises that aim to establish de facto standards through alliances). (4) They guarantee the enthusiasm of new business operators (by avoiding big company ills and providing incentives that unleash entrepreneurship). (5) They have access to the parent firm's various forms of infrastructure. NTT's launch of NTT DoCoMo can be described as a type of carve-out, even if the shoe does not quite fit as far as sheer size goes and from the strict perspective of corporate venturing. There has long been a strong urge among Japanese companies to get their subsidiaries listed on the stock market, and in 1999 the number of listed subsidiaries reached 291; hence there should not be that much reluctance to carve out ventures and ultimately see them make their IPO.

Extensive use is made of strategic carve-outs in North America and Europe. Some of the best-known examples are: (1) GM's carve-out of Electronic Data Systems, the world's biggest data processing company; (2) GM's carve-out of Delphi, the world's biggest car parts division; (3) Ford's carve-out of Visteon, its biggest parts division; (4) AT&T's carve-out of Lucent, its communications equipment manufacturing arm; and (5) Ericsson's carve-out of Enterprise Solutions, its cell phone manufacturing arm. All these carve-outs proved effective in enhancing global competitiveness and corporate value.[26]

The above-quoted definition formulated by the Spin-Off Study Team does not draw a clear distinction between a "carve-out" and "spin-off." If however one insists on making a distinction, a "spin-off" may be described as a loose partnership with the parent firm, while a "carve-out" involves the parent firm to some extent main-

[26] See Shintaro Hori, *Nihon Kigyo Shinka no Joken* (Conditions for Evolution of the Japanese Corporation), Toyo Keizai, 2002.

taining an actual stake in the venture, say by owning stock. The ideal would be if, rather than a single firm launching a carve-out on its own, two or more firms were to join together in carving out divisions that have a synergistic relationship and merge them. The parent firms would each make a commensurate investment, and a carve-out fund or the like would also put up money while monitoring potential and the technology's marketability from a third-party perspective. Eventually the venture, having evolved into a global leader, could make its IPO. It is to be hoped that many such ventures will emerge. In sectors such as IT, electronics, and machinery, there are many areas where it would be possible for two different companies to carve out promising divisions that together would be able to achieve an unassailable technological position on the global stage. The fact is that too often a new technology with potential to become a major revenue source ends up never being commercialized, either because the parent company holds back on R&D spending or because the technology is too unstable when only a single company is involved. Plus, as Christensen points out in *The Innovator's Dilemma*, "disruptive technologies" have an adverse impact on a big corporation's existing profitable businesses, so intra-company dynamics sometimes result in failure to commercialize a great technology. Carve-outs would be highly effective in a case like this.

Furthermore, Japanese electronics manufacturers have until now been too ready to sign cross-licensing agreements. In consequence, before a manufacturer that has developed a new product on its own even has the chance to reap the rewards, similar products will appear on the market, leading to rampant price competition even though the item is brand new. That is one reason that the rate of profit on sales has remained so low. Cross-licensing has helped Japanese manufacturers raise their technology standards and offer a comprehensive lineup. But if companies want to pursue effective management of technology -- in other words, develop new breakthrough products and make items that other companies do not -- then a different approach will be more effective: either monopolize the new product technology, or have each manufacturer carve out the division involved as a joint-development enterprise with the goal of establishing a de facto standard.

Many Japanese electronics firms and automobile companies have highly competitive parts manufacturing divisions or device divisions. Carving them out, just as GM carved out Delphi, could facilitate sales to outside clients and boost the total share value of the group as a whole.

In the US, a normal equity carve-out is a frequently used way of coaxing value out of a 100%-owned subsidiary, with a portion of the shares owned (usually around 20%) being publicly offered. This is a flexible technique in that it leaves the parent company with additional opportunities to sell. For example, in the US a two-stage approach is often to be observed: an initial sale is made to ordinary investors when the subsidiary's shares go public, then the rest are later sold off to existing shareholders in a spin-off. For the parent company, this approach has an advantage over making a public offering of all the shares it owns in that it does not completely relinquish control of the business.

2. Recent Developments around Spin-Offs and Carve-Outs

Japan too is gradually starting to witness developments in the area of spin-offs and carve-outs. The government and METI tend to use the term "spin-off" indiscriminately to refer to either a spin-off or a carve-out, but at any rate the subject is coming to garner broader interest. Here we describe recent developments.

2.1. Developments at the Government Level Etc.

- The report of METI's Spin-Off Study Team (April 2003) and the spin-off subsidy program

Consisting of twenty expert members plus observers, the study team compiled a report recommending promoting spin-offs as a way to foster innovation. (The team was chaired by Professor Takeru Oe of Waseda University's Graduate School of Management). In parallel with the team's deliberations, METI also set up a program to subsidize commercialization efforts by spin-off ventures (this provides a subsidy of ¥100 million a year to spin-off ventures, for a maximum of ¥200 million over two years).

- METI hosts the Spin-Off Venture Promotion Forum (in Tokyo in November 2003 and Osaka in March 2004)

This forum was organized to ponder the sources of Japan's industrial growth to date and engender a new type of venture -- one that is not of the "catch-up" type -- as a locomotive for new growth. It was inspired by the belief that an extremely potent means for Japan to beef up its industrial competitiveness would be to spin off the technological seeds, R&D, and human resources that lie dormant in big corporations and nurture them into new ventures under a system of partnership with parent companies. The forum presented the spin-off venture as a new Japanese model for how businesses can evolve in partnership with their parent companies, in a win-win relationship with big corporations. It showcased this model as the key to innovation as corporate Japan recovers.

- METI formulates a New Industry Creation Strategy (May 2004)

METI oversaw compilation of the New Industry Creation Strategy, which was referred to the Council on Economic and Fiscal Policy in May 2004 and ultimately incorporated into the government's so-called "large-boned" policy blueprint. One of the recommendations was to "provide consistent growth support to R&D ventures, including spin-offs from large corporations, from the applied R&D stage through to commercialization."

- Cabinet Office's Council for Science and Technology Policy: R&D Ventures Project Team (May 2003)

In May 2003 the team, chaired by Professor Matsuda of Waseda University, submitted its proposal, "Creating and Nurturing R&D Ventures: A Way of Tapping Japan's Latent Strengths in Technology." This recommended providing support to ventures spun off from large corporations and touched on the subject of reforming pensions to that end.

- Japan Productivity Center for Socio-Economic Development: Practical Research Group on Corporate Venturing (May 2003)

The Group examined strategies rooted in the "open innovation" approach, such as harnessing external resources, as a means of overcoming certain obstacles that are constant concerns to Japanese corporations when developing new businesses and opening up new fields; these include friction with a company's existing business, and the dilemma created by conflicts with its current direction. Specifically, the Group studied the efficacy of strategic corporate venturing, including spin-off ventures and carve-outs as well as the traditional in-house venture. At the Conference on Promoting Collaboration between Industry, Academia, and Government in June 2003, the Group recommended promoting spin-offs through MOT as a way of stimulating development of new business by large corporations.

- Study on carve-outs by the Japan Techno-Economics Society (February 2004)

The Japan Techno-Economics Society, an association of chief technology officers (CTOs) from Japan's leading manufacturers, has also been compiling recommendations and research on carving out R&D-driven businesses.

- The Industrial Technology Utilization Center, an NPO, is slated for launch in September 2004

Preparations are currently afoot to launch an NPO that will assist in efforts to make effective use of the technological seeds that large corporations possess and provide comprehensive support to spin-outs and spin-off ventures. Among the organizers are Professor Takeru Oe of Waseda University's Graduate School of Asia-Pacific Studies and Professor Akio Nojiri of the University's Advanced Research Institute for Science and Engineering. Waseda University graduate students and MBA students will provide technology commercialization support services as part of their practical training. The Center will implement technology commercialization support programs in conjunction with such outside partners as venture support agencies, regional industrial promotion bodies, and public financial institutions.

- Special Forum: The Kanagawa "Business Launch Support" Caravan (January 2004)

Organized by the Kanagawa Federation of Small Business Associations, this event featured discussion on the efficacy of spin-offs and the like. It included a panel discussion on the subject "Spin-off ventures will change Japan!" with guest Professor Noboru Maeda of the Graduate School of Osaka City University.

- Discussions of the Limited Liability Company (LLC) format

The LLC is a form of company organization that has been attracting much interest recently as a mechanism for R&D-driven corporate value creation. It is also compatible with spin-offs and carve-outs. Consisting of a body of individuals possessing a high level of expertise and subject to limited liability, the LLC has tax benefits for the investing parent firm thanks to conduit tax treatment. Extensive use is made of LLCs in North America and Europe, which have been developing the necessary legislative infrastructure since the 1990s (the US has around one million LLCs, as opposed to ten million joint-stock companies). The LLC gained the spotlight as a powerful tool for conducting joint R&D following the success of EUV-LLC, an LLC set up to develop the next generation of extreme ultraviolet (EUV) lithography technology for semiconductors.[27] In Japan too discussion has gotten under way on the subject. In May 2003 the report "Creating and Nurturing R&D Ventures" was submitted to the Council for Science and Technology Policy, and in November 2003 a "Proposal on a New Form of Organization for Harnessing Human Resources" was presented to METI; both included mention of adopting the LLC format. In the US it is becoming increasingly common to use the LLC format to implement projects in secondary core businesses for which it is hard to attract sufficient funds -- as opposed to projects in the company's core business that can be commercialized in a short time.

2.2. Business Corporation Support for Spin-Offs and Carve-Outs

An increasing number of companies announce support for spin-offs and carve-outs on their web sites and elsewhere. Here is a rundown.

- Nikko antfactory K.K.

A business corporation 96% owned by the Nikko Cordial Group. It works with large corporations and middle-tier firms in providing support to group subsidiaries and business divisions.

- Technology Alliance Group, Inc.

A business corporation established and 100% owned by Mitsubishi Corporation. It focuses on carve-outs of business divisions.

- Leading Innovation, Inc.

Supports the creation of new businesses within existing companies and helps with the launch of unique venture businesses, both of which will be indispensable to the successful pursuit of innovation by Japanese industry. It was a pioneer in recommending the spin-off venture format to Japanese industry, and since FY 2002 it has been promoting such ventures under contract from METI.

- Japan Industrial Partners, Inc.

An investment firm owned by Mizuho Securities Co., Ltd., Bain & Company Japan, and NTT Data Corporation. It promotes establishment of branch companies in support of business reconstruction, restructuring, and renewal (in other words, reconstructive carve-outs). It also provides funding support to companies striving to adapt to the market climate by switching business formats.

- Works Capital Inc.

An investment firm 75% owned by Mitsubishi Corporation. It supports growth firms in carving out independent ventures and launching new companies through, e.g., capital participation.

[27] The company was established in 1997 by a private-sector industry consortium led by Intel, Advanced Micro Devices, Motorola, Micron Technology, and Infineon Technologies. Working with several Department of Energy research laboratories, it developed extreme ultraviolet (EUV) lithography technology designed to boost semiconductor function. It plans to use that technology to manufacture a 10 GHz microprocessor in 2005-2006.

- Feature on carve-outs in the *Nikkei Business Daily*

This feature described ADTX Co., Ltd., launched when IBM Japan carved out its hard disk drive division, and Accela Technology Corporation, launched when NEC carved out its data retrieval technology and automatic Japanese-English translation server divisions. It also referred to Sony Corporation: "The entrepreneurial spirit of Masaru Ibuka and Akio Morita still lives on unbroken, and the company is pursuing a carve-out strategy designed to capitalize on the independent spirit of its employees."[28]

2.3. Actual Cases of Spin-Offs and Carve-Outs

The following is a list of actual examples of spin-offs and carve-outs, some identified by METI or at the Second Conference on Promoting Collaboration between Industry, Academia, and Government,[29] others identified by the author. As already mentioned, the government and METI do not distinguish between spin-offs and carve-outs; here therefore they are enumerated without distinction, being listed in the Japanese equivalent of alphabetical order.

- Accela Technology Corporation

The carve-out of NEC's data retrieval technology and automatic Japanese-English translation server divisions. It develops and sells the eAccela text retrieval, translation, and sorting software for business.

- Axell Corporation

Independent offshoot of Nippon Steel Corp. It develops semiconductors for computer games and other amusement equipment, its flagship products being graphics and sound LSI and ASIC.

- Askul Corporation

Originally launched in 1993 as a business division of major stationery manufacturer PLUS Corporation, Askul was carved out in 1997. Among other things, it conducts mail-order sales of office supplies.

- ADTX Co., Ltd.

The carve-out of IBM Japan's hard disk drive division. Its areas of business include disk drive arrays and system solutions.

- Advics Co., Ltd.

This carve-out was established in 2001 with joint funding from Toyota, Aisin Seiki, Denso, and Sumitomo Electric Industries. It develops and sells brakes for automobiles. The company aims to achieve ¥250 billion in annual turnover by FY 2005 from sales of braking systems to Toyota and other automobile manufacturers.

- Alpha Electronics Corp.

Independent offshoot of TDK. It has the biggest share of the domestic market for ultra-precision metal foil resistors and is also a supplier to NASA.

- Itochu Techno-Science Corporation

Carved out by Itochu Corporation in 1972 to strengthen its presence in the information systems field. It creates total solutions in system consultation, integration, administration, and maintenance. It also provides educational services and sells network equipment.

- Incs INC.

Independent offshoot of Mitsui Mining and Smelting. It manufactures metal molds using 3D CAD.

- Internet Initiative Japan Inc.

A spin-off from the Japan Management Association. An Internet provider, it is setting up a communications firm specializing in transmission of business data with Toyota and Sony.

- ST LCT Corp.

A joint carve-out set up by Sony Corporation and Toyota Industries Corporation. It caters to the growing market for low-temperature polysilicon TFT liquid crystal displays, which are in increasing demand for use in video cameras, digital still cameras, personal digital assistants (PDAs), and cell phones. Its aim is to become the world's No. 1 LCD manufacturer by combining Sony's superlative R&D with Toyota's prowess in manufacturing technology.

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[28] *Nikkei Sangyo Shimbun*, April 2-3, 2003.
[29] In the speech by Professor Noboru Maeda of the Graduate School of Osaka City University.

- S-LCD Corporation

This carve-out was jointly launched by Sony Corporation and Samsung Electronics Co., Ltd. in 2004. It is building an assembly line to manufacture the seventh generation of amorphous TFT liquid crystal display panels, chiefly for use in large-size TVs. It plans to spend around US$2 billion on installing this seventh-generation manufacturing facility.

- NEC Plasma Display Corporation et al.

Carve-out of NEC's plasma display set and module division. Another carve-out is slated for September 2004: NEC will grant Pioneer Corporation ownership of all the shares of NEC Plasma Display, which it owns, along with its intellectual property rights in the field of plasma displays.

- NEC Laser Automation Co., Ltd. et al.

Established as a branch firm within the company in 1985 to manufacture and market laser equipment. In 2004 it merged its laser processing division with those of NEC and NEC Robotics Engineering Ltd. Now a new company is to be launched in a joint carve-out with funding from Japan Industrial Partners, Inc. and Cyber Laser Inc. This company will capitalize on future synergies with a broad-range of next-generation light-source technologies, starting with the state-of-the-art femtosecond laser light-source technology owned by Cyber Laser. And it will boldly expand business under swift, dynamic management. The aim is thus to help beef up the competitiveness of the Japanese optics industry.

- NTT DoCoMo, Inc.

This ultra-blue-chip company was carved out in 1991 in accordance with the government's policy of splitting off NTT's mobile communications arm in order to improve service.

- OMviro Co., Ltd.

Established in 2004 as a joint carve-out in the business of manufacturing and selling catalysts for comprehensive treatment of flue gas. These catalysts, which incorporate technology developed by Mitsubishi Heavy Industries, Ltd. and Osaka Gas Co., Ltd., also simultaneously remove sulfur oxides.

- Optware Corporation

Independent offshoot of Sony. It develops, manufactures, and sells super-high-capacity memory devices. It is developing a one-terabyte optical disk read/write device that melds holographic memory technology with optical disk technology and is upwardly compatible with CDs and DVDs.

- Crystage Incorporation

Independent offshoot of Hosiden and Philips and Matsushita Electric Industries. It develops and manufactures next-generation liquid-crystal devices and provides consulting services. It also develops equipment for manufacturing active matrix organic EL panels.

- SAMCO International Research Laboratory

Independent offshoot of NASA. It develops, among other things, compound semiconductor manufacturing equipment and semiconductor and LCD manufacturing equipment.

- Cybozu, Inc.

Independent offshoot of Matsushita Electric Works. It develops groupware for the Internet.

- THine Electronics,Inc.

Independent offshoot of Toshiba. It conducts system LSI design and designs signal processing for liquid crystal displays.

- Zaxel

Independent offshoot of Sony launched in Silicon Valley. It develops 3D video film equipment and software.

- Seven-Eleven Japan Co., Ltd

In 1973 Ito-Yokado Co., Ltd. founded York-Eleven, which was carved out by a group around Toshifumi Suzuki, then a section manager with Ito-Yokado.

- Sony Computer Entertainment Inc.

Plans, develops, produces, and sells home video game equipment and software for PlayStation and such. Sony originally carved out the company as a secondary core business, but then it became its biggest revenue generator, and in 1999 Sony did a "spin-in" by performing an equity swap, turning it into a 100%-owned subsidiary.

- Sony Ericsson Mobile Communications Japan, Inc.

Sony Ericsson Mobile Communications AB was established in London in 2001 as a joint venture between Ericsson and Sony Corporation in the mobile phone handset business. Both firms carved out their mobile phone handset divisions, the goal being to seize the No. 1 spot in the multimedia communications terminal market within the next few years.

- Digital Fashion Limited

Independent offshoot of Toyobo Co., Ltd. It supplies software and hardware for digitally supporting the fashion industry. It also uses computer graphics to perform fashion design and consulting.

- NuCore Technology Inc.

Independent offshoot of Intel Japan and Hitachi Medico, founded in Silicon Valley. It designs semiconductors for high-speed image processing in digital cameras. It is currently developing an 81-megapixel-per-second digital image processor, as well as the next generation of analog image processors.

- North Corporation

Independent offshoot of Sony. It manufactures and develops semiconductor components and printed-wiring assemblies. Its fortes are techniques for connecting copper in air and 3D mounting technology.

- Novus Flash Media Co., Ltd.

In 2003 Toshiba Corporation and Hagiwara Sys-Com jointly carved out their respective NAND flash memory products divisions. The focus of the new company's business is planning and promoting sales of applied products that take advantage of the features that NAND flash memory offers. The aim is thereby to foster more widespread use of NAND flash memory.

- Pado Corporation

Independent offshoot of Ebara Corporation. This planning company edits and publishes community information magazines that are home-delivered for free. It produces information magazines that serve as a newsletter for the local community, as well as information magazines for salarymen and female office workers.

- Pixera Corporation

Independent offshoot of Toshiba founded in Silicon Valley. It develops, manufactures, and sells high-resolution digital CCD camera equipment for microscopes.

- Fujitsu Limited

Fuji Communications Equipment Manufacturing Co., Ltd., the predecessor of Fujitsu, was launched in 1935 when Fuji Electric Co., Ltd. carved out its telephone division.

- Fanuc Ltd.

In 1956 Fujitsu began developing servomechanisms with NC, and in 1972 Fanuc was carved out of Fujitsu's Numerical Control Division.

- Fab Solutions Company Limited

Independent offshoot of NEC. It develops and sells e-beam-based semiconductor inspection equipment. (The company receives funding from IT venture capital firms.)

- PharmaDesign,Inc.

Independent offshoot of Yamanouchi Pharmaceutical and pioneer in the field of genomic drug development ventures. It supplies pharmaceutical firms with experimental data to help with development of new drugs, and designs low-molecular drug compounds tailored to target drugs.

- Progressive Pictures Co., Ltd.

Independent offshoot of Victor Company of Japan. It performs digital cinema planning and production, supplies shooting and editing technology, and also advertises distribution.

- Frontier Carbon Corporation

Carve-out of intellectual property and production technology in the possession of the Mitsubishi Corporation and Mitsubishi Chemical Corporation Group. It manufactures carbon nanotubes of fullerene and similar materials and develops fuel cells etc. using them. It receives funding from

Nanotech Partners, an investor in the nanocarbon field.

- Protein Wave Corporation

Independent offshoot of Sumitomo Metal Industries. It develops chips for analyzing the structure of proteins and the like. It is attracting the limelight with protein analysis technology, the next big wave in biotechnology after genome analysis.

- Future System Consulting Corp.

Independent offshoot of NTTPC Communications, Inc. It builds management strategy information systems for the distribution and finance industries, as well as providing consulting services.

- Ball Semiconductor

Independent offshoot of Texas Instruments Japan, established in Dallas, Texas. It is developing the technology to build integrated circuits on the surface of spherical semiconductors. The company receives funding from such investors as Kyocera.

- MegaChips Corporation

Independent offshoot of Ricoh. A fabless company specializing in system LSI design and R&D. It also provides security monitoring services and sells film system software.

- UKOM

Independent offshoot of Sony, established in Silicon Valley. It is developing semiconductor technology to replace the conventional tuner that converts radio waves to a program signal. It has an alliance with IBM.

- Yozan Inc.

Spin-off from a consultant. It develops semiconductors and system software for mobile multimedia equipment.

- Lattice Technology, Inc.

Independent offshoot of Ricoh. It develops and produces technology for radically reducing the weight of 3D data.

- Land Solution Corporation

Kurita Water Industries carved out its soil contamination division and launched this company in 2001 in partnership with Dowa Mining and the Development Bank of Japan. It provides total solutions in the field of soil contamination.

- RealVision, Inc.

Independent offshoot of NEC. It designs and develops LSI for 3D image processing, which technology has been adopted for use in NEC workstations.

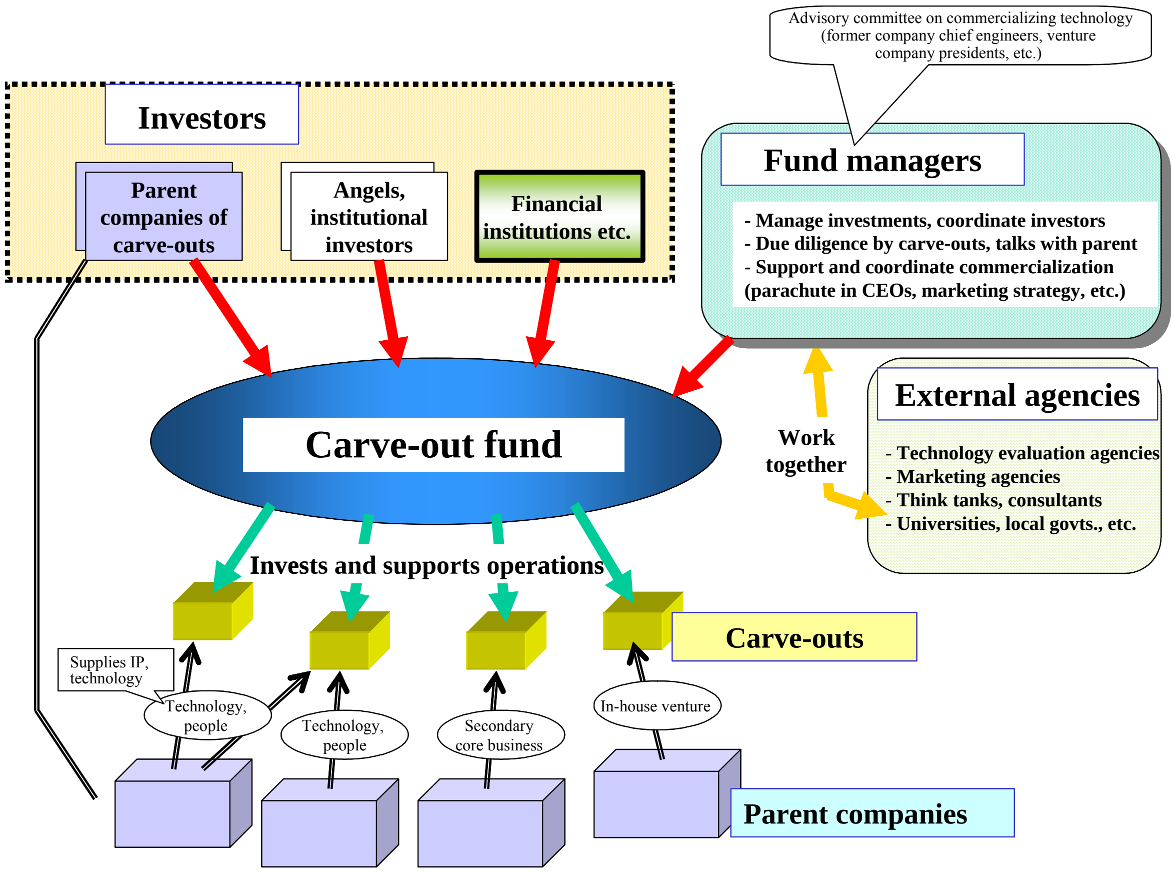
3. A Realistic Strategy for Japan: Use Carve-Outs to Create New Industries

Many an in-house venture was born back in the days of the "in-house venture boom," but few really succeeded. A spin-out has the advantage that it paves the way to success by drawing out the potential of the individual: an entrepreneur bursting with independence leaves the company to set up his own business. However, in many cases there are serious obstacles in terms of the relationship with the parent firm, such as clarifying who owns intellectual property rights, or the imposition on the new venture of a duty not to compete with its parent. And if the spin-out involves a parting of the ways with the parent firm, the new company will find itself shut out of doing business not just with the parent firm itself but, in some cases, also with anyone else to whom the parent firm has ties. In that regard a spin-off has the advantage that, by maintaining loose ties with the parent firm, it can tap into the credibility that the parent has built up, gain access to resources, and expand sales channels. A carve-out, in which the parent firm to some extent maintains a stake by owning shares or whatever, will find it even easier to obtain the support of the parent company in terms of raising funds, developing sales and supply channels, and gaining access to human resources and intellectual property.

Big corporations and middle-tier firms for their part should have less of an antipathy to carve-outs than to spin-outs and spin-offs. Though not realistic in a company's core business, carve-outs should proceed fairly smoothly in secondary core businesses or in areas that have the potential to become part of a firm's core business in the future. If pioneering Japanese big corporations and middle-tier firms are able to create some carve-out success stories, that might unleash a whole wave of carve-outs, with huge ramifications for the Japanese economy as a whole. The setting up of independent venture businesses alone will not be enough to trigger the emergence of robust new industries in Japan; also needed is a flurry of carve-outs in promising business fields, launched by big corporations and middle-tier firms that conduct extensive R&D and have large numbers of elite engineers on staff. That would reinvigorate Japan's big corporations and middle-tier firms, which easily get trapped by the aforementioned "innovator's dilemma" because of their successes in the past, and by extension help economically reinvigorate Japan as an innovator nation. Figure 3-4 presents a possible mechanism for supporting carve-outs and sketches the outlines of a carve-out fund, which would be valuable to achieving this goal.

According to Professor Noboru Maeda of Osaka City University, by 2010 450 high-tech ventures that are spin-offs in the broad sense (i.e., including carve-outs) will be listed on the stock market, and 80,000 engineers will be associated with them.[30] That figure -- 450 -- represents 10% of the listed companies in Japan. If businesses are launched at that rate, it is not beyond the realm of possibility that Japan could come to lead the world as an innovator nation, as both the big corporation and the venture firm are transformed into something radically different from what they are today.

Figure 3-5 summarizes the characteristics, advantages, and disadvantages of in-house ventures, spin-outs, spin-offs, and carve-outs as



Source: Compiled by author.

Figure 3-4. Conceptual Diagram of a Support Mechanism for Carve-Outs

[30] See Noboru Maeda, *Supinofu Kakumei* (The Spin-Off Revolution), Toyo Keizai, 2002.

This is the first priority in the case of Japan. Ventures should have an impact on GDP.

1. In-house ventures
   The parent company puts up most of the capital and helps sell product etc. Even if the venture fails, the employees' jobs are guaranteed.
   → Such ventures fail to create true entrepreneurs willing to take risks and stake their livelihood on a business. All that is accomplished is the establishment of a firm within a firm.
2. Spin-outs
   Technologists performing R&D work with a firm leave it to set up their own independent business.
   Essential condition for development of true industrial clusters (e.g., San Diego's Hybritech)
   → In the case of many spin-outs, no links whatsoever are maintained between the technologists who strike out on their own and the company they leave. There may also be disputes over, e.g., ownership of IP.
3. Spin-offs
   The same as a spin-out insofar as technologists leave a firm to set up their own business.
   (Spin-off is sometimes used as a blanket term for spin-outs and carve-outs.)
   → A spin-off tends to maintain loose ties with the parent company despite the break.
4. Carve-outs
   A venture by a large corporation, in which management "carves out" a portion of the company's business as a management strategy, with the venture receiving third-party input in the form of evaluation, investment, etc. The carve-out is made with support and collaboration from the parent company, including a certain amount of funding.
   → This type of arrangement is well suited to commercializing R&D under conditions such as Japan's, where large corporations actively engage in R&D, possess the seeds of new technologies, and have skilled technologists on staff. It also has advantages for the parent firm (upside risk, spin-ins).

Source: Compiled by the author.

Figure 3-5. Methods of Harnessing the Technological Seeds that Lie Dormant in Big Corporations

(1) Gain the understanding and support of the parent firm
(2) Create a win-win situation for both parent firm and new investors
(3) Formulate a clear exit strategy and enshrine it in the shareholders' agreement
(4) Encourage mobilization of intangible assets including human resources
(5) Provide hands-on support to carve-outs
(6) Provide risk-money support in the form of carve-out funds etc.
(7) Train coordinators capable of winning over the top brass of big corporations and middle-tier firms
(8) Clarify working conditions and overhaul severance pay and the pension system etc. to accommodate permanent staff transfers
(9) Streamline and standardize rules for on-the-job inventions, as well as confidentiality agreements and non-compete requirements

Source: Compiled by the author.

Figure 3-6. Challenges to Promoting Carve-Outs and How to Meet Them

methods of harnessing the technological seeds that lie dormant in big corporations.

4. Challenges to Promoting Carve-Outs and How to Meet Them

Let us end this paper by examining what challenges exist to promoting carve-outs and how to meet them. The nine main points are summarized in Figure 3-6.

(1) Gain the understanding and support of the parent firm

The first condition is to get people within the company, especially at the management level, to understand that carve-outs are an effective way to commercialize technology, and that, with the pace of innovation picking up speed, conducting commercialization completely in house will result in lost business opportunities. Even if people in the company's in-house ventures coordination section or business planning arm make up their minds to launch a carve-out, the idea may be rejected during the company decision-making process. Vague hopes that what is merely a secondary core business today could eventually develop into something valuable may engender opposition to such a bold step as a carve-out. Japan's corporate captains are all unanimous about the importance of MOT in principle, but when it comes to specifics they tend to hesitate. As already noted, the Japan Techno-Economics Society, an association of chief technology officers (CTOs) from Japan's leading manufacturers, has been discussing the subject of carve-outs as a means of promoting R&D, and METI has organized a Spin-Off Study Team. The need for carve-outs and spin-offs is thus slowly but surely coming to be acknowledged, and the idea needs to be promoted over a broad front. The New Industry Creation Strategy, which was referred to the Council on Economic and Fiscal Policy in May 2004 and ultimately incorporated into the government's 2004 "large-boned" policy blueprint, also calls for promoting ventures and spin-offs (including carve-outs) by large corporations. The idea will, it is hoped, percolate throughout Japanese society.

(2) Create a win-win situation for both parent firm and new investors

The parent firm should consider strategies for ensuring the management autonomy of the company that it carves out, and for guaranteeing that it has the freedom to develop its own sales channels. One way to accomplish that would be for the parent firm to own less than a 50% stake. Tapping outside capital and investment funds would be an effective means to that end. Conceivable sources of such new investment might include industrial investors with connections to the carved-out business, funds such as carve-out funds, companies in a similar line of business, and client firms. Thus what is needed is a mechanism that creates a win-win situation for both the parent firm that makes the carve-out and those who newly invest in it.

(3) Formulate a clear exit strategy and enshrine it in the shareholders' agreement

In the case of a venture fund or private equity fund, the exit strategy -- where the venture ends up upon success -- is relatively clear, typically entailing either an IPO or M&A. A carve-out, too, has a good chance of ending in an IPO or M&A, but another major option in terms of exit strategy is a "spin-in" or "buy-back" -- i.e., the parent firm reacquires the carve-out. In such cases the general practice would be to conduct the buy-back at the current market price. In some cases, however, one option might be for the parent firm and the fund (or whatever) to conclude a shareholders' agreement at the time of the carve-out that presupposes a spin-in or buy-back.

(4) Encourage mobilization of intangible assets including human resources

Today many Japanese companies try to mobilize assets as a way of tapping into their fixed assets and accounts receivable. It is becoming common for companies to transfer ownership of buildings in their possession to a special-purpose company (SPC) registered in, say, the Caymans as a way of getting those assets off their own balance sheet and thus improving their ROE and ROA. It is also common to mobilize assets upon ensuring that conditions of true sale and bankruptcy remoteness are fulfilled. Carve-outs can be analyzed on the same analogy. As hardly needs pointing out, mobilizing intangible assets like intellectual property (IP) and human resources like engineers will enable more effective use to be made of the IP and engineers that lie dormant inside big companies, which in turn will help reinvigorate the Japanese economy. The carve-out is a tool for accomplishing that end. It is to be hoped that, just as big corporations have used mobilization of assets and asset finance as tools for improving management efficiency, they will now take aggressive steps to mobilize their intangible assets. Indeed, if mobilizing intangible assets comes to be seen as the next big tool in improving management now that mobilization of fixed assets has run its course, a wave of it could instantly sweep across Japan. In asset finance, certain terms and conditions are order-made in favor of the originator (the firm from which the venture stems), such as right of first refusal; developing new financing techniques similarly customized to the wants of the parent firm would be one way to help promote carve-outs.

(5) Provide hands-on support to carve-outs

As a rule, what is carved out from the parent firm consists mainly of IP and the team of engineers that developed it. Naturally, marketing staff and management are usually not included in the carve-out, so they need to be supplied by the fund (or whatever) instead. Many a spin-out or management buyout (MBO) in Japan has, despite going independent with great technology, failed because it was not market-oriented, or ceased to be viable as a company in the absence of proper management. A marketing strategy for commercializing outstanding technology in a manner tailored to the market is vital, as is indeed an overall business strategy. Business is more likely to grow if the carved out staff are permanently transferred to the new firm and an adequate system of stock options and other incentives is set up. In order to provide hands-on management support, it would also be a good idea to develop an environment where access is available whenever necessary to advice from presidents of ventures that themselves have spun out or spun off from big corporations and have after much toil ultimately achieved success.

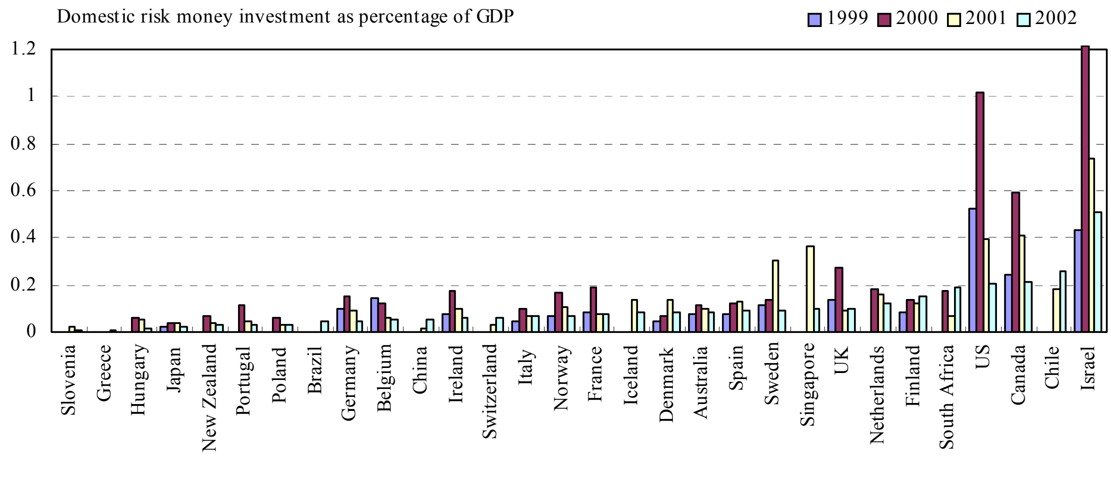
(6) Provide risk-money support in the form of carve-out funds etc.

Availability of risk money is of course vital to unleashing the technologies and engineers that lie dormant in big corporations. The total amount of money held by venture funds and the like in today's Japan is fairly small as a percentage of GDP. As the analysis is the previous section demonstrated, a carve-out is a middle-risk, middle-return proposition compared to a venture investment. That being the case, funds that cannot be risked on a venture investment but are still looking for a certain level of upside risk could be channeled into carve-outs as an alternative investment; that would give a stimulus to carve-outs per se. In that regard support from government and the like would also help due to the risk of market failure.

Figure 3-7 gives amount of risk money supplied in financial support of innovation as a percentage of GDP, as calculated by America's Babson College et al. Chapter I presented a similar comparison made by the OECD, and the results are similar. These percentages do not take account of all forms of risk money: for example, in-house financing and indirect financing are not counted. Nonetheless, one general pattern is clear: Japan suffers a particular shortage of the risk money so vital to innovation. That is one reason why it would be a good idea to establish a carve-out fund or the like to ensure the smooth supply of risk money. Public support should also be provided as needed, since at the initial stage there will be limits to how much the private sector can put up on its own.

(7) Train coordinators capable of winning over the top brass of big corporations and middle-tier firms

In the case of a carve-out, winning over the parent firm and reconciling interests with it are vital. It would therefore be a good idea to have coordinators capable of providing advice from the standpoint of someone who can be trusted to a certain extent by the parent firm as well.



Source: Compiled from "Global Entrepreneurship Monitor 2004."

Figure 3-7. Financial Support for Innovation
(Supply of risk money as a percentage of GDP)

(8) Clarify working conditions and overhaul severance pay and the pension system etc. to accommodate permanent staff transfers

Since staff are permanently transferred, clarification of working conditions and the question of severance pay and pensions are all issues that will need to be promptly resolved; these are key issues in promoting spin-offs as well. In Japan, anyone who quits his company to start a business or join another firm will in many cases lose out on severance pay and pensions. Here, surely, and in the whole Japanese mentality of wanting to work for a big company, lies the reason why few engineers ever start their own business once they land a good job with a large firm.

(9) Streamline and standardize rules for on-the-job inventions, as well as confidentiality agreements and non-compete requirements

As exemplified by the lawsuit over blue light emitting diodes between Professor Shuji Naka mura of the University of California at Santa Barbara (UCSB) and Nichia Corporation, inventions made on the job constitute a massive concern. Some companies offer a standard reward of ¥50,000 for inventions, while in other cases the courts may award as much as ¥20 billion in payment for an invention made on the job, as happened with Nakamura. Interviews with presidents of spin-out companies reveal that they are often expressly prohibited from doing, for at least a year, any work that would place them in competition with their parent firm, or instructed not to take with them any patents for inventions made on the job. Therefore it would be best to define clearly what portion of a patent or the like belongs to the individual; it would also be wise to formulate a reasonable set of terms and conditions, acceptable to both sides, for confidentiality and non-compete agreements. As long as such matters are left vague, the risk of litigation will always hang in the air, stifling freedom of corporate activity.

If these challenges can be overcome, the carve-out and similar tools should prove invaluable as a way for large corporations and middle-tier firms that are losing their mobility and find themselves slipping into the "innovator's dilemma" to briskly commercialize their R&D findings. That in turn will, it is fervently hoped, contribute greatly to creating robust new industries and reviving Japan as an industrial power.

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