Dr. Harrison

4/12 Note to: Norm / Frank – we need to get our Fed'l strategy worked out and a plan for implementing it by Department & region of the country. (P.S. see last page)

Dr. N file

4) [redacted]S

A communications vacuum at the national level threatens the US competitive position in biotechnology. There is no evidence of a groundswell of national political support for or commitment to the biotechnology industry. This commitment is a prerequisite for the United States to compete successfully in the worldwide biotechnology industry.

At the recent AgBIOTECH '88 Conference, John F. Hussey warned biotechnology company executives not to ignore national policy makers who can support and send signals to go for it. Such signals will create a more stable environment that will allow the industry to proceed as rapidly as good science permits. Effective communications is essential to create an atmosphere of public trust. Misinformation or the lack of information can undermine public confidence in the science and derail industry's progress.

Noting that members of Congress generally share a cautious support for biotechnology, Hussey encouraged industry executives to provide objective, credible information to legislators in order to win their confidence and leadership. He called on industry to meet with governors, state legislators, state farm group directors and other state opinion leaders to generate support for biotechnology.

Hussey, former corporate vice president of public affairs for Monsanto Company, applauded the industry for its communications programs associated with field tests and new products, noting fewer incidences of demonstrations, vandalism and protests by critics.

Enter Headline numbers to read, PREVIEW, AGAIN, MORE, BACK, STOP, or HELP
-->

PAUL F. GLENN
BLACK ROCK TRAIL
SCOTTSDALE, AZ 85253

What's Ahead for Business

Edited by Howard Banks

GOVERNMENT'S R&D TREASURE TROVE

Federal spending continues to increase

SPENDING ON RESEARCH AND DEVELOPMENT IN THE U.S.—government, corporate plus universities and foundations—will total $131.5 billion in 1988, according to a new survey by Battelle's Columbus division.

That's a healthy 7% or so up on 1987 levels, but slower than the 10% to 11% national average maintained through the mid-1980s.

Slower growth this year mainly affects corporate spending. Economic uncertainty is to blame, says Battelle's Jules Duga.

Federal R&D spending, however, is slated to remain buoyant. The National Science Foundation predicts around a 10% increase over 1987, despite budget squeezes. The feds in 1988 will account for over 49% of all R&D spending (up from 46% in 1987).

The big spenders—who they are and what it's for

FOUR GOVERNMENT DEPARTMENTS DOMINATE, not surprisingly headed by the Department of Defense (about two-thirds of federal R&D spending). The others are Health & Human Services, mostly through the National Institutes of Health (around 12%); Energy (8%); and the National Aeronautics & Space Administration (7%; *see p. 101*).

Aerospace will continue to dominate. Of the $24 billion to be spent on R&D in this sector in 1988, almost 80% will be federally funded. The electrical machinery and telecommunications sectors will together spend just over $10 billion, 40% of it federally funded.

But most manufacturing sectors pay for much of their own R&D. In 1988 machinery will spend $11.9 billion (12.5% federal money); chemicals $9.4 billion (3%); autos and trucks $9.2 billion (23%); instruments $6.8 billion (15%); petroleum $2.5 billion (virtually none of it federal money); rubber $1.5 billion (16%); and food and beverages $1 billion (none).

The top ten corporate spenders? General Motors, IBM, Ford, AT&T, GE, Du Pont, Eastman Kodak, UTC, Hewlett-Packard and Digital Equipment.

Please won't somebody take advantage of us?

SPENDING BY THE 600 FEDERAL LABORATORIES and their 100,000 scientists, run by 12 government departments—$16.4 billion this year, up from $15.5 billion in 1987—is included in these totals.

An attempt is under way to encourage industry to use the results of this government research commercially. The Federal Technology Transfer Act of 1986 even allows corporations to negotiate exclusive rights to particular government research, for a share of the profits.

Individual government researchers can benefit, too, with up to 15% a year of industry's payments for the life of the patent, to a maximum of $100,000 a year. One winner is Robert Gallo of NIH's National Cancer Institute for techniques used in detecting the AIDS virus.

But this sort of example is rare. Few corporations have latched on to what should be a treasure trove—U.S. corporations, that is. Since the doors on these federal labs were opened, U.S. business visitors have been outnumbered ten to one by those from Japanese companies.

Copy to Susan, Harmon

Industrial Innovation in Japan and the United States

EDWIN MANSFIELD

Japanese firms tend to be quicker and more economical than U.S. firms at developing and introducing new products and processes, but this advantage seems to exist only among innovations based on external technology, rather than internal technology. Whereas U.S. firms put more emphasis on marketing start-up, they put much less emphasis on tooling, equipment, and manufacturing facilities than do Japanese firms. Applied R&D in Japan, which focuses more on processes than in the United States, seems to have yielded a handsome return; but there is no evidence that the rate of return from basic research has been relatively high in Japan. In robotics, the Japanese edge seems to increase as one moves from R&D toward the market.

AMERICAN TECHNOLOGICAL LEADERSHIP IS BEING SEVERELY challenged in many high-technology industries by the Japanese (*1*). Yet very little systematic investigation has been carried out to determine how much of an advantage, if any, Japan has over the United States in developing and commercially introducing the new products and processes that are central to success in these industries. Intensive empirical studies have not been conducted to compare the extent, composition, and effectiveness of the research and development (R&D) activities of Japanese firms with those of comparable U.S. firms. We do not have an adequate understanding of the differences between Japan and the United States in the rates of diffusion of many new technologies (*2*).

In this article, I summarize some of the principal results of a 2-year study, based largely on data obtained from carefully selected samples of several hundred Japanese and U.S. firms, which shed new light on these important topics. Differences between the two countries in the quickness and cost of developing and introducing new products and processes are evaluated, and the size, composition, and effects of industrial R&D expenditures in the two countries are compared. Also, the introduction and diffusion in both countries of a particular new technology, the industrial robot, are analyzed.

Table 1. Mean ratio of U.S. to Japanese innovation times and of U.S. to Japanese innovation costs, from data provided by 50 Japanese and 75 U.S. firms for 1985 (*5*).

Industry	Mean ratio of innovation times		Mean ratio of innovation costs	
	U.S. estimates	Japanese estimates	U.S. estimates	Japanese estimates
Chemicals	1.04	0.96	1.02	1.14
Rubber	1.16	1.10	1.16	1.22
Machinery	1.17	1.23	1.21	1.28
Metals	0.99	1.18	0.95	1.10
Electrical	1.03	1.42	1.04	1.32
Instruments	1.00	1.38	1.23	1.40
All industries	1.06	1.18	1.10	1.23

Time and Cost Differentials

In the chemical, rubber, machinery, instruments, metals, and electrical equipment industries (*3*), firms from both countries tend to agree that the Japanese develop and commercially introduce new products and processes more quickly than the Americans, although their advantage in this respect is not as great as is sometimes claimed. This finding is based on detailed data obtained from a random sample of 50 Japanese and 75 U.S. firms. Averaged over all six industries, the time differential in 1985 was about 18%, according to the Japanese firms, or 6%, according to the U.S. firms (Table 1). However, the picture varies from industry to industry. In some industries, like machinery, both the Japanese and U.S. firms indicate that there was a substantial differential. In other industries, like instruments, the Japanese firms indicate that there was a substantial differential, whereas the U.S. firms do not. In still other industries, notably chemicals, both the Japanese and U.S. firms indicate that there was no large differential. These data pertain to the length of time elapsing from the beginning of applied research (if there was any) by the innovator on a new product or process to the date of the new product's or process's first commercial introduction (*4*).

On the average, the Japanese also develop and commercially introduce new products and processes more cheaply than the Americans. Averaged over all six industries, the resource cost differential in 1985 was 23%, according to the Japanese firms, or 10%, according to the U.S. firms. Here too, the situation varies from industry to industry. For example, in machinery and instruments, based on both the Japanese and U.S. estimates, the cost differential seemed substantial; in chemicals, on the other hand, the U.S. firms do not indicate that any substantial differential existed. The cost figures used here include all costs to the innovator of developing and introducing the innovation. Specifically, they include the costs (before the innovation's first commercial introduction) of applied research, preparation of project requirements and basic specifications, prototype or pilot plant, tooling and manufacturing equipment and facilities, manufacturing start-up, and market-

The author is director of the Center for Economics and Technology and professor of Economics at the University of Pennsylvania, Philadelphia, PA 19104. This article is adapted from his talk at the 25th anniversary of the School of Management at Rensselaer Polytechnic Institute, Troy, NY, 27 February 1988, and from his testimony before the Joint Economic Committee of Congress, Washington, DC, 2 December 1987.

ing start-up. Because the Japanese cost figures were converted to dollars on the basis of purchasing power parities for resources used in the innovation process, they indicate approximately how much the resources used in Japan would have cost in the United States.

To understand the factors responsible for these cost and time differentials, one must recognize that some innovations are based largely on external technology (that is, technology developed outside the innovating firm), whereas others are based largely on internal technology (that is, technology developed within the innovating firm). To see whether these cost and time differentials depend on whether innovations are based on internal or external technology, I picked a random sample of 60 major Japanese and U.S. firms in the chemical industry (defined broadly to include pharmaceuticals and petroleum), the machinery industry (including computers), and the electrical equipment and instruments industries. The sample is composed of 30 matched pairs; each pair consists of a U.S. and a Japanese firm of roughly comparable size in the same industry. Every firm indicated how much time and money it devoted, on the average, to the development and commercialization of each of the new products it introduced from 1975 to 1985, depending on whether the product was based on external or internal technology. According to expert opinion, the new products introduced by each pair of firms were reasonably comparable.

Like the estimates obtained from the 125-firm sample described above, the results indicate that the Japanese tend to have significant cost and time advantages over U.S. firms. However, these advantages seem to be confined to innovations based on external technology (where the cost and time differentials are greater than those indicated above). Among innovations based on internal technology, there seems to be no significant difference in average cost or time between Japan and the United States (*5*).

Innovations Based on External Technology

As a first step toward understanding why the Japanese have cost and time advantages over U.S. firms with respect to innovations based on external technology, it is important to recognize that, according to the above data, U.S. firms take almost as long, and spend almost as much money, to carry out an innovation based on external technology as one based on internal technology. In the development part of the innovation process (beginning at the start of R&D and ending when the product is developed), a U.S. innovation based on external technology takes less time and money than one based on internal technology; but in the commercialization part (beginning when the product is developed and ending when it is first introduced commercially), the time and cost are at least as great as one based on internal technology.

In Japan, on the other hand, firms take about 25% less time, and spend about 50% less money, to carry out an innovation based on external technology than one based on internal technology. Moreover, this is true in all industries included in my study. The contrast between Japanese and U.S. firms in the commercialization part of the innovation process is particularly striking. Whereas in the United States the commercialization of an innovation based on external technology takes more time and about as much money as the commercialization of one based on internal technology, in Japan it takes about 10% less time and over 50% less money than the commercialization of an internal technology–based innovation.

Many innovations based on external technology are new products that imitate others in important respects. The relatively higher commercialization cost for innovations based on external technology in the United States than in Japan seems to have been due in part to the fact that the Japanese, in carrying out such innovations, have been more likely than the Americans to make significant technical adaptations of the imitated product and to reduce its production costs substantially. The Americans have been more inclined than the Japanese to invest heavily in marketing start-up costs in an effort to position such innovations optimally in the market, the emphasis being more on marketing strategies than on technical performance and production cost. On balance, despite the Japanese emphasis on tooling, equipment, and facilities, this seems to have resulted in relatively high commercialization costs for such innovations in the United States.

Resource Allocation in the Innovation Process

Japanese firms, in carrying out an innovation, allocate their resources quite differently than do U.S. firms. Table 2 shows the proportion of the total cost of developing and introducing a new product (introduced in 1985) that was incurred in each of the following stages of the innovation process: applied research, preparation of project requirements and basic specifications, prototype or pilot plant, tooling and manufacturing equipment and facilities, manufacturing start-up, and marketing start-up. My sample was chosen from the chemical, machinery, electrical equipment, instruments, rubber, and metals industries (*3*). It contains 50 matched pairs, in which each pair consists of a U.S. and Japanese firm of roughly comparable size in the same industry.

The percentage of total innovation cost devoted in Japan to

Table 2. Percentage distribution of innovation costs, 100 firms, Japan and the United States, 1985 (*5*).

Stage of innovation process	Japan* (%)	United States (%)
Applied research	14	18
Preparation of product specifications	7	8
Prototype or pilot plant	16	17
Tooling and manufacturing equipment and facilities	44	23
Manufacturing start-up	10	17
Marketing start-up	8	17
Total	100	100

*Due to rounding, numbers do not sum to total.

Table 3. Company R&D funds as a percentage of net sales, Japan and the United States (*12*).

Industry	Japan (1986)	United States (1985)
Food	0.8	0.4
Textiles	1.2	0.5
Paper	0.7	1.3
Chemicals	3.8	4.7
Petroleum	0.4	0.7
Rubber	2.9	2.2
Ferrous metals	1.9	0.5
Nonferrous metals	1.9	1.4
Fabricated metal products	1.6	1.3
Machinery	2.7	5.8
Electrical equipment	5.1	4.8
Motor vehicles	3.0	3.2
Other transportation equipment	2.6	1.2
Instruments	4.5	9.0
Total manufacturing	2.7	2.8

tooling and manufacturing equipment and facilities is almost double that in the United States. (Moreover, this difference is found in practically every industry in the sample.) This reflects, of course, Japan's emphasis on process engineering and efficient manufacturing facilities. On the other hand, the percentage of total innovation cost devoted to manufacturing start-up is significantly higher in the United States than in Japan. This may reflect greater difficulties in attaining desired quality levels in the United States than in Japan and the tendency of Japanese engineers to work more closely and directly with their work force than American engineers do (*6*).

Particularly striking is the difference in marketing start-up costs—that is, the expenses of pre-introduction marketing activities. In every industry in the sample, the percentage of total innovation cost devoted to marketing start-up in the United States is almost double that in Japan. If U.S. firms could reduce this percentage to the Japanese level (while holding constant the amount they spend on other stages of the innovation process), it appears that about 60% of the Japanese cost advantage would be eliminated (*7*).

Industrial R&D

Many observers are impressed by the efficiency of Japanese industrial R&D. Indeed, the president of the Semiconductor Research Corporation has gone so far as to state that: "The United States may never match Japan's R&D efficiency" (*8*, p. 40). If one is willing to accept a highly simplified, but frequently employed, econometric model (*9*), the results are consistent with the contention that applied R&D in Japan has yielded a higher rate of return (*10*) than in the United States. This contention seems reasonable, given Japan's greater emphasis on commercial (rather than government-financed) projects and its reliance on advanced technology from the West, which could be adapted and improved at relatively low cost. On the other hand, the econometric results provide no indication that basic research has been particularly effective in Japan (*11*). Based on these findings, the Japanese advantage has been confined largely to applied R&D, particularly R&D concerned with the adaptation and improvement of existing technology.

Comparison of official data in both countries shows that the R&D intensity of manufacturing firms has increased more rapidly in Japan than in the United States, which is not surprising, given the previous finding that the rate of return from applied R&D has been higher there than here. In 1986, company-financed R&D expenditures in manufacturing were about 2.7% of sales in Japan, in comparison with about 2.8% in 1985 in the United States (Table 3) (*12*). In 1970, the corresponding figures were 1.3% for Japan and 2.2% for the United States. In all industries other than machinery, instruments, paper, and petroleum, Japan has narrowed the gap substantially. In some industries (food, textiles, metals, and rubber) Japan now leads; in other industries (paper, petroleum, machinery, and instruments) the United States now leads; and in the rest there is a relatively small difference in R&D intensity.

Japanese firms seem to give users of their R&D results a more important role in shaping their R&D programs than do U.S. firms. Japanese firms seem to base about one-third of their R&D projects on suggestions from their production personnel and customers, whereas only about one-sixth of U.S. projects come from these sources. Both production personnel and customers tend to be users of a firm's R&D results. In contrast, U.S. firms seem to put more emphasis than do the Japanese on the R&D function as a generator of R&D projects. Particularly in the electrical equipment industry, U.S. firms tend to base a larger percentage of their R&D projects on suggestions from R&D personnel than do Japanese firms.

Composition of Industrial R&D

Because R&D projects are so heterogeneous, it is important to look behind the total R&D figures at the composition of firms' R&D expenditures. Fifty Japanese firms were chosen at random in the chemical, electrical equipment, instrument, machinery, rubber, and metals industries, and for each Japanese firm I picked at random a U.S. firm of the same industry and approximate size. The firms in this sample carry out about 25% of the R&D in each country in these industries. Based on detailed information obtained from each of these 100 firms (50 matched pairs), the Japanese seem to devote about as large a percentage of their R&D expenditures to relatively risky and long-term projects as do U.S. firms (Table 4). This differs greatly from the early 1970s, when Peck and Tamura characterized Japanese industrial R&D as composed very largely of "low-risk and short-term projects" (*13*).

However, it is by no means true that Japanese and U.S. industrial R&D have become essentially the same. Whereas U.S. firms report that almost one-half of their R&D expenditures are going for projects aimed at entirely new products and processes, Japanese firms report that only about one-third of their R&D expenditures go for this purpose (*14*). (Outside the chemical industry, in which there is little difference in this regard, the gap is even wider.) Of course, this is in accord with a great deal of anecdotal information to the effect that the Japanese devote more of their R&D resources to the improvement and adaptation of existing products and processes (rather than to the development of entirely new products and

Table 4. Composition of R&D expenditures, 100 firms (50 matched pairs), Japan and the United States, 1985 (*9*).

Industry	Percentage of R&D expenditures					
	Basic research	Applied research	Products (rather than processes)	Entirely new products and processes	Projects with <0.5 estimated chance of success	Projects expected to last >5 years
			All industries combined			
Japan	10	27	36	32	26	38
United States	8	23	68	47	28	38
			*Chemicals**			
Japan	11	42	48	42	24	39
United States	11	39	74	43	39	41
			Machinery,† instruments, metals, and rubber			
Japan	9	23	32	28	26	37
United States	4	9	62	51	16	36

*Including drugs. †Including electrical equipment and computers.

processes) than do U.S. firms.

Even more striking is the difference between Japanese and U.S. firms in their allocation of R&D resources between projects aimed at improved product technology and projects aimed at improved process technology. The U.S. firms in this sample devote about two-thirds of their R&D expenditures to improved product technology (new products and product changes) and about one-third to improved process technology (new processes and process changes). Among the Japanese firms, on the other hand, the proportions are reversed, two-thirds going for improved process technology and one-third going for improved product technology (*15*).

These results shed new light on a major issue concerning industrial R&D in the United States. Many observers have criticized U.S. industry for neglecting process innovation. As the President's Commission on Industrial Competitiveness puts it, "It does us little good to design state-of-the-art products, if within a short time our foreign competitors can manufacture them more cheaply" (*16*, p. 20). Contrary to the common impression that U.S. firms have in recent years begun to react to such criticism by paying more attention to process innovation than in the past, my results do not indicate that there was any perceptible increase between 1976 and 1985 in the proportion of their R&D expenditures devoted to new or improved processes. Thus, in terms of the allocation of their R&D funds, U.S. firms do not seem to have put more emphasis on processes, despite this criticism.

Industrial Robots: A Case Study

An important industry in which the Japanese are often cited as being ahead of the United States is industrial robots. Given that this is the case, it is interesting to compare the innovation process in the two countries in this industry. From data obtained from a sample of U.S. and Japanese robot producers that account for almost 90% of U.S. robot output and about 20% of Japanese robot output, it appears that the Japanese tend to be faster (by about 20 to 30%) and use less resources (by about 10%) than their U.S. rivals in developing and introducing a new robot (of comparable novelty, importance, and complexity). U.S. firms devote a much larger percentage (37% versus 10%) of innovation cost to marketing start-up, and a much lower percentage (4% versus 23%) to tooling and manufacturing equipment and facilities than do Japanese firms (*17*).

The composition of innovation costs differs between high-growth and low-growth robot producers. In both countries, high-growth robot producers tend to devote a much higher proportion of innovation costs to tooling and manufacturing facilities than do low-growth robot producers, and the proportion devoted to marketing start-up seems to be much lower among high-growth than low-growth robot producers. In this industry at least, it appears that the more successful firms in both countries, like the Japanese, tend to emphasize manufacturing in the innovation process, not marketing.

Given the oft-stated assertion that Japanese managers are often more patient than their U.S. counterparts, it is interesting to note that the proportion of R&D expenditure devoted to relatively long-term projects (those expected to last more than 5 years) does not differ significantly between the two countries—and the sample proportion is higher in the United States than in Japan (Table 5). Moreover, in contrast to other industries (as shown in Table 4), the share of R&D expenditure devoted to new products and product improvements (rather than new processes and process improvements) is higher for Japanese robot firms than for U.S. robot firms. Perhaps this is an indication that, as their technology becomes more advanced and they become world leaders in particular areas, Japanese firms will devote more resources to product R&D (relative to process R&D), and become more like U.S. firms in this respect.

In both countries, high-growth robot producers tend to be more research-intensive and technologically ambitious in their R&D programs than low-growth robot producers. The percentage of sales devoted to R&D was about two or three times as great among high-growth as among low-growth producers. The percentage of R&D expenditures devoted to research (rather than development), and the percentage aimed at entirely new products and processes, was at least twice as high among high-growth as among low-growth producers. In the robot industry, the more successful firms seem to devote a larger share of their R&D to more fundamental and technologically ambitious projects, which is likely to have contributed to their success (*18*).

Table 5. Composition of R&D expenditures, Japanese and U.S. robot producers, 1985 (*18*).

Characteristics of firms*	Percentage of R&D expenditures				
	Basic research	Applied research	New products and product improvements	Entirely new products and processes	Projects expected to last >5 years
Japanese firms	12	23	65	51	10
Large	12	24	65	53	8
Small	11	17	73	10	34
High growth	15	32	73	63	6
Low growth	6	11	51	34	12
U.S. firms	13	21	39	46	17
Large	15	23	41	44	11
Small	2	8	25	56	50
High growth	14	29	48	52	12†
Low growth	15	4	22	19	11†

*In the United States, a small robot producer is one with 1984 sales below $5 million; a large robot producer is one with 1984 sales of $5 million or more. In Japan, a small robot producer is one with 1983 sales below 800 million yen; a large robot producer is one with 1983 sales of 800 million yen or more. In the United States, high-growth producers are defined as those that had more than a 50% average annual increase in robot sales from 1982 to 1985; low-growth producers are those that had a 50% increase or less. (Of course, this is a short period, but the robot industry is very young. In one case where data were unavailable for 1982 to 1985, the growth rate had to be based on only part of the period.) In Japan, high-growth producers are those that had an average annual growth rate of sales of more than 50% during 1979 to 1984; low-growth producers are those that had an average annual growth rate of 50% or less. (In cases where data were unavailable for 1979 to 1984, the growth rates had to be based on only part of the period.) For lack of data, not all of the sample can be classified as "high growth" or "low growth." Joint ventures between U.S. and Japanese firms are omitted, since they are neither purely American nor purely Japanese. †Because of lack of data, not all of the sample can be classified as "high growth" or "low growth." This explains why both these percentages are below the figure of 17% given in this column for all U.S. firms.

The Diffusion of Industrial Robots

Although the industrial robot was largely an American invention, the rate of imitation for industrial robots in the United States was slow, relative to other major industrial innovations. On the basis of data I obtained from a random sample of 100 major firms, it took, on the average, about 12 years (from the date of first use in the relevant industry) for half of the major potential users in ten industries—autos, auto parts, electrical equipment, appliances, steel, nonferrous metals, aerospace, farm machinery, machine tools, and other machinery—to begin using robots (Table 6). In contrast, it took only about 5 years, on the average, for half of the potential users in an industry to begin using numerically controlled machine tools, an important precursor of robots (*19*).

In Japan, where U.S. robotics technology began to be transferred in the 1960s, the rate of imitation was faster than in the United States. On the basis of data I obtained from a random sample of 75 firms, it took, on the average, about 8 years (from the date of first use in the relevant industry) for half of the major potential users in four industries—autos, electrical equipment, metals, and machinery—to begin using robots. In both the United States and Japan, the imitation process can be represented reasonably well by a simple econometric model I suggested a number of years ago (*20*). According to the results, Japan's higher rate of imitation can be explained entirely by its later start, which enabled it to use earlier experience in the United States and elsewhere.

Turning from the rate of imitation (the growth over time in the number of firms using robots) to the intrafirm rate of diffusion (the growth over time in the number of robots used by a firm), it seems clear that the intrafirm rate of diffusion has tended to be much greater in Japan than in the United States. In my sample, the number of robots used per 10,000 employees in 1985 was about four to eight times as great (depending on the industry) in Japan as in the United States (*21*).

In considerable part, this observed difference in robot use between Japan and the United States seems to be due to differences in the minimum rate of return required to justify investing in robots. Whereas the Japanese often invest in robots yielding returns of 20%, U.S. firms frequently insist on 30% or more. This difference in minimum required rates of return has been noted in other studies as well, and it may reflect a tendency, cited by Kaplan (*22*) and others, for U.S. firms to exaggerate their cost of capital. On the basis of data I obtained from the Japanese firms in the sample, it seems that, if they had applied the same "hurdle rates" as their U.S. rivals, their robot use would have fallen by 50% or more.

Table 6. Number of years before half of major potential users introduced robots, Japan and United States, by industry (*19*).

Industry	Number of years
United States	
Autos and trucks	15
Auto parts and equipment	8
Electrical equipment	17
Appliances	19
Nonferrous metals	20
Steel	3
Farm and construction machinery	18
Machine tools and industrial machinery	16
Other machinery*	1
Aerospace	7
Mean	12
Japan	
Autos	6
Electrical equipment	2
Metals	9
Machinery	15
Mean	8

*Because the sample in this industry is small, this result should be treated with considerable caution.

Conclusions

At least five conclusions seem to follow from the studies described above. First, with respect to the differences between the two countries in innovation cost and time, the situation is much more varied and complex than is generally portrayed by the largely anecdotal accounts that have begun to appear. Whereas the Japanese have substantial advantages in this regard in some industries (notably machinery), they do not seem to have any substantial advantage in others (notably chemicals). Whereas they have very great advantages in carrying out innovations based on external technology, they do not seem to have any in carrying out innovations based on internal technology.

Second, a large part of America's problem in this regard seems to be due to its apparent inability to match the Japanese as quick and effective users of external technology. As Brooks has warned, "The United States, so long accustomed to leading the world, may have lost the art of creative imitation" (*23*, p. 17). This is not to deny that part of the Japanese advantage may be due to factors like their propensity to overlap various stages of the innovation process, their subcontractor network, and their fewer organizational barriers and better communication between functional departments of firms. But the fact that the Japanese advantage tends to be limited to innovations based on external technology suggests that it is in this area that many central problems lie.

Third, part of these problems may be related to the differences between Japan and the United States in the way resources are allocated in the industrial innovation process. Whereas U.S. firms emphasize marketing start-up to a much greater degree than do the Japanese, they put much less emphasis on tooling, equipment, and manufacturing facilities than do Japanese firms. Perhaps U.S. firms might consider whether they safely can reduce the cost and time devoted to marketing start-up without impairing the vital interface between R&D and marketing. Although it would be foolish for the United States, which has long been at the forefront of industrial innovation to attempt mindlessly to mimic the Japanese, it would also be foolish not to try to learn from them.

Fourth, my results, which are subject to many limitations detailed elsewhere (*9*), support the contention that applied R&D in Japan has yielded a handsome return, higher than in the United States. In large part, this can be explained by Japan's greater emphasis on commercial (rather than government-financed) projects, by its ability to obtain Western technology that was more advanced than its own, and which could be adapted and improved at relatively low cost, and by its emphasis on process technology, which according to many experts has tended to be neglected in the United States. On the other hand, there is no evidence that the rate of return from basic research has been relatively high in Japan. Apparently, the Japanese advantage has been confined largely to applied R&D, particularly R&D concerned with the adaptation and improvement of existing technology.

Fifth, my results concerning robotics, an important area where the Japanese currently seem to have an edge, suggest that the Japanese advantage increases as one moves from R&D toward the market. Whereas the Japanese seem to be quicker and more efficient innovators, they do not seem to be more effective at R&D. Whereas they have introduced many more robots than U.S. firms, they have not been quicker to begin using them (when account is taken of their later start). If, as many observers claim, U.S. industry has not used robots as fully as it should, the principal fault does not seem to lie with U.S. R&D. Instead, this case seems to illustrate the contention that, in those areas where the United States is falling behind competitively, it is due frequently to problems not so much in R&D or inventiveness, but in the commercial application of science and technology.

REFERENCES AND NOTES

1. For important studies of the relation between technological change and economic growth, see E. Denison [*Trends in American Economic Growth* (Brookings Institution, Washington, DC, 1985)] and J. Kendrick [J. Kendrick, Ed., *International Comparisons of Productivity and Causes of the Slowdown* (American Enterprise Institute/Ballinger, Washingon, DC, 1984)].
2. For two articles dealing with the competitiveness of U.S. industry, see S. Cohen and J. Zysman [*Science* **239**, 1110 (1988)] and L. C. Thurow [*ibid.* **238**, 1659 (1987)].
3. The chemical industry referred to in this section includes pharmaceuticals; the machinery industry includes computers.
4. The overall U.S.–Japanese differences in Table 1 are highly significant in a statistical sense; the all-industry mean ratios differ from 1.00 at the 0.01 probability level. This is also true for many of the figures in the machinery, instruments, and chemical industries, but in other industries like metals and rubber, many of the figures are based on relatively few observations. Note too that, although the estimates in Table 1 were based on reasonably precise data concerning the firms' own times and costs, they sometimes had to be based on the best judgment of the firms' leading executives concerning their rivals' times and costs. The data in my 60-firm sample described later in this article are free of this problem.
5. For a more detailed account of the studies in this and the next two sections, see E. Mansfield (*Manage. Sci.*, in press).
6. It may also be related to the fact that the percentage of innovation cost devoted to tooling and manufacturing equipment and facilities is lower in the United States than in Japan.
7. For all industries combined, the difference between Japanese and U.S. firms in the percentage of innovation cost devoted to tooling and manufacturing cost and facilities, as well as the difference between them in the percentage devoted to marketing start-up costs, is statistically significant at the 0.01 probability level.
8. L. W. Sumney and R. M. Burger, *Issues Sci. Technol.* **3**, 32 (summer 1987).
9. For this model as well as a more detailed account of the studies described in this and the next section, see E. Mansfield [*Am. Econ. Rev.* **78**, 223 (1988)].
10. As pointed out in (*9*), this rate of return pertains to entire industries, not to particular firms, in Japan and the United States.
11. The National Science Foundation's definitions of basic research, applied research, and development are used here.
12. Bureau of Statistics, *Report of the Survey of Research and Development in Japan* (Bureau of Statistics, Tokyo, 1987); National Science Foundation, *National Patterns of Science and Technology Resources, 1987* (Government Printing Office, Washington, DC, 1988). G. Saxonhouse translated the Japanese material.
13. M. J. Peck and S. Tamura, in *Asia's New Giant*, H. Patrick and H. Rosovsky, Eds. (Brookings Institution, Washington, DC, 1976).
14. Of course, the distinction between an entirely new product or process and an improved or modified product or process is often arbitrary (although it frequently is used).
15. Among the large R&D spenders (top 20%), this difference between U.S. and Japanese firms is significant at the 0.01 probability level. From the point of view of the economy as a whole, a large proportion of the resources allocated to product technology in the United States really goes for processes, since one firm's products frequently are parts of another firm's processes. Thus, this difference between Japan and the United States reflects a difference in how much of the process R&D for a given product is carried out by the producers of the product and how much is done by equipment producers and other suppliers of the producers of the product. As many observers have stressed, there can be disadvantages in leaving this sort of R&D to the latter firms. (Of course, the observed U.S.-Japan difference in this regard is due partly to differences in industrial and firm structure.)
16. President's Commission on Industrial Competitiveness, *Global Competition: The New Reality* (Government Printing Office, Washington, DC, 1985).
17. These U.S.–Japanese differences are statistically significant. For a more detailed account, see E. Mansfield (paper presented at Symposium on Research and Development, Industrial Change and Economic Policy, University of Karlstad, Sweden, June 1987). Also, see R. Ayres, L. Lynn, and S. Miller [in C. Uyehara, Ed., *Technological Exchange: The U.S.–Japanese Experience* (University Press of America, Washington, DC, 1982), pp. 77–115].
18. E. Mansfield, *Manage. Decis. Econ.*, in press. For the statistical significance of these differences, see E. Mansfield in (*17*).
19. ———, "The diffusion of industrial robots in Japan and the United States" (working paper, Center for Economics and Technology, University of Pennsylvania, Philadelphia, 1987).
20. ———, *Econometrica* **29**, 741 (1961).
21. Also see K. Flamm [*International Differences in Industrial Robot Use* (Brookings Institution and Development Research Department, World Bank, Washington, DC, May 1986)].
22. R. Kaplan, *Harv. Bus. Rev.* **64**, 87 (1986). According to some economists, the cost of capital is higher in the United States than in Japan. This too might account for the higher hurdle rates in the United States than in Japan.
23. H. Brooks, *Japanese Technological Advances and Possible United States Responses Using Research Joint Ventures.* Testimony before Subcommittee on Science, Research and Technology of the House Committee on Science, Space, and Technology, 98th Cong., 1st sess., 29 to 30 June 1983.

24. The research on which this article is based was supported by grants from the National Science Foundation, which, of course, is not responsible for the views expressed here.

Three Gloomy Reports on US Industrial Prospects Issued by OTA

In the Washington report-writing industry, it's a boom season for dour productions on the ineptitude of American industry. Checking in with the following new trio in this genre is the Congressional Office of Technology Assessment (OTA), whose topics of study directly reflect Capitol Hill's concerns:

Advanced Materials by Design (GPO Stock No. 052-003-01095-0, 353 pp., $14), reports that US industry is mainly sitting on the sidelines, waiting to see whether research on exotic materials can be used in saleable products, while Japanese manufacturers are closely involved with early efforts at commercializing the next generation of composites and ceramics. OTA notes that a large part of the US effort is financed by and focused on the needs of the Pentagon, and that "By a margin of 2 to 1, the US ceramics companies interviewed by OTA felt that Japan is the world leader in advanced ceramics R&D."

Commercializing High-Temperature Superconductivity (GPO Stock No. 052-003-01112-3, 106 pp., $8), reports that "American companies may already have begun to fall behind." OTA adds that "Japanese firms have been much more aggressive in studying possible applications of HTS (high-temperature superconductivity), and have more people at work, many of them applications-oriented engineers and business planners charged with thinking about how to get HTS into the marketplace."

Paying the Bill: Manufacturing and America's Trade Deficit (GPO Stock No.052-003-01124-7, 88 pp., $4), notes that "US pre-eminence in many manufacturing fields has evaporated," and one big reason is that "American manufacturers have fallen behind in the practical application of technology."

OTA doesn't prescribe for its Congressional clients. But the options offered in the three reports include closer collaboration of the federal, academic, and industrial sectors, expanded efforts to extract industrial value from military R&D, and increased federal financing of research in industry.

Superintendent of Documents, USGPO, Washington, DC 20402; tel. 202/783-3238.

Job Changes & Appointments

Anne G. Keatley, Executive Director for Government and Public Affairs, National Academy of Sciences, has been appointed Director of Institutional and External Affairs at the Carnegie Institution of Washington, effective August 1.

Eric Fischer, formerly with the Senate Budget Committee as a Congressional Fellow of the American Association for the Advancement of Science, has been appointed Deputy Director of the Smithsonian Tropical Research Institute. Fischer was formerly on the faculty of the University of Washington (Seattle). He succeeds ***James R. Karr,*** who has been appointed Professor of Biology at Virginia Polytechnic Institute and State University, Blacksburg, Va.

Thomas L. Poulos, Professor of Biochemistry, University of Maryland, has been appointed Director of the Center for Advanced Research in Biotechnology (CARB), jointly sponsored by the University, the National Bureau of Standards (NBS), and Montgomery County, which borders on Washington, DC. ***Walter J. Stevens,*** a computational physicist at NBS, has been appointed Deputy Director of CARB, one of four research centers in the Maryland Biotechnology Institute, which aims to nurture high-tech industrial development.

Howard J. Silver has been appointed Executive Director of the Consortium of Social Science Associations, a Washington-based lobby that represents social and behavioral sciences scholarly and professional organizations.

Silver has held the post on an acting basis since the resignation last January of ***David Jenness.***

Medical Award Honors NCI Head for Developing Hodgkins Therapy

Vincent T. DeVita Jr., Director of the National Cancer Institute, has been named the first recipient of a $150,000 prize established by the Pezcoller Foundation of Trento, Italy, to honor outstanding medical researchers. DeVita was cited for the development of treatments for Hodgkins Disease and diffuse large-cell lymphomas. The award, to be given every three years, is financed by Alessio Pezcoller, now age 90, for many years a cancer surgeon in Trento, and a major bank in that city. The award selection was made by an international committee of medical reseachers.

SGR Wins Investigative Prize

Science & Government Report has been named the first recipient of a new prize for "exclusive or investigative reporting" by newsletters.

The award was for SGR's coverage of fraud charges against Stephen E. Breuning, a research psychologist accused of fabricating data on tranquillizer dosage for retarded children (SGR March 15, April 1, 1987). Breuning's research was branded fraudulent by the National Institute of Mental Health and he was subsequently indicted on federal criminal charges. He has denied any wrongdoing.

The newsletter prize, $1000, is sponsored by the National Press Foundation, an independent, non-profit organization that annually awards prizes in various categories of journalism.

Political Heat Rising on Sharing of Federal R&D Funds?

From Equity, Excellence, and the Distribution of Federal Research and Development Funds *(88 pp.), an analysis prepared for Congress by William C. Boesman and Christine Matthews Rose, staff members of the Science Policy Research Division, Congressional Research Service, Library of Congress.**

•

In addition to the comprehensive universities, there are approximately 182 research institutions falling outside the "top" 100 universities [in receipt of federal R&D funds], that are qualified to conduct cutting-edge research. Major discoveries made in the field of high-temperature superconductors . . . occurred at the University of Houston and the University of Alabama, Huntsville. The University of Alabama received $3.2 million in Federal support for science and engineering while the University of Houston received $7.9 million for R&D in fiscal year 1985. In comparison, Johns Hopkins University and the Massachusetts Institute of Technology, both "top-100" institutions, received $429.2 million and $187.7 million, respectively.

Proponents arguing for "geographical equity" in dispersion of Federal science funds contend that policies and programs should be established to strengthen and maintain strong science programs at these 182 research institutions. These "non-elite universities," or "second- and third-tier universities" as described by David Eli Drew, Claremont Graduate School, ["Finest Science Not Always Found in the Fanciest American Universities," *Los Angeles Times*, October 18, 1987], are receiving a small fraction of Federal R&D funding while productively engaged in basic research. These institutions, along with the comprehensive institutions, are employing many doctoral science faculty members from the top 100 institutions from which they graduated . . . . Proponents maintain that the present institutional concentration of Federal science funds has failed to respond to shifts in the distribution of scientific talent. The best researchers and the best ideas are not necessarily limited to the leading institutions.

[Whatever] the merits of the peer/merit review system, and there are many, that system is intended to select the best proposals for scientific research from among those available mainly on the basis of present scientific merit regardless of extraneous factors, including geographical considerations. Thus, the peer/merit review system is likely to reinforce the existing geographical distribution of R&D funding to scientific institutions as long as it correlates with the distribution of research excellence.

•

[Various data suggest] that a relationship exists (whether causal or derivative is unknown) between Federal R&D funds expended in a State and the economic level of the State as measured in terms of per capita personal income . . . . [Of] the 17 States having per capita personal income at or above the US average in 1985, 10 also received Federal R&D funds above the US average per capita level. Perhaps even more significantly, of the 34 States having per capita income below the US average, 31 also received Federal R&D funds below the US average per capita level.

While much more than Federal R&D funds expended in a State determine its relative economic development, patterns [of distribution of Federal R&D funds] suggest that the concerns of State and regional policymakers about the importance of R&D to their State may not be misplaced. Such patterns also suggest that the unequal distribution of R&D funds may become more of a political and economic issue in the future than it has been over the last couple of decades.

**Reports produced by the Congressional Research Service are directly available only to members of Congress. But the legislators and their staffs routinely fulfill outside requests for copies. To get this one, specify that it's a report from the Congressional Research Service, give the full title and the identifying document code: 88-422 SPR. The main Capitol switchboard number is 202/224-3121.*

Science & Government Report
Northwest Station
Box 6226A
Washington, D.C. 20015

Second class postage paid at Washington, D.C.

Memo To: Bill MIles 9/2/88

From: Norm Latker

Subject: How USET Can Take Advantage Of The U.S.SBIR Program.

As you know,the SBIR legislation requires that every Federal Agency conducting R&D above an identified funding level set aside 1&1/2% of their R&D budget to fund small business R&D proposals which are responsive to Agency solicitations. While solicitations are aimed to solve Agency problems,they have been sufficiently broad to presume that a home could be found for most technology USET controls. I calculate that the amount of funding available to small businesses under the program is something in the order of 600,000 million dollars (1&1/2% X 40 billion dollars).The the 40 billion is derived from subtracting the 25 billion spent on Agency intramural programs which are not subject to the legislation from the 65 billion appropriated for the entire government R&D program.

SInce the law has been intrepreted to exclude universities and its investagators as "small businesses",organizations such as USET are in an ideal position to move its university technology through the innovation process by licensing small business looking for technology to develop with SBIR funding. Indeed given the continued development of our SBIR database we could within short order identify the small businesses who have been most successful in competing for SBIR. We could further start with those small businesses closest to the university client creating the technology. (I would add inferentially that their is little likelihood that the exclusion of universities from the direct benefits of the program will be soon reversed since the university community openly and vigorously opposed this legislation.) Even though a university or its investagators cannot be recipients of SBIR awards, half of a second phase award can be subcontracted by a small business awardee to a university. Second phase awards can run between $250,000 and $500,000. Indeed we could condition the licensing of a small business on their subcontracting part of their SBIR award to the university who created the technology.

Other factors make undertaking this approach attractive. Investagation indicates that SBIR awardees can use their funding to file patent applications. Universities are precluded from using grant awards for this purpose. GIven appropriate timing we might be able to pass on to the SBIR awardee the responsibility to protect the licensed technology with award funds.

Even the current belief that the inability of small business to obtain product liability insurance makes them unreliable licensees, seems to work to our benefit in the SBIR situation. The university community does not seem to recognize that the small business can be used as a vehicle to obtain SBIR funding for value added research and their marketing of a resulting product conditioned on obtaining product liability insurance. If they cannot,the product can be licensed to a company that can, subject to part of the royalty being shared with the small business.

As you know the Bayh-Dole bill (P.L.96-517) provides for small business ownership of resulting patentable inventions. The SBIR bill (P.L.97-219) goes a step further and provides for ownership of technology data which translates into permiting the small business creator to keep some ideas as trade secrets. (This was one of the contributions I made to the Act.) This could be important in the context of improving university software with SBIR funding.

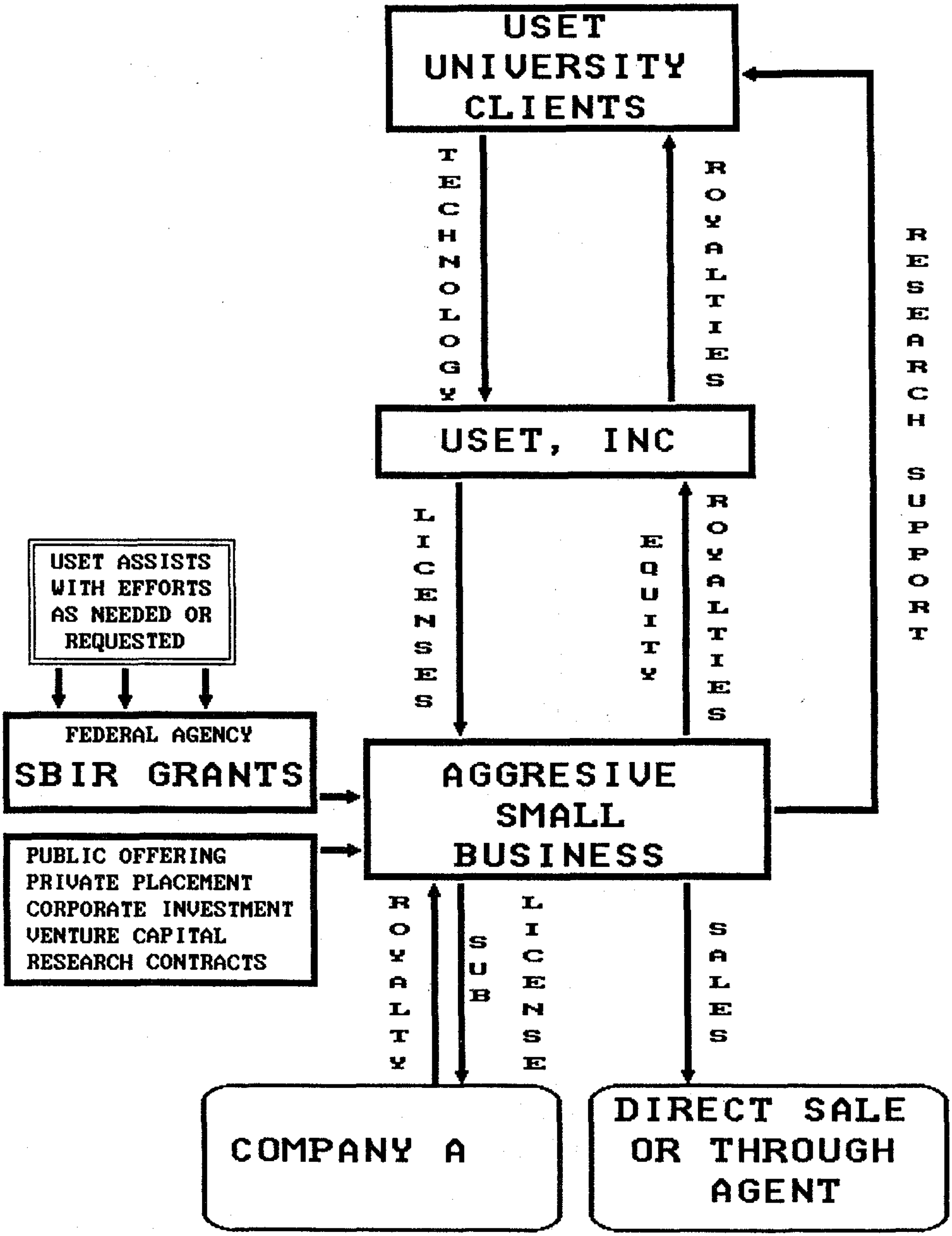
My interest in SBIR was peaked by a visit from Bill Partridge, the President of Utah Bioresearch. Bill's interest is our management of a number of interesting patented inventions which appear to have at best limited markets. While reviewing them with him it became evident that each had attracted SBIR funding including phase 2. On the basis of this I asked whether Utah would be interested in some of USET's technology as the focus of An SBIR award. He said he was "intrigued" with the offer and has since indicated that ~~the~~ he, representing Utah, would like to meet with you on both we manageing their technology and they being a licensee under our technology. In our discussions he did not appear to have any problem with some of the license conditions noted above, i.e., subcontracting a part of the SBIR funding back to our university client. Unfortunately you will be out of town at a time he was available in Westport.

I am attaching a schematic that Jim Liverman and I created to simplify what we think USET should be considering. We believe this to be a Win-Win possibility that could give USET a very positive new image with clients and the technology community. I would like to proceed with getting the 10,000 SBIR awardees online so that we can find out their location and who are multiple winners. I would consider this a stand alone exercise from the T.I.C. database since it has the potential of assisting technology management in Westport now. It seems to me that it will also assist T.I.C. later since most of the SBIR data is available only in hardcopy.

Attachment

CC: Bob Siegel
Carl Wootten

P.S. I discussed this with Bob and Carl — You should make appointment with Bill Partridge if interested — I have gone through SBIR data and found a number of multiple winners who I dealt with during the legislative process.


USET UNIVERSITY CLIENTS
TECHNOLOGY
ROYALTIES
RESEARCH SUPPORT
USET, INC
LICENSES
EQUITY
ROYALTIES
USET ASSISTS WITH EFFORTS AS NEEDED OR REQUESTED
FEDERAL AGENCY
SBIR GRANTS
AGGRESIVE SMALL BUSINESS
PUBLIC OFFERING
PRIVATE PLACEMENT
CORPORATE INVESTMENT
VENTURE CAPITAL
RESEARCH CONTRACTS
ROYALTY
SUB
LICENSE
SALES
COMPANY A
DIRECT SALE OR THROUGH AGENT

MEMORANDUM

TO: Mr. Bill Miles
Bill

FROM: Mr. Norman Latker
Nor

SUBJ: Retreat Subjects

DATE: October 14, 1988

The following are items that you may wish to discuss or may be quizzed about on retreat next week. We have discussed all these matters so no detail is provided.

1) On-line database.
2) In-house database.
3) SBIR.
4) University R&D Directory.
5) Physical location of Washington office.
6) SUPA Journal.
7) Possible acquisitions:

    a) Inside R&D.
    b) Dvorkowitz.
    c) Lloyd Patterson, Inc.
    d) NERAC.

8) USET Involvement with Maxwell Foundation (including contract guiding, conduct of research activities).
9) Smithsonian and Maryland Biotech Institute.
10) New clients (foreign and domestic).

NL:srn

University Science, Engineering
and Technology, Inc.
8000 Westpark Drive, McLean, VA 22102
Tel: 703/821-2030 Fax: 703/821-2049

MEMORANDUM

Bill

TO: Bill Miles

Norm

FROM: Norman Latker

DATE: November 18, 1988

SUBJECT: "TECHSTART International"

Enclosed are the advertising materials for "TECHSTART International", another of the growing list of companies identified that solicit abstracts of current technology on a specified format, create an in-house database and then sell handcopy access to the technology areas that subscribers have indicated an interest in.

The following companies are generally following the same approach as TECHSTART:

Technology Catalysts
NERAC
Lloyd Patterson, International
Dr. Dvorkowitz and Associates
Technology Insights (Inside R&D)
Biomedical Business International
(BBI is now part of MCC through McMillan acquisition.)

Each company has some characteristics that distinguish them from the others.

Technology Insights and BBI disclose their technology by newsletters. BBI limits itself to the Life Sciences and also has a conference capability.

Technology Catalysts claim that its database has much technology from small businesses and also discloses through conferences. Technology Insights puts great emphasis on reviewing the Patent Office's weekly Gazette for new patents with high technology potential.

Lloyd Patterson has only twenty one clients which he services on a very personal basis including small conferences.

NERAC searches not only its own database, but other on-line databases to address specific technology problems.

Dr. Dvorkowitz is franchising his database overseas and solicits a great deal of foreign technology. He recently sold his conference capability.

While, in theory, all the companies have access to all technology sources, it does not appear that any one company has attempted to get their arms around all sources. Their appears to be little evidence that the federal laboratories are being tapped to any great extent. Their is a surprising amount of technology available from industry sources.

With the possible exception of Technology Catalysts, there is no evidence that these companies have tapped the SBIR abstracts.

As best as I could determine, all the companies are running in the black. While this is in no means an exhaustive study of the companies reviewed, it should assist in designing any service we intend to provide around a technology database.

At the appropriate time, we certainly need to discuss in greater depth what technology sources should be pursued and the process for that pursuit. That will necessarily require an understanding of what resources are needed and available. Part of this discussion should include the possibility that an integrated Orbit, USET and BBI could provide a better product than the separate components.

cc: Mike Behar

University Science, Engineering
and Technology, Inc.
8000 Westpark Drive, McLean, VA 22102
Tel: 703/821-2030 Fax: 703/821-2049

September 28, 1988

Jim L.

Richard Carlin
TIC
2900 Wilcrest
Suite 400
Houston, TX 77042

Dear Richard:

Enclosed herewith are:

1. The following SBIR Abstracts of Awards:

Department of Agriculture
SBIR Technical Abstracts - 1986
SBIR Technical Abstracts - 1987

Department of Commerce
SBIR Abstracts of Phase I Awards - 1987
SBIR Abstracts of Awards - 1988

Department of Defense
SBIR Abstracts of Phase II Awards - 1985
(Army) SBIR Abstracts of Phase I Awards - 1987
(Navy) SBIR Abstracts of Phase I Awards - 1987
(Air Force) SBIR Abstracts of Phase I Awards - 1987
(Defense Agencies) Abstracts of Phase I Awards - 1987

Department of Education
SBIR Abstracts of Awards - Phase I - 1987
SBIR Abstracts of Awards - Phase II - 1987

Department of Energy
SBIR Abstracts of Phase I Awards - 1987

Environmental Protection Agency
SBIR Abstracts of Phase I and Phase II Awards - 1983-1985
SBIR Abstracts of Phase I and Phase II Awards - 1987

Health and Human Services
SBIR Abstracts - Phase I and Phase II Awards - 1987

National Science Foundation
SBIR Abstracts of Phase I Awards - 1985
SBIR Abstracts of Phase I Awards - 1987

Solutions Thru Technology

2. Small Business Administration
   Listing of all SBIR Awardees - 1987

3. Abstracts of inventions recommended by NBS to DOE for funding under the Energy-Related Inventions Program; and,

4. Executive Summaries of Technology from UTC clients.

I estimate that the materials in 1 and 2 identify approximately 10,000 technologies that have been either recommended or have been granted funding through a government evaluation process. There are approximately 180 technologies in the UTC portfolio. Note that the UTC abstracts do not follow a consistent format, which could require some reorganization of information on your part. Under separate cover, I will be sending you the electronic version of the HHS hard copy segment identified in No. 1 above since the electronic version contains more information than that found in the hard copy version. With these materials and FEDRIP I believe that we have the beginnings of the database we've discussed.

When organizing this information I believe that FEDRIP should be broken up into at least Grants and Contracts since these categories represent different stages of the innovation process. That is also true of Phase I and Phase II of the SBIR Abstracts provided which are already categorized as either Phase I or Phase II. You should carefully review the Energy-Related Inventions abstracts for categorization within the innovation process. Roughly, they appear to be similar to the abstracts you will find in Phase I or Phase II of the SBIR awards.

Databases we are still seeking, but are not yet available are:

1. The United Kingdom Research in Progress, or BEST Database, which as defined to us is a rough equivalent of FEDRIP and is possibly available electronically through Pergamon Orbit;

2. The UPI equivalent of the UTC Executive Summaries;

3. The Dvorkovitz World Technology Database;

4. Pergamon Orbit's on-line technology databases, for example, AQUALINE and RAPRA;

5. Technology from federal laboratories, whether contractor or employee managed, and technology from non-client universities. To some extent the Dvorkovitz database, if acquired, would bring us some non-client (domestic and foreign) university technology and technology from foreign government databases; and,

6. Technology obtained through solicitation of editors of Pergamon journals. While we have requested that Robert Maxwell contact the journals on this matter, the draft letter provided has not yet been sent.

Many problems are attached to the acquisition of the six databases identified above and no definitive time can be predicted as to when acquisition can be completed. In addition, a great deal of work remains to be completed in assuring the continuous flow of information from the databases enclosed with this letter. Identification of those problems and how they might be resolved will be more easily addressed as you begin inputting the materials in your possession.

Sincerely,

Norman J. Latker
Vice President
USET

NJL:rk
cc: Bill Miles

Enclosures