

Anybody listening?

My wife talks about my former incarnation when I was a research director as "back in the days when you used to work for a living." I hear this a lot when I go off on dandy trips on which she can't accompany me. (She has this second grade class, see, and . . .)

Anyway, all at once several stimulating conferences bunched up on me. From some we got full papers, which you'll see soon. But others just gave me a notebook full of nuggets. Here they are, unpolished.

Since my mind wanders when I listen "too much" I write down some of my own thoughts. They're in italics. Enjoy!

BJK

"Tenure loses a certain appeal if the university can't pay your salary."

Alvin W. Kwiram
University of Washington
Addressing the ACS President's
Conference on Professionalism

Think about teaching a class of 400.

"In most companies, the priorities of the two disciplines are different. To oversimplify, the R&D people take a long-term view and think in terms of technological achievements and patent opportunities. Rightly so. The marketing function tends to seize on shorter term opportunities and sometimes operates from a 'Get the money and run' perspective. In pure terms, neither one always focuses on the consumer—her needs, her feelings."

E. Peter Raisbeck
Group V.P. Product Management Avon Corp.
Addressing the Conference Board

The telling characteristic of the responsible technical person is not how he works but on what. Selecting the right project is usually more crucial than how well one dispatches the work. Given the right opportunity many can bring off the experimentation and data-gathering.

"We can find an enzyme that can do anything that chemists can do. From there it's just a matter of cost."

William F. Amon, Jr.
Vice President Cetus Corporation
Addressing the Commercial Development
Association/Licensing Executives Society

It's not enough to design the plant before you design the pilot plant. You ought to design the market, too, especially if you have a new marketing concept, for example, the Xerox machine or the Polaroid camera. Membrane separation is like that.

Seminal thoughts from Robert N. Hamilton, Vice President of Norton Abrasives, addressing the Conference Board:

"Listening is silent flattery."

"We've been teased about having abrasives salesmen."

"The distributor is like the third leg on a milking stool."

"Nobody ever lost his job while listening."

Calvin Coolidge

Does anybody remember whether Calvin Coolidge got a second term?

In introducing the subject of technology transfer and corporate development, Norman A. Jacobs, president of Amicon had this to say to the CDA/LES:

"Technology is the total knowledge required to produce and sell a product or a service at a profit or any significant element of that knowledge."

"The value of technology is inversely proportional to the number of organizations which possess the same or equivalent knowledge. (Ed.: the proportionality constant has more to do with the market's perception of the value of technology than it does with the cost to develop it.)"

"The owner of technology must develop a consistent strategy for its use and protection. That strategy must explicitly include licensing."

Cub scouts in cub packs and chemists in ACS both ask "Why join?" There are things that you can do together that you can't do alone. In the case of cub scouts, it's going to ball games and running pinewood derbies, using profits from cookie sales for charity, and learning how to wrestle. In the ACS it could be all these things and more, but it's more than subscribing to periodicals.

Some people say that academic faculty have to be entrepreneurial today. That's not quite the modern view of entrepreneurship. The ancient view of entrepreneurship was one person against the world, the individual frontier craftsman who did everything by himself. That kind of entrepreneurship doesn't work very well today. As it's been said, "You don't start vast projects with half-vast ideas." To get anything done today in an innovative way requires teams of people. Perhaps that's why the lone academic, although he or she has to strive for personal upkeep, isn't perceived as contributing a great deal to that of society.

"Because of Japan's evident success in the market place, it's conventional to look at what we do differently. One thing we do differently is to have over 40 times more attorneys; whereas Japan has the same number of engineers as America does, it has only one tenth the number of 'scientists.'"

Allen C. McClelland
Personal Administrator, DuPont

GOVERNMENT FINANCING AND BROKERING OF
HIGH RISK BUSINESS VENTURES

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HIGH RISK BUSINESS VENTURES

Presented to:

Mohawk Research Corporation
3268 Summit Ave.
Highland Park, IL 60035

Presented by:

Herbert E. Kierulff
Kierulff/Associates
815 W. Argand
Seattle, WA 98119
(206) 285-1583

In collaboration with:

Arthur Ramseur, Jr.
Arthur Ramseur Consultants
12615 La Bahia
San Antonio, TX 78233
(512) 656-2852

PREFACE

This paper was written by Herbert E. Kierulff to present the ideas and concepts developed by Arthur Ramseur and the author together in meetings at Knoxville, on June 13, 1982. Further discussions took place by telephone on June 19, 1982, between the two parties. Mr. Ramseur will submit a paper separately which deals with some specific background materials and ideas which both he and Dr. Kierulff believe to be of significant importance.

INTRODUCTION

There appears to be little doubt that smaller companies play a major role in the American innovation process. An Office of Management and Budget (OMB) study found that over the period 1953-1973, firms with less than 1,000 employees accounted for half of all major U.S. innovations. These firms produced four times as many innovations per employee in research and development than did larger companies.¹

According to Chilton and Hatfield,² the National Science Foundation (NSF) has data showing that small companies "produced 24 times the number of major innovations per R & D dollar than large firms (those with more than 10,000 workers) and four times that of medium-sized firms." On the other hand, this historical R & D advantage may be dwindling. The American Association for the Advancement of Science reviewed the OMB study and showed that the smaller firms (1,000 or under in employment) did indeed produce the greatest number of innovations between 1953 and 1967. However, the greatest number of innovations produced between the subsequent years 1968 and 1973 belonged to the large firms (10,000+ employees).³

Whether the six year time period (1968-1973) is long enough to establish a trend is questionable. The key factor is that smaller businesses are essential sources

of innovation in the United States. An important question, then, is what -- if anything -- the federal government can do to encourage innovation among inventors and smaller businesses. It is assumed that more early stage financing of ventures is currently both desirable and necessary. A debate on this issue is beyond the scope of this paper.

The emphasis in this paper will be on the financing of inventions and of smaller innovative firms employing under 100 people. The background of venture finance will be examined and a set of alternatives for federal government assistance will be provided. The alternatives will include suggestions for legislation and direct government participation in the innovation process.

BACKGROUND: INVESTING IN INVENTIONS

In the private sector inventors and entrepreneurs look to one or a combination of sources of investment or equity capital. The most visible of these sources is the sophisticated venture capitalist, although the dollar contribution of this sector is relatively small. Potential investors evaluate inventions using several different criteria.

Sources of Financing

Sources of equity capital for new inventions and the entrepreneurs who create business firms around them are numerous. They include:

The Entrepreneur. The entrepreneur may be the inventor of a product or a process or a businessman or a team of people who believe they are able to successfully commercialize the product. Generally, inventors make poor entrepreneurs because they are oriented towards the product rather than the market for it and because they often lack management training and/or skills.

Research sponsored by the National Federation of Independent Businesses (NFIB) indicates that the inventor and entrepreneur is the major source of venture capital.⁴ He may draw upon savings, mortgage or sell his house or

other possessions or use short term credit. Sixty percent of funds for start up businesses in the NFIB sample came from personal resources. The percentage may be larger than that because lending institutions that contribute start up capital (23 percent from this source) almost always require collateral from the entrepreneur or co-signers on the notes. If the entrepreneur already owns his business, he may partially or completely finance a project from internally generated funds (profit).

In a broader sense, the entrepreneur derives personal capital from two other sources. The first is his own efforts to develop the business for which he is either unpaid or undercompensated. This contribution is sometimes referred to as "sweat equity."

The second is the savings in equity capital which the entrepreneur may realize from the careful management of the limited resources he does have. Hewlitt Packard, for example, began in a garage, not in a modern factory. Many new companies start business with used furniture and pay careful attention to their expenditures (especially overheads), accounts receivable, and inventory levels. In these cases, "a penny saved is a penny earned."

Relatives, personal friends and acquaintances. Most of these people are relatively unsophisticated as investors, but are excited about the project. They may feel a sense of obligation to the entrepreneur -- or a concern about being left out if the invention succeeds. And they have a

few thousand to invest. The previously mentioned NFIB sample indicated that friends and relatives contributed 9 percent to business startups.

Employees: potential or actual. By investing in the project in the form of cash and/or unreimbursed hours, a potential employee can hope to secure a position for himself and a nest egg for the future. CPAs, lawyers and consultants who provide services free or at less than the going rate for the opportunity to obtain founder's stock also fit into this category.

Potential suppliers and customers. Many companies have been formed to produce and market an invention because a supplier seeking a customer or a customer seeking that product or service has been willing to help finance the business. Their investment often comes in the form of liberal credit, in the case of suppliers; and prepayments for the product in the case of customers.

Wealthy Individuals (the "old boy network"). Persons with inherited or self made wealth sometimes seek promising inventions for commercialization. These people are willing and able to provide \$50 - \$100,000 or more to an entrepreneur. Given that a substantial amount of the wealth in this country is owned or controlled by women -- many of whom are astute investors -- the well-worn phrase "old boy network" may be misleading.

Professional Persons. Medical doctors, dentists, lawyers, CPAs and others with above average incomes seek the

shelter of capital gains and the opportunity for above average returns by investing in new enterprises. Often these people have \$10,000 or more in discretionary capital to invest in a venture.

Corporations. Many inventors who recognize their managerial limitations will seek to license their inventions to a medium sized or large corporation that will produce and sell the product. Entrepreneurs may seek out small or medium sized corporations to manufacture the product while they arrange for its distribution and sale. The manufacturer may own a portion of the new corporation in exchange for services rendered.

City, State and Federal Governments. Government run venture capital corporations can be found in the states of California, Connecticut and Massachusetts. Buffalo, New York also has a venture capital fund.⁵ At the federal level the National Science Foundation (NSF), the Energy Related Inventions Program (ERIP) and the Department of Defense (DOD) are venture capital sources.

Professional Private Venture Capitalists. These highly sophisticated investors manage pools of investment capital established for the purpose of financing ventures. In 1981, the pool of venture capital neared \$6.0 billion, up from \$2.8 billion in 1977 and approximately \$4.5 billion the previous year (1980). Investors in this pool consist of corporate subsidiaries, private venture capital firms and Small Business Investment Companies.⁶

Venture capital firms and SBICs (many of which are owned by banks and commercial finance companies) will often draw their support from wealthy individuals who have neither the time nor the expertise to invest themselves. More recently, pension funds have become a major source. By 1981, these funds had contributed \$481 million to the pool, up from \$255 million in 1979. Major contributors as of year end 1981 included General Electric (\$57 million), American Telephone and Telegraph (\$50 million) and Atlantic Richfield (\$16 million).⁷

Risk/Reward Evaluation and Investors

The nature and extent of investor evaluation of an entrepreneur and his product tend to vary with the investor's level of sophistication. A close friend or relative may accept an entrepreneur's intuitive belief that "this will make us all millionaires." The more sophisticated investor will examine four aspects of a venture very closely: (1) the capabilities of the management team, (2) the market for the product, (3) the strategy for producing and selling the product (the business plan) and (4) the financial feasibility of the venture as presented in its pro forma cash flows, income statements and balance sheets.

A professional venture capitalist, for example, will objectively analyze the financial characteristics of a venture by forecasting its potential cash flows over a 3 to 5 or 7 year period and then calculating the value of

the firm at the end of this time period. He will then discount the cash flows and company value at an appropriate rate to arrive at the present value of the company.

The discount rate used represents his expectations about inflation, monetary demand and supply factors in the marketplace and a subjective estimate of the probability that the cash flows will be met. The latter is determined to a great extent by the stage of product development and/or commercialization. The earlier the stage of development of the project, the greater is the risk, other things being equal. The greater the risk, the larger is the discount rate.

G. P. Lewitt⁸ has defined the term "innovation" as a "process by which new technology-based products or processes are conceived, developed and brought to the point where they are utilized." Ten stages of development from earliest to last, are defined as: (1) concept definition; (2) concept development; (3) laboratory test; (4) engineering design; (5) working model; (6) prototype development; (7) prototype test; (8) production engineering; (9) limited production/marketing; and (10) production and marketing.

Venture capitalists talk about "seed capital," that money used to fund the early development of a business; "start up" funding for the formation of a firm; and "second, third, fourth, etc., round" financing leading up to a public offering or sale of the company to a large corporation. They also refer to "primitive" financing, where a venture

capitalist himself develops a product idea and then forms a business around an entrepreneur whom he selects and finances.

Exactly how the foregoing terminology fits Lewitt's is unclear, but the author's guess is that seed capital and primitive financing would cover stages (1) concept development, through (8) production engineering or (9) limited production/marketing. "Start up" funding would include (10) production and marketing, but might, in the minds of some venture capitalists, take in earlier stages. Second, third and subsequent round financing would take place after the company was operating.

In the 1970's, the professionals avoided seed capital and start ups as a general rule and concentrated on later stage financing and leveraged buyouts of existing firms. The rapid increase in the size of the venture capital pool over the last four years, however, has driven many professional venture capitalists back to the seed capital, start-up and primitive financing stages. According to Stanley Pratt, start-up financing in 1981 was used in 200 ventures and made up 30 percent of the venture capital investments.⁹

These data suggest that, while professional venture capital represents an important source of funding for new ventures, this represents a small part of the total base of new venture financing. None of the NFIB sample mentioned above was financed by private venture capital, although that source was listed.

The Survey of Current Business shows that almost 581,000 businesses were incorporated in 1981, up from nearly 534,000 in 1980.¹⁰ Of course, a strict comparison of the two sets of data, 200 versus 534,000, is inappropriate since the Survey of Current Business includes small proprietorships and partnerships which have existed for numbers of years and then incorporated. Furthermore, the Survey's data include incorporation of many firms in the retail, wholesale, service, manufacturing and mining industries that will not exert the leverage on employment, GNP and balance of payments that can be expected from many professional venture capital investments.¹¹

On the other hand, the venture capital funds receive a disproportionate amount of publicity given their relatively small role in the scheme of things. Of the 126 listings in the library DIALOG File under "venture capital" from 1980-82, well over half dealt exclusively or primarily with private venture capitalists, SBICs, pension funds and large companies.

Despite the publicity bias, it seems clear that the vast majority of venture funding, especially in the early stages, comes from the entrepreneur and local investors.¹² And it is here that data on number and size of investors and quality of venture evaluation is sparse and generally anecdotal. Unlike national and regional stock exchanges, the markets for venture capital are not visible and are highly unstructured.

SPECIFIC RECOMMENDATIONS

Given that it is desirable to increase the flow of venture capital to inventors/entrepreneurs and very small firms -- especially at the earlier stages of technology-based innovations -- several recommendations may be made. These include special legislation, investment guarantees or grants for early stage investments in certain industries or product areas, and the establishment of a brokerage network to pull together investors, entrepreneurial teams, business plans, technical evaluations and venture capital.

It should be noted that none of the recommendations to be presented have been tested, although similar programs have been and are in existence. A considerable amount of field work needs to be done before implementation.

Special Legislation

Following the stock market crash and the ensuing Great Depression of the 1930's, much legislation was enacted to protect the investor. Few will argue that investor protection through full disclosure of risk is inappropriate and was long overdue when enacted.

However, the pendulum may have swung too far, so that the small investor is prevented by the government from taking a risk "for his own good." For example, to

invest in ventures one must now qualify as an "accredited investor." This effectively eliminates all but the very rich from investing in new ventures that are not registered. The legal and other fees associated with registering securities, and the time factor involved, impose severe hardships on small entrepreneurs.

A review of the law in the area of investor protection is in order. Some legal requirements may very well be too paternalistic for the good of the country because they inhibit innovation and deprive a citizen of the right to use his money in ways he sees fit.

Pension funds and the funds of other institutions such as insurance companies and mutual funds are also carefully regulated by the government. At this time, some portion of some funds may be used for new ventures, but such use is limited. Liberalization of regulations could lead to greater investment in the embryonic stages of a venture. Again, the law needs to be examined in some detail and new guidelines considered.¹³

Furthermore, those current regulations which encourage investment -- capital gains provisions, safe harbor leasing, R & D partnerships, and so on -- need to be kept in force. Perhaps they could be liberalized further in the case of investments at earlier high risk stages in a project's life cycle. For example, the capital gains in founder's stock in a new corporation might be taxed at a lower rate (or not at all).

Finally, since smaller companies tend to be more labor intensive than larger ones, payments for social

security, state and federal unemployment, and required disability insurance bear more heavily on them. It would be appropriate to find out the extent to which the kinds of smaller ventures the government wishes to encourage are labor intensive. Some relief may be in order.

Investment Guarantees or Grants

Currently, the Small Business Administration (SBA) guarantees certain bank loans up to 90 percent of their value with a \$500,000 limit. It would be worth examining the feasibility of establishing an organization to either guarantee investments or provide outright grants to professional venture capitalists, corporations or other qualified investors or syndicates of investors. This would permit leveraging of the existing pool of venture capital. Just as the SBA is "lender of last resort," the proposed organization would become the "venture capitalist of last resort."

The guarantee would not exceed, say, 50 percent of the investment required for a project. The percentage amount would increase the further back one went in the stage of investment. Thus, a percentage guarantee for laboratory testing or engineering design (Lewitt's stages 3 and 4) would be larger than for prototype testing or production engineering (stages 7 and 8).

It may be prudent not to guarantee the very early concept stages on the theory that the need for "sweat

equity" and some financial commitment on the part of the inventor/entrepreneur and his friends, relatives and others would weed out obviously undesirable dreamers. Alternatively, the percentage guarantee might peak at stage 4 or 5 and decline as one went further back. This could accomplish the same general weeding out process.

The advantage of the guarantee is that it requires no immediate outlay of government funds. Only if the project failed would it be necessary to provide capital.

On the other hand, one must recognize that many (probably most) early stage projects will fail. It may appear too easy to guarantee a project when no up front cash is required, and for this reason, it may be better to provide a cash grant.

The guarantee or grant would be conditional on several factors. At minimum, the project should:

1. Assist in achieving the economic objectives of the United States, i.e.:
 - a. Growth in Gross National Product,
 - b. Low unemployment levels,
 - c. Stability in the general price level,
 - d. Balance in the U.S. Balance of Payments.
2. Be in specific areas of the country and/or in specific industries that the government believes to be of special importance.
3. Have an acceptable technical evaluation appropriate to the venture's stage of development. The evaluation might be carried out through one or more government agencies such as the Energy Related Inventions Program.
4. Show that some attention has been paid to the market feasibility of the product.

Brokerage Network

The administration of a program of guarantees or

grants could be carried out by a knowledgeable and sophisticated group of regional administrators linked together by a central administrator located in Washington, D.C. Their roles could cover a spectrum of activities ranging from the relatively passive one of promoting the program to interested publics and approving and monitoring guarantees or grants, to the active role of brokering -- matching inventions, entrepreneurs and venture capital..

The passive role is most suited to the philosophy that professional venture capitalists and other private investors are best equipped to evaluate and deal with the risks and challenges involved in increasing investment at earlier stages in venture development. All that is needed are incentives such as guarantees, grants, and/or legislative enactments to obtain the desired results. We have seen that as the pool of venture capital grows, more early stage investments become attractive.

At the other end of the spectrum is the activist role. Such a role may be appropriate if a grant or guarantee program and/or legislative proposals are not forthcoming or are deemed insufficient in themselves. In this case, the regional administrator would have several functions including:

1. Promoting and administering the guarantee/grant program if it existed.
2. Developing and working with a Board of Advisors made up of prominent community members. An active Board could multiply the outreach of a regional administrator many times and possibly serve as a source of venture capital.

3. Developing sources of venture capital. This would involve meeting with the venture capitalists known to operate in the region including federal, state and city venture capital operations. Further, the administrator would seek out the wealthy individuals and corporations who could be considered likely investors, as well as CPAs, lawyers, and stockbrokers who have contacts with investors and/or money to invest themselves.
4. Seeking out promising inventions and evaluating their technical and marketing feasibility.
5. Seeking out promising entrepreneurs and helping to form entrepreneurial teams and business plans.
6. Matching entrepreneurs with venture capital.
7. Monitoring each project both before and after a corporation has been formed, and providing assistance where possible.
8. Interacting with other regional administrators across the country to provide ideas, and broker entrepreneurial talent, venture capital and inventions where possible.

The more activist role would naturally require a more sophisticated and entrepreneurial administrator than otherwise. In addition, more administrators (smaller regions) would probably have to be defined and staffs would be larger.

It is suggested that, no matter what the level of involvement of the government, some financial compensation could be expected. The government could charge a fee or points to make an investment guarantee. A grant could become a loan due within a certain time period with interest payable when cash flow permitted. Or the grant could become a convertible debenture or straight common stock upon incorporation of the entity. Brokering activity of

a more active nature could command a greater fee or ownership interest.

In any case, it is desirable that some compensation be paid to offset the cost of providing any level of government services. It would be difficult to justify the free use of government funds to subsidize the creation of another Xerox. People who put money into risky situations and enjoy the good fortune of having invested in another Xerox are entitled to their profits. This acts as encouragement to other investors. At the same time, it would appear that the taxpayer should obtain some return on these highly profitable ventures to make up for the inevitable losses sustained on others.

Finally, any serious entry of the government into the venture capital arena should be long term. Sophisticated venture capitalists do not expect much of a return on their investments for five to ten years.¹⁴ Venture investors enter into limited partnerships that have a life cycle of from seven to twelve years.¹⁵

Evaluation of the effectiveness of a network would probably have to be done using generally unsatisfactory input measures such as number of contacts made, number of deals completed, etc., for perhaps 10 - 15 years. After that, output measures in the form of return on investment data would become available.

SBA Approaches

In 1978, an idea for a new vehicle for providing early stage venture capital through the existing structure of the Small Business Investment Company (SBIC) was introduced by the Small Business Administration. Patricia Cloherty, Deputy Administrator of the SBA explained the concept of Venture Specialized SBIC's in testimony before the Subcommittee on Capital, Investment and Business Opportunities, Committee on Small Business, House of Representatives.¹⁶

In essence, these SBIC's would specialize solely in venture capital financing of small business concerns. This would mean more restricted investment requirements than applied to regular SBICs. The Venture Specialized SBIC would own only (1) common and preferred stock, (2) the right to purchase such stock, and/or (3) unsecured subordinated debentures of a small business with no part amortized for 5 years.

Venture Specialized SBIC's could be subsidiaries or affiliates of existing SBICs or could be independently formed by private investors. The private capital or equity base of these companies (minimum \$500,000) would be leveraged 3:1 through subordinated 15 year debentures issued by the company and guaranteed by the SBA. The debentures would carry a low interest rate for the first 10 years of the term and no principal payments would be

made until the end of the 15 years. The Venture Specialized SBIC would pay a modest portion of any capital gains to the SBA.

At the same time, a limited SBA guarantee for a narrowly restricted set of "new start" business investments was being considered. These guarantees would cover 50% of the net investment loss on certain investments of the Venture Specialized SBICs. To be eligible, a business would have to (1) be two years old or less and (2) operate predominately in an area of 'national need,' involving technological innovation with market potential.¹⁷

By October of 1978, the idea of a Venture Specialized SBIC (now referred to as a Venture Capital Investment Company) appeared in a bill -- HR11445. The Venture Capital Investment Company (VCIC) concept was discussed favorably in the Senate, but was never passed.¹⁸ According to Mr. Jerry Feigen¹⁹ of the Small Business Administration, the VCIC was part of an omnibus bill that did not pass for other reasons.

Mr. Feigen²⁰ discussed ideas now current in the SBA with the author and noted SBA publications which examine these. The publications are:

1. "New Marketing Approach for SBA: Innovation Development"
2. "Innovation Hearings." Based on a compilation of hearings held in Boston, San Francisco and St. Paul.

Of particular interest is the idea that the SBA could co-venture with a venture capitalist through the SBA Loan Guarantee Program. The SBA would be brought into the prospective investment opportunity at the start up stage after a technical evaluation had been made.

The venture capitalist would fund, say, 50 percent or more of the required investment. If the SBA was satisfied that sufficient equity was present, the 90 percent loan guarantee could be used to encourage bank participation. Rand Capital in Buffalo, New York, teamed in this way with the local SBA office to finance Nanodata.

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Innovation Development Methodology:
A Role for the Federal Government

prepared by

Yao Tsu Li, Ph.D., Professor Emeritus and Senior Lecturer
Massachusetts Institute of Technology
William J. Leong, Executive Director
Chinese Economic Development Council, Inc.
Michael S. OBryon, Director of Business Development
Chinese Economic Development Council, Inc.
Andy C. Lai, Manager, Budget and Control Department
Foster Wheeler Energy Corporation
Nan Liu, Professional Business Organizer

July 21, 1982

William J. Leong
Chinese Economic Development
Council
Suite 201
31 Beach Street
Boston, MA 02111
(617) 482-1011

Yao Tsu Li, Ph.D.
Setra Systems
45 Nagog Park
Acton, MA 01720
(617) 729-0361

Introduction

The federal government has mandated Federal agencies to assist inventors and technological innovations through the development of small businesses to increase the U.S. productivity and development activities by the Small Business Act of August 1981. In the current process of enterprise development, there exists a gap between the Universities who educate individuals on the theories of business and the venture capitalists and R&D limited partnerships who invest in emerging enterprises hoping to "hit a few winners". This gap of assistance to innovations at the early stages of development has been lacking in part due to the absence of a systematic methodology for innovation development. Private sector venture capitalists gamble on a "Seat-of-the-Pants" intuition of the entrepreneur. Yet, the venture capital mode of operation works and is the most commonly used vehicle available to inventors. The efforts of the National Bureau of Standards and the Department of Energy have attempted to develop a methodology and, although limited, show promise. However, the role of the government should be more as a facilitator to private sector efforts rather than one of intervention into the innovation development process. It is proposed that the innovation development process can be significantly improved for use by venture capitalists through the use of Parameter Analysis in the early stages of a product's development. Because, private sector is reluctant to fund new approaches to venture capital, the federal government's role should be to assist efforts to implement a systematic innovation development methodology.

Organization

Figure 1 shows the conceptual plan of an innovation development methodology. In the diagram, the center circle shows the Enterprise Formation Corporation ("Corporation") a private for-profit company similar to the British National Research and Development Corporation (NRDC). This organization will implement the Parameter Analysis method of innovation development with the guidance and innovation resources drawn from the Institute for Technological Innovation ("Institute"), left large circle. As a non-profit 501(C)3 the "Institute" can more easily interface with university resources and provide continuous assistance to the "Corporation". The "Corporation"'s product is emerging enterprises and it will derive fees from the various enterprises. The "Corporation" provides an apprenticeship for emerging enterprises and entrepreneurs. Upon graduation from the apprenticeship program, each emerging enterprise will be able to enter private sector industry "on-the-right-foot" with adequate funding. Such funding will be provided by R&D Limited Partnerships, conventional financing or the EFC ("Fund"), a private venture capital fund affiliated with the Corporation, large right circle.

RIGHT ? →

Operation

The inventor, innovation or entrepreneur approaches the "Corporation" either independently or is referred by the National Bureau of Standards. If accepted by the Corporation, an evaluation of the R&D needs will be made along with cost and time determinations. After a mutual agreement on the the client's needs and available funds, the "Corporation" will assist in providing initial equity funding from a R&D Limited Partnership or the EFC Fund. In the case of high-risk, high promise innovations, a First Injection Fund will be available from the "Corporation" itself. At this point the apprenticeship program begins. The "Corporation" will use its resources to provide the R&D assistance necessary for each innovation. Concurrently, the "Corporation" will work to establish the entrepreneurial team for emerging enterprises. As the team and product matures an iterative evaluation process will be used to guide its development. In the final stages, the Corporation will assist the emerging enterprise obtain funding from the EFC "Fund", R&D Limited partnerships or conventional financing which includes banks, other venture capital companies, and/or traditional governmental programs. Thus the enterprise enters private industry properly financed, properly marketed, and properly organized.

Funding

The EFC Fund is currently in the process of raising \$5-6 million in private sector funds for the venture capital limited partnership. Once fund raising is completed, 40-50% of the private funds will be injected into an SBIC formed and operated by the EFC Fund. Thus, if \$6 mm is privately raised and \$3 mm invested into an SBIC which has a 2:1 ratio through the SBA, the EFC Fund and its SBIC would have a total of \$12 mm available for investment. Management of the fund will in part be done by the "Corporation". The Venture Capital Fund anticipates six months to raise the \$5 to 6 million dollars. Once raised, 50-60% of the Fund will be available for investment, the residual being used to start SBIC.

The "Corporation" will derive its principle funding from a variety of governmental agencies. The start-up costs for the "Corporation" are \$1.5 mm for the first year. Funds required are: staff \$300k; overhead \$300k; evaluation \$250k; equipment \$250k and the First Injection Fund \$400k. During the second year significantly less resources will be required with self-sufficiency anticipated by the third year. It is estimated a minimum of 20 enterprises will be handled by the "Corporation" on a yearly basis. The "Corporation" has committed to lease 20,000 square feet in a central downtown Boston location. A start up date of October 1, 1982 is anticipated with full operational status by January 1, 1983. Future plans call for the establishment of three additional "Corporation" locations in the major R&D and Venture Capital Centers, namely the San Francisco Bay area, the Houston-Dallas area, and the Chicago area; based on the success of the Boston project.

The \$1.5 million first year costs are being sought through the Department of Energy combined with the National Bureau of Standards, National Science Foundation, the Department of Commerce and the Office of Productivity and Development. Existing linkages can be further developed with the Small Business Administration, Office of Community Services in the Department of Health and Human Services, and the Department of Education.

When funded and in operation, the "Fund" is an additional possible source of dollars. The relationship of the "Fund" to the "Corporation" significantly enhances the ability to raise private sector dollars since the "Corporation" start up costs will not be born by the private sector investors. It is conceivable that the \$1.5 million could be leveraged into \$12 million.

Conclusion

In Professor Y.T. Li's book, Technological Innovation in Education and Industry, VNR 1980, he discusses Parameter Analysis as a methodology for training technological innovators and entrepreneurs. Parameter Analysis has one unique objective-to come up with a new configuration for a marketable product. This new configuration is arrived at by the chief innovator, with guidance from a team of skilled mentors, who construct a plan which is continually reshaped and implemented by an operational team. The success of every innovative entrepreneur is based on his ability to formulate the conceptual model and constantly revise it to guide his team. It is the method of revision which is the key element in determining the success of a venture. Through the use of Parameter Analysis, essential decisions can be scrutinized in a more analytic manner and, ultimately, can decrease the financial risks associated with bringing an innovative product to the market place. In short this program strives to:

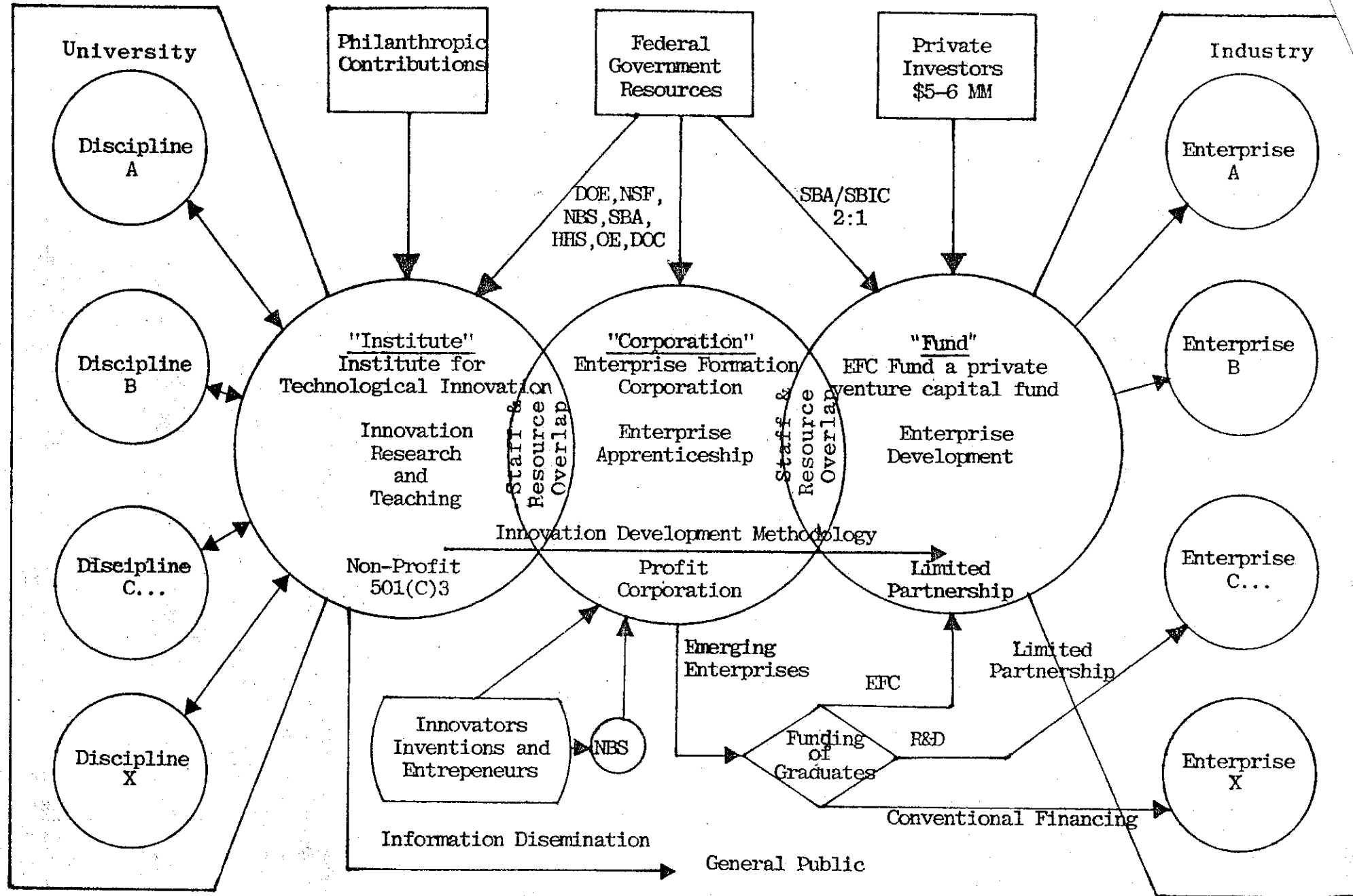
- o provide an environment for a systematic understanding of the various ingredients necessary to bring an innovative product to the market place;
- o provide an environment for a continuous step-by-step evaluation of the developmental process and;
- o provide the necessary resources, both human and financial, to facilitate the development of a marketable product, and a successful enterprise.

To implement this tested and improved general method of minimizing the cost and maximizing the success rate of bringing an innovative product to the market place, entities have been structured around the motivations of the innovator; the mentor/teachers; the R&D team; the venture capitalists, and finally, the entrepreneurs and industrialists so that they can provide a cost-effective process for the development of viable new products.

The efforts described herein are the operationalization of the necessary activities to introduce how technological innovations aimed at bringing new products to the market can be provided through an adaptive feedback management concept with judicial application of parameter analysis.

It is believed that the methodology described is the beginning of a systematic approach to bring the mystic nature of enterprising and venture financing into a "science" or "knowledge" where the cause and event of this kind of human endeavor may be traceable and thereby can be improved upon. The objective is to improve the yield of innovation development so as to reduce the risk factors for the private sector investors.

Figure 1 A Conceptual Operationalization of the Innovation Development Methodology



RESEARCH ON INDEPENDENT AND SMALL BUSINESS
INVENTORS AND INNOVATORS;
SOME RECOMMENDATIONS FOR A FEDERAL INITIATIVE

Draft Copy

Gerald G. Udell, Ph.D.
Center for Innovation Evaluation and Research
2265 Shields Avenue
Eugene, Oregon 97405

RESEARCH ON INDEPENDENT AND SMALL BUSINESS
INVENTORS AND INNOVATORS;
SOME RECOMMENDATIONS FOR A FEDERAL INITIATIVE

INTRODUCTION

Very little serious thought and/or research has been given to independent inventors and smaller technological innovators. The bulk of innovation-related research and, hence, the literature, has focused on the industrial innovation process itself, new product development in corporate settings,¹ and the diffusion of innovation in the marketplace.² These areas of research are important in their own right. However, they are virtually useless and often misleading in terms of understanding and/or making (and evaluating) public policy affecting independent inventors and smaller technological innovators--in both high and small scale technologies.

THE CURRENT LITERATURE

On the positive side, there is an increasing amount of qualitative and quantitative literature which presents, if not supports, the hypotheses that A) independent (and small business) inventors are still a major, if not the major, source of significant industrial innovations, and B) smaller enterprises are more efficient than their larger counterparts in the research and development of new products/technologies. Among some of these studies and their conclusions are the following:

- F. M. Scherer cites several studies which credit large corporations with no more than a third of the more important technological innovations;³
- Jacob Rabinow, formerly Chief of the Office of Invention and Innovation at the National Bureau of Standards, claims that most of the major inventions of this century (with the exception of transistors and color television) have come from independent inventors.⁴

- Jewkes states that seven of the eleven major inventions in the steel industry were made by independent inventors. In aluminum welding, fabricating, and finishing the major producers accounted for only one in seven in a group of 149 important inventions,⁵
- Independent inventors account for about a fifth of all patents issued--a drop of about 25 per cent in the last twenty years,⁶
- In the U. S. semi-conductor industry innovation has historically been spearheaded by new technological enterprises and has later been taken up by larger existing businesses,⁷
- A National Science Foundation-funded study indicates that small enterprise research and development may be as much as twenty-four times more efficient than large enterprise R & D,⁸
- A Small Business Administration follow-up study indicates that when measured on a per employee basis, small business is at least twice as productive as large business.⁹

RESEARCH NEEDS

On the negative side, this research does not yield much in the way of insights into:

- The impact, in more definitive terms, of independent and small business inventors and innovators as measured in terms of:
 - Jobs created,
 - Taxes paid,
 - New products introduced,
 - Productivity,
 - National defense,
 - Environmental impact;
- How and why inventors invent;
- The types of incentives that can be applied to stimulate the rate and influence the direction of independent and small business invention;
- The effect of current public policy in the following areas on independent and small business inventors and innovators:
 - Regulation (and perhaps the lack thereof),

- Patent system,
- Tax incentives (such as R & D-limited depreciations, rapid depreciation and other tax-related issues),
- Procurement (such as small business set-asides),
- R & D funding,
- Management and technical assistance (in both the public and private sectors),
- Technology transfer,
- Pre-venture capital availability,
- New venture capital availability,
- Expansion capital availability, and
- New venture initiation and preservation;
- The kinds of tools and techniques that are available to aid and assist independent and small business inventors and innovators;
- The public (federal, state, and local) and private sector sources of assistance that are available throughout the industrial innovation process;
- The effectiveness and efficiency of these sources of assistance in increasing the quality and quantity of inventions and high and small scale technological innovations among independent and small business inventors and innovators;
- Things that can be done to make them more effective and efficient;
- The specific needs of independent and small business inventors and innovators at the various stages of the industrial innovation process;
- The public and private initiatives that are necessary to provide networking and linkages between these sources of assistance and inventors and innovators;
- The costs and consequences of taking and/or not taking any specific actions; and
- The appropriate roles for the public and private sectors.

Some of the data necessary for responding to the preceding is qualitative in the sense that it is lodged in the minds and experiences of those concerned with or involved in independent and small business invention and innovation. Other data are quantitative and can be gathered and analyzed using traditional research and quantitative analytical tools. Some data isn't "discoverable," at least in the short run, and must be taken on faith or discovered through trial and error. Whatever approach is used, this data should be analyzed and disseminated with the needs of the user in mind.

RECOMMENDATIONS

Obviously, not all of the above research questions can be answered immediately. This is as it should be. We lack sufficient definition to properly guide and structure research in this area. With the economic and political realities of the times in mind, the following specific research-related recommendations seem at first glance to be appropriate:

- Establish a "think tank" (informal?) of relevant individuals (and groups?) from both the public and private sectors to:
 - A. Collect, organize, and analyze existing data/research about independent and small business inventors and innovators; and
 - B. Advise the federal government in establishing direction and priorities in research (and public policy) affecting independent and small business invention and innovation.
- Identify the federal agencies with research missions/capabilities/budgets relevant to invention and innovation. Encourage these agencies to use a portion of their resources to study independent and small business inventors and innovators.
- Establish channels of communication with those individuals and groups within the administration, Congress, and the several federal agencies for the dissemination of information.
- Sponsor a conference on Independent and Small Business Invention and Innovation at a high enough level within the federal government and

in the public sector to insure visibility, interest, credibility and participation under joint sponsorship by, for example, the Council on Productivity and Innovation, the Harvard Business Review, the National Congress of Inventor Organizations, the National Federation of Independent Businesses, the Licensing Executives Society, the Patent Office Society or the American Patent Law Association, and so on.

- Establish a dialogue with the associations representing the several academic disciplines which relate most directly to invention and innovation in general and, more specifically, independent and small business inventors and innovators.
- Begin to fund some specific research projects. For example:
 - A longitudinal study of independent inventors to examine how they invent, their needs, objectives and contributions. Some data and a large sample of over 20,000 inventors exists on NBS (OERI), Innovation Center, and NCIO member mailing lists. The methodology for such a study has already been developed (for studying entrepreneurs) and could easily be adapted to independent inventors;
 - A study of impact of specific tax incentives on independent and small business inventors and innovators;
 - Examination of regulation upon the productivity of independent and small business inventors and innovators;
 - Evaluation of existing sources of financial, management and technical assistance in terms of their current and potential impact on independent and small business inventors and innovators. Prepare and publish (on an on-going periodic basis) an assessment of these programs. Examples of current federal catalogs of a similar nature are The Directory of Federal Technology and The Small Business Guide to Federal R & D. A mere listing, however, would be insufficient--the proposed catalog of current programs should be specific as to requirements and types of assistance available and should evaluate the various programs in terms of their potential value to independent and small business inventors and innovators;
 - Examination of foreign public policy and incentives--and their effectiveness and applicability to the United States;
 - A study of the sources of industrial innovation of sufficient sophistication and participation to settle this issue. This topic has been studied for over twenty years--sparsely and sporadically. Public policy in this area still functions on the basis of opinion--not fact or reasonable assumptions.

- A study of the impact of small scale technology on the economy and the federal government. The impact of even incremental improvements is sometimes substantial. For example, twenty year projections for the Shepherd Rifle Scope (invented by a Nebraska carpenter) envision federal tax payments in excess of \$60 million. No new technology is involved. In this instance the inventor simply made an application of a long-standing principle to a specific problem. Patent is pending. This study could be incorporated into the longitudinal study mentioned above.

In terms of priorities, three of the preceding recommendations stand out:

1. The establishment of a think tank--particularly to aggregate and analyze existing published and unpublished data and to advise the federal government;
2. The preparation and publishing of a catalog of current programs relevant to independent and small business inventors and innovations. As noted above, this catalog should go beyond the mere listing of programs and should include an assessment of their potential; and
3. The beginning of a longitudinal study of independent and small business inventors and innovators to provide a data base for future research and public policy decision-making.

These projects could be initiated with a relatively modest research budget.

CONCLUSION

One of the basic problems at this time is that many in both the public and private sectors do not think that there is a problem worthy of public policy initiatives in this area. Some have no opinion, and others have strong opinions based on a variety of assumptions such as faith in the ability of individual initiative to overcome all barriers or the ability of corporate inventors and innovators to meet societal needs. Thus, the objective of a federally-sponsored research initiative, however limited, ought to be to establish the truth of the matter and to communicate its findings to those within the government responsible for affecting and implementing public policy impacting on independent and small business inventors and innovators.

FOOTNOTES

1. Gerald Udell and Mike Oneil, The New Product Decision-Making Process: A Selected Annotated Bibliography of the Current Literature (Eugene, OR: University of Oregon, 1978).
2. (Rogers, The Diffusion of Innovation)
3. F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally, 1970) p. 56.
4. "Is American Genius Being Stifled?" U. S. News & World Report (Dec. 23, 1974) p. 46.
5. John Jewkes and Others, The Sources of Invention (New York: St. Martins Press, 1959). pp. 71-85.
6. Haber, "The Decline of the Better Idea" The Sciences (October 23, 1974) p. 46.
7. Citation missing.
8. As per conversation with Frank Swain. Study funded by his office. Also, may be cited in "Small Business Report to the President."

INNOVATION FINANCING:
A NEW MARKET APPROACH
FOR SBA

BACKGROUND

Currently, the United States is experiencing an economic malaise that has plunged the nation into a recession. With unemployment rising, and the Dow Jones & GNP stagnating, this economic decline threatens to thwart a resumption to the nation's financial health blueprinted by the President's Economic Plan. Reacting to the gloomy economic indicators, the White House and Congress have increased their attention to small business and technological innovation.

Small businesses still remain the backbone of American industry. They provide more than half of all new jobs and major technological innovations to the economy. Senators and Congressmen alike, with the President's support, have carefully targeted R&D dollars to small businesses in the proposed Small Business Innovation Research Act of 1981. The Senate's Rudman Bill takes note that "technological innovation creates new jobs, increases productivity, enhances the competitiveness of products in foreign markets and stimulates economic growth." With the Executive and Legislative Branches of government striving to improve the financial welfare of the country through small business innovation, it is time the nation's small business advocate does the same.

PROPOSAL

Let the Small Business Administration implement an Innovation Development Marketing Emphasis (IDME) that would focus agency efforts on innovative, high technology firms. Typical SBA loans go to retail, service, and just plain marginal businesses that do little for economic growth. Roland Tibbetts, Director of the National Science Foundation Small Business Innovation Research Program, states, "Jobs gained by one firm are often lost by a competitor or would have been created by the competitor." The IDME proposal would encourage development of businesses that contribute substantial growth to the economy.

The following represents a five stage SBA program to encourage small business innovation with minimum administrative costs and dollar outlays.

1. Adopt specific SBA total loan portfolio objectives with "quality" targets (as opposed to merely artificial numerical goals) for increasing the total SBA business loan portfolio of "innovative" small firms. District Offices should be encouraged to make innovative small firm development loans representing approximately a 10 percent sector of their annual 7(a) guaranteed loan portfolio. This target number should be construed as only a target, not a bullseye that must be hit. Offices will in no way be penalized for missing the mark.

Administrative changes in SBA's SOPS could be written to authorize greater loan officer flexibility when recommending approval of funding to "innovative" small firms. This discretion and authority on the part of the loan officer, District Director, and/or Regional Administrators would take into consideration the subordinated private sector equity or long-term loan positions in the small business. The subordinated debt will act to provide reasonable assurance that the SBA guaranteed loan will be repaid.

As a broader initiative, any future nationally emphasized industries may receive priority targeting, determined by the Administrator pursuant to Administrative Procedures and Practices.

2(a). Encourage banks that have a preference prime for small businesses to participate in the guaranty program. Banks that grant lower interest rates for smaller businesses, such as First National Bank of Boston, usually have departments that specialize in providing management counseling for these firms. Such counseling could prove to be a powerful remedy for an innovative firm's growing pains.

(b). Limit the guaranty protection for a bank between 70% to 90% of the loan. By increasing the bank's participation, it will be encouraged to monitor the recipient's financial condition closely, being alerted to any negative trends that may develop. (This close bank scrutiny will be facilitated by allowing the bank to receive the same financial statements and documents that the small business submits to the venture capital firm, while not increasing the paperwork load for the innovative firm.) A larger percentage stake in the borrower will also dissuade the lending organization from premature write-off if unfavorable financial problems develop.

(c). Develop a "dating service" that would match venture capital firms which specialize in a particular high technology field with participating banks (within the client firm's district) that have managerial expertise in the same technical area. Such coupling would promote strong working relationships between venture capital firms and banks, and provide better managerial guidance to the innovative business.

3. Develop a cadre of technology advisers with differing scientific expertise from governmental agencies, the private sector and/or within SBA. This group should be created to assist SBA district offices with technological evaluation of innovative firms that are being reviewed by SBA or have already been financed by SBA. SBA could provide special instructions to the field as to how to seek out innovative firms who need financing and how to tie into technological societies, universities, engineering schools and applicable trade associations.

Handwritten notes:
Admin. ?

4. Highlight during Small Business Week an Innovative Small Business of the Year Award.

5. Use Regional Advocates as field agents/brokers between venture capital community, innovative small firms and Federal Agencies having programs to stimulate small business innovations.

POINT/COUNTERPOINT

Any new approach will face some opposition prior to its inception; the Innovation Development Marketing Emphasis will be no different. What, then, are the major reservations SBA officials have concerning the implementation of an innovative loan approach.

Q. The SBA has already tried an Innovation Loan Program in the late 1960's, and it was a disaster. Why try again?

A. There are two major weaknesses with this argument. First, the ILP was never adequately promoted and developed. Only two pages concerning this program could be found in the old SOP. Moshman Associates, Inc. stated that the ILP suffered from lack of criteria, direction, resources, promotion, and follow-through. The Innovation Loan Program was an Administrator's dream, but, due to the lack of adequate planning and agency commitment, became a bureaucratic nightmare.

Second, comparing the ILP with the IDME is ludicrous, since this would be comparable to matching the agency's direct lending program with its guaranty program: they are indeed two distinct animals. Given the proper commitment & support, the Innovation Development Marketing Emphasis could become the highlight within SBA's loan programs.

Q. The SBA should only be in the loan-making business, why get involved with more "speculative" ventures?

A. Any SBA loan has some degree of risk involved. The IDME recognizes that there is extra uncertainty involved with new, innovative businesses with strong growth potential. But by subordinating any venture capital firm's long-term debt or equity position to the SBA-guaranteed loan (of which the financial institution involved obviously believed in the company's repayment ability), there is indeed reasonable assurance that the loan will be repaid.

OK
subordinating
equity

OK

Q. There is new emphasis at SBA to demand "sound" credit. The IDME, even with our position superior to another lender, would not meet this new demand.

A. SBA has recently embarked in a new direction, emphasizing the need for making quality loans to reduce our loss rate, and halt the burgeoning liquidation portfolio. The filtering process of the IDME would ensure that the SBA 7(a) innovative firm portfolio would not have a drastically higher loss rate than the overall 7(a) guaranty program.

Q. How does the IDME filtering process prevent substantial losses in a field which is marked by a high fatality rate?

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A. An innovative firm must safely go through three well-guarded checkpoints in order to obtain the SBA guaranteed loan. First, a venture capital firm must provide long term debt or equity to the small business, demonstrating their belief in the viability of their client. Second, a bank must be willing to obligate its funds to finance this innovative company. Since banks tend to be rather conservative institutions, their "guardpost" will filter out the riskier of the innovative firms. Finally, the SBA loan officer, aided with technical expertise from public or private sources, would have to give his approval to the loan guaranty. It is therefore highly unlikely that IDME loans will significantly add to the SBA loss rate.

Even if the loss rate would slightly increase, the key question is what role SBA should be playing with its loan programs. A medical center that treats colds and minor illnesses will have a lower loss (death) rate than a complex that treats heart and lung diseases. To therefore have a government policy that funds only the former medical centers would be pure folly. Likewise with SBA, should we not donate at least a small portion of our resources to help finance those firms which have the greatest potential for contributing to our national welfare. Even the loss-plagued ILP was reported to have been profitable overall to the government due to the tax revenues of the successful companies.

Q. Why should SBA develop another loan program; why not just concentrate on our present portfolio?

A. The IDME is not a new program, rather it is a new market approach for an existing program. Our present policies are ignoring a vital need in encouraging the development of high growth, high technology firms. SBA would be keeping in step with the latest Congressional initiatives by focusing our attention on these small businesses. The Rudman Bill seeks not to aid dry cleaning stores, bars, restaurants, retail outlets, or "mom and pop" enterprises, rather, solutions to our present economic difficulties are sought through innovative, technological firms.

THE BOTTOM LINE

Resistance to new ideas and changes are a natural occurrence in any organization. The beliefs that "we should concentrate on what we have" and "it's a good idea, but..." are easily ingrained in many a manager's head. However, there comes the time when action is required, when the problems of economic malaise must be addressed. The current loan policies of SBA promote little economic growth in the country. To meet the challenges of our economic future, to address the needs of innovative, high tech firms that promise not only new jobs, improved productivity, and increased American competitiveness with foreign firms, but possibly even significant public benefit, the Small Business Administration should adopt and implement the Innovation Development Marketing Emphasis.

Fate info. source -

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1717 MASSACHUSETTS AVENUE, N.W.
WASHINGTON, D.C. 20036
1202) 667-6551
CABLE: "INSTADMIN"

June 25, 1982

Dr. Randy Stephens, Chief
Small Scale Technology
Mail Stop 5B 115
U.S. Department of Energy
1000 Independence Ave., S.W.
Washington, D.C. 20585

Dear Randy:

Enclosed is a list, put together with the help of my colleague Shan Holt, of several initiatives for bringing to bear the resources of small business and individual inventors on issues of technological innovation and productivity improvement. As you will see, we have set forth the various initiatives according to their target clientele -- technology developers and technology users. These distinctions are important to observe, especially if the government is serious about increasing productivity.

We start with a general problem statement which puts the separate initiatives into context. Each initiative is preceded by a brief statement of the problem it is to address and followed by a description of the most relevant model or research. I strongly feel that this is not the time to re-invent the wheel. Rather, it is time to adapt from the wheels that are working well out there.

In this connection, I would urge you to be less modest about the relevance of the DOE/NBS Energy Related Inventions Program. Its importance as a model is particularly great now that Congress has mandated an R&D set-aside for small business. Unless the mission agencies learn from ERIP, they are going to throw a whole lot of taxpayer money into the street on Mickey Mouse programs to meet the letter of the new law.

Stephens
Page 2

The format of our approach is consistent with Livasay's paper setting the historic context of the initiatives suggested. Alas, I did not have time to integrate the two papers so I am sending them each as "stand alones." I like what Hal said and would support every word.

Looking forward to hearing how it all comes off.

Cordially,

Sumner

Enclosures

GENERAL PROBLEM STATEMENT

Numerous studies of innovation have shown that small businesses are significantly more innovative than their large counterparts. Small businesses generate a disproportionate share of breakthrough innovations and provide the lion's share of new jobs. For these reasons alone small business is of particular interest to a government concerned with economic growth.

Small business is of concern for another, less upbeat, reason. The productivity of too many small businesses is so low that they endanger their own survival in competitive world markets and thereby weaken the U.S. economy. The paradox of poor productivity is that -- because such situations result from neglectful management -- they are relatively easy to correct by paying attention to them. From the economy's point of view this relatively easy job is well worth doing. Ed Denison, author of Why Growth Rates Differ, asserts that if all U.S. companies were brought up to "best practice" the effect would be the equivalent of generating new knowledge.

To be successful as technological innovators, small businesses have to overcome two major problems: (1) inadequate capital, and (2) inexperienced management. IPA research for NSF has shown that 31.6% of innovations in new ventures fail because of a shortage of capital. An additional 26.3% are lost because of poor management. Together these two factors, management and money, account for almost half of the new venture failures.

The management problems of small companies need no elaboration here. Suffice it to say that they arise largely from the fact that small businesses are so concerned with their immediate problems that they tend to focus on the here and now. In the case of new ventures, the new entrepreneur is often someone with a strong technical background and a weak business/managerial background. The several initiatives discussed below address these management problems.

The tougher issue to address is money -- because the government wants to spend so little of it. Yet a little spent on innovation in the right way will boost the economy as it helps small business innovators and inventors.

Innovative small technology businesses often run out of operating and research money and collapse before the technology under development is sufficiently proven to attract private venture capital. Because small ventures invest heavily in a very small number of projects, the failure of any one can wipe out the business. Few businesses, even large ones, support enough projects to completely avoid this "gambler's ruin" effect, but small innovators are especially vulnerable.

Small business innovators need a program to bridge the gap between the innovative idea and a product that is developed enough to interest private capital. Such a program would help them avoid the "gambler's ruin" which might otherwise block their progress to the market-place.

The government, for its part, needs a program device which will find and support the development of so-called "linchpin" innovations in areas of public concern. A linchpin technology is a development of one component of a system which makes possible a substantial positive change in the entire system. Linchpins are of particular interest to government funders, because, though they are very often high leverage technologies, the success of which would be in the public interest, they are not high on the industrial scale of priorities.

From an industry point of view, linchpins can be of two types:

Bridesmaid technologies: ideas which may interest individual companies, but are passed over, especially by larger companies, because company R&D has too short a time horizon, and/or competing priorities;

Invasionary technologies: ideas which build major new elements into the system and would force changes in the established materials, production and/or marketing methods used in the industry, for which the industry is unprepared.

The small business set-aside is one form of guaranteeing the availability of Federal capital to small business. But a set aside for small business is not synonymous with a set aside for

innovation. Not all small businesses are innovative. If the government focussed on supporting invasionary and bridesmaid technology, the public goals of fostering innovation and improving the American technological base could be addressed. In addition, innovative small business would be almost guaranteed the lion's share of the needed R&D, because small businesses, are far and away the most innovative industry segment.

There are several high leverage ways of upgrading the management of both new ventures and existing small businesses. Substantive research, as well as the experience of the programs used here as models, demonstrates that the combination of some management improvement, and an effort to find and fund linchpin innovations can do more than include small business in Federal R&D; but it can also rapidly uncover and develop enough innovative ideas to set the economy on fire.

TECHNOLOGY USERS

GROUP CONSULTING THROUGH ASSOCIATIONS

PROBLEM: Small companies, especially those in labor intensive industries, still rely on dated and inappropriate management and production methods. Below average management results in below average productivity.

Lacking managerial training themselves, many entrepreneurs don't appreciate the value of investing in the best available management talent. Thus small companies generally do not hire well-trained managers with up-to-date skills, either as in-house staff or as specialized consultants from outside the company. Consultants are a special problem: Small companies seldom know how to hire them and direct their work. But even if they did, few small companies have the up front money to spend for outside managerial advice even though such advice would pay for itself many times over.

INITIATIVE: Encourage trade associations to provide group consulting services to member companies. The association would hire a few top notch professionals to train paraprofessionals in each company and guide their work.

MODEL: The almost directly transferable model is the NEAMA program in Fall River, Massachusetts. Using DOC funds, the NEAMA hired a top notch engineer from an established apparel consulting firm and spread the cost of his services over the 42 participating companies.

The professional engineer selected promising shop people in each company and trained them on the job to work as in-house paraprofessionals. The engineer worked with each paraprofessional to install needed management systems and technologies for enhancing productivity. Once the systems were up and running, the engineer continued to provide guidance through occasional visits and frequent telephone conversations.

Within about a year the average productivity of the plants involved improved by 20-30% with only minor capital expenditures.

TECHNOLOGY USERS

SMALL BUSINESS DIAGNOSTIC TEST

- PROBLEM: Owner/managers of small businesses often fail to see and deal with potentially serious problems until it's too late. Small business time horizons tend to be short and dictated by immediate survival needs. To the extent that owners do see problems, they don't know how to prioritize them and attack them systematically. This often leads to in the misapplication and under use of technologies.
- INITIATIVE: Encourage trade associations to develop self-administered business diagnostic tests for their industries which would help small companies make better decisions about technology.
- MODEL: Self-administered diagnostic test being developed by IPA and The Wharton School for small businesses in the apparel industry. The IPA/Wharton diagnostic is based on drawing simple comparisons from data readily available to owner/managers. It is designed to give owner/managers an awareness of the interrelationships of management and technology problems to use as the first step in the problem solving process.

TECHNOLOGY USERS

MANAGEMENT EDUCATION CLINICS

PROBLEM: Owner/managers of small businesses, particularly new ventures, often have technical rather than managerial or marketing backgrounds. They are not trained in systematic management, and therefore tend to operate intuitively. Intuitive managers don't seek out formal management training because nothing in their business experience persuades them of its power. This is a Catch-22 situation: No experience, no interest; no interest, no training; no training, no experience.

INITIATIVE: Sponsor management clinics which would break into the Catch-22 situations by introducing small business managers to systematic management, especially as it applies to technology.

MODEL: Management Education Clinics for the apparel industry.

The clinics are designed to educate those owner/managers in the apparel industry who seldom if ever take advantage of the standard offerings of trade associations and universities.

The purpose of the clinic is not to offer a complete course in any subject area, but to open the eyes of the participants to the power of systematic problem solving. Each clinic session begins with and builds on a problem diagnostic. Case examples are used to demonstrate the effectiveness of systematic management techniques in solving a particular problem. The session concludes by showing participants how to expand on the clinic experience using existing resources (universities, consultants, seminars, training programs, books, etc.).

TECHNOLOGY DEVELOPERS & USERS

INDUSTRY ADVISORY TEAMS

PROBLEM:

Small technology companies tend to be too short-sighted and locked into their own technological approaches to appreciate the significance of new technological and market developments which might affect their businesses. The daily concerns with business survival prevent owner/managers from anticipating and making needed "mid course" corrections in product development until it is too late. The relevant government agency may be aware of a developing problem, but they are too far removed from the business scene to offer real-world advice. (For example, multinational apparel manufacturers are now shifting their business strategies -- just as the Japanese auto makers did -- from price competition to quality competition. In order to meet this kind of competition, domestic manufacturers -- most of which are small -- have got to begin their quality programs now. But this news is not getting through, and the apparel industry may repeat the history of the American auto industry.)

INITIATIVE: Set up very small teams of experts to visit groups of companies in industries of national concern, to exchange information and insights regarding new technological directions.

MODEL: Solar Industry Assessment Team, project for the Department of Energy.

The SAT was a small team of distinguished experts chosen for their business acumen, technical competence and personal objectivity. The functional expertise of the three people in the core group corresponded to the three critical functions of a small solar company: design and applications engineering; production; and marketing.

The Team visited the plants and installations of members of the industry, and talked with groups of solar business people about business problems and strategies and the government's policy focus. Based on the interaction the team recommended several unexpected new marketing and technological directions to both the government and the industry.

The major recommendation was to move out of the hot water business and into home heating and cooling. This recommendation was based on the teams' assessment of (1) emerging technologies for heating water which promised to be far more cost/competitive than solar and (2) the size of the retrofit heating market. The team also urged the industry to develop low cost plastic collectors and abandon the inherently costly metal and glass collectors.

TECHNOLOGY DEVELOPERS

UNSOLICITED PROPOSALS

(Small Business Set-Asides)

PROBLEM: Mission agencies now have a Congressional mandate to set aside R&D money for small businesses. To say that they are reluctant to do this is understating the case. At the same time the agencies need to find and support linchpin innovations which would contribute to specific program objectives.

INITIATIVE: Develop in each mission agency the capacity to receive and systematically review unsolicited technology proposals from small businesses and individual inventors.

MODEL: The Energy Related Inventions Program

Because ERIP was set up to handle large numbers of unsolicited proposals, the Program was inundated with ideas -- many of them inspired. Several of these, by the way, had previously been reviewed and turned down by the appropriate mission offices within DOE, because the idea "didn't fit" the program.

Mission agencies find unsolicited proposals difficult to handle. They vary substantially in format and content and sometimes carry more political weight than technical merit. The General Accounting Office suspects that unsolicited proposals inevitably lead agencies to fund projects of questionable value. The ERIP program developed several techniques for effectively handling unsolicited proposals. First, they accepted and reviewed a large "critical mass" of proposals. No one had any more weight than another, and there was room for a large group of worthwhile linchpin ideas to surface. Second, the technical merit of the proposals was evaluated twice by outside experts. This deflected whatever political pressure there might have been. More importantly, it gave ERIP's funding choices enormous credibility and exposed the funded inventors to helpful members of the private technology community.

Agency program offices currently have no way to incorporate "unsolicited" innovations into existing programs. There is, in fact, a

tendency to avoid even promising ideas rather than adapt a stated program plan and time line to the realities of a newly developed technology. Furthermore, program offices assume that all important needs can be perceived, defined and then researched. Not that government technocrats don't have any innovative ideas -- but they don't have a monopoly on innovative ideas. As NSF research has shown, fully one quarter of successful innovations, often the most important, are "unsolicited." They often point out problems which no one had perceived, by presenting workable solutions. This type of innovation can only reach mission agencies through effective handling of unsolicited ideas.

TECHNOLOGY DEVELOPERS

INNOVATION MENTORS

PROBLEM: New technology-based companies are generally started by people with little, if any, business and management experience. The process of bringing a technology to market is, however, largely a business process. It is intricate and unpredictable, and at many points in that process the new entrepreneur sorely needs objective and seasoned business advice. This role is usually filled by the private venture capitalist, once he has invested in the new company.

INITIATIVE: Set up an innovation mentor program using successful inventor/entrepreneurs who would share their experiences, acting as continuing "talking partners" for the new entrepreneur from the early stages through the business start-up process.

MODEL: The SCORE Program
Grant Moon, at the Small Business Administration, wrote his Ph.D. dissertation on the SCORE Program, and enthusiastically agreed that the SCORE

Program is an excellent model for an Innovation Mentor program. The key to an effective program for innovation is that the SCORE-type business mentor must have almost daily familiarity with the developments affecting the new venture and continuing interest in its success.

COORDINATING FEDERAL PROGRAMS INVOLVED IN THE INNOVATION
PROCESS AND RELATED ACTIVITIES

Submitted By:

Marcia Grad Burke
Johnark Research Corporation
3265 Summit Avenue
Highland Park, Illinois 50035

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COORDINATING FEDERAL PROGRAMS INVOLVED IN THE INNOVATION
PROCESS AND RELATED ACTIVITIES

BACKGROUND

Since World War II the Federal Government has supported research and development believed to be in the national interest. The National Science Foundation (NSF) has the primary responsibility for developing and implementing science and technology research and development programs; only recently (since 1959) has applied research been included in the NSF mission. At various times since World War II, technology development, innovation, entrepreneurship and small business programs have been developed and implemented by federal agencies in order to fulfill specialized needs and solve problems. It is interesting that each type of program has been developed and maintained individually rather than under an umbrella of innovation-related programs. Examples of such programs are:

- Small Business Administration: direct loan programs, loan guarantee programs, Small Business Investment Companies
- Department of Commerce: Experimental Technology Incentives Program, Office of Productivity, Technology, and Innovation programs, Technology Commercialization Program, National Technical Information Service and its licensing program
- Department of Energy: Energy-Related Inventions Program
- National Aeronautics and Space Administration: Technology Utilization Program, Technology Briefs Program, Technology Diffusion Program

- National Science Foundation: Innovation Centers,
Cooperative R&D Program, Small Business Innovation
Research Program, Federal Laboratory Consortium,
Intergovernmental Technology Program

Even the U. S. Department of State, Aid for International Development, Office of Science and Technology has, at various times, undertaken efforts in these fields. Clearly, the government has demonstrated an interest in entrepreneurship, small business, technological development and innovation.

Discussions concerning federal involvement have always revolved around the issue of interfering in private sector activities and/or giving one firm or industry a competitive edge by supporting its R&D activities--a viewpoint strongly expressed by members of this administration. Another viewpoint stressed at this time is that "if it's really necessary and important to business, the private sector will do it."

This paper is concerned with federal programs that perform private sector activities critical for technological new product/process development and commercialization, but which are insufficiently or inadequately performed by the private sector. For example, non-military prototype development--especially development of production prototype--is very difficult for individuals and smaller companies to adequately finance. And, until a production prototype is built and tested, it is unlikely that a larger company will buy the product, place orders for the product, or otherwise underwrite production of the product; likewise, it is unlikely that financing will be forthcoming from traditional sources of capital under such conditions--no matter how worthy the project. However, some federal programs are designed to meet needs such as these, they are:

- Technology Commercialization Program, Department of
Commerce

- Energy-Related Inventions Program, Department of Energy
- Small Business Innovation Research Program, National Science Foundation.

And, this paper is only interested in federal efforts that deal with a specific target audience:

- Individuals and smaller companies with technologies to license, sell or otherwise commercialize
- Programs that attempt to deal with problems or fill gaps in the private sector in order to achieve commercialization of technologies.

Traditionally, these federal programs have been considered mavericks within federal agencies, have operated on a shoestring budget, have had low visibility, and have been run by program officers with both public and private sector experience as well as entrepreneurial natures.

THE PROBLEM

Over the years various organizational arrangements have been tested to manage technology/innovation/small business/commercialization programs. The federal agencies have brought all of the these programs together into a single group at some times and at other times have dispersed them throughout the agencies based on their science/technology content area.

The only effort made by federal agencies to work together was the Federal Council for Science and Technology. It's Committee on Domestic Technology Transfer published a Directory of Federal Technology Transfer in June 1975. This directory includes descriptions of technology transfer programs then operated by each federal agency. While this effort did not result in interagency cooperation on an ongoing basis, it did result in the formation of an informal network which

still operates effectively today. It also set the precedent for the National Science Foundation publication titled "Small Business Guide to Federal R&D" which is published annually.

Thus, to date little effort has been made to establish a cooperative relationship among agencies dealing with smaller, technology-based businesses. And, no effort has been made to leverage federal resources by working closely with state/local programs with similar goals/objectives or with the private sector. The reasons for this lack of cooperation have to do with matters of "turf" and the fact that smaller, technology-based businesses are a large, disaggregated group of individuals most of whom are too busy running their businesses to become involved in efforts to improve the relationship between the private sector and the federal government. Furthermore, the government tends to deal primarily with those businesses it knows and understands best--not smaller businesses but larger or large businesses based on sophisticated technologies and generating large returns on investments.

An interesting footnote to this discussion is that the Department of Commerce, Economic Development Administration has requested proposals to design a mechanism which would coordinate national, regional and state efforts to increase productivity and innovation in the United States.

At this time, contact among program officers involved in innovation-related programs is on an informal, intermittent basis. And, the resources of the federal government remain disaggregated for the smaller, technology-based, innovative business community--except for those who are experienced "grantsmen." Furthermore, this lack of communication among federal agencies coupled with a lack of communication among smaller businesses result in the gap between the public sector and the growth-oriented business community widening rather than narrowing.

PROBLEM SOLVING

The following resolution is proposed in order to:

- Narrow the gap between the needs of technology-based, innovative smaller businesses and the presently available resources of the Federal Government designed to stimulate innovation and productivity
- Increase the federal agency program officer's knowledge of the operational realities existing in smaller, technology-based businesses
- Facilitate the development of linkages among federal programs designed to stimulate innovation and productivity thereby improving problem-solving capacity and better assisting smaller, technology-based businesses
- Fill needs not currently being met within the private sector by increasing (i.e., stimulating) private sector activity and leveraging currently available Federal resources

In short, the public sector has been making resources available to the smaller, technology-based business community based on what policy makers believe is necessary rather than on knowledge of what is available; and, federal program officers have been hampered in achieving the objectives of their programs by infrequent communication and intermittent contact with others who have similar goals.

One way to begin solving this problem is to develop a mechanism involving working members of these Groups--rather than "studiers" and policy makers--that will result in problem solving and increased activity in the private sector with

the public sector only filling gaps where the private sector can not or will not take action. It is important that this mechanism not be another means to build bureaucracy, but that it be a functioning, working group that cooperates to achieve a common goal until that goal is achieved and then disbands.

The components of the proposed mechanism are:

- Private Sector Resource Group
- Public Sector Agency Advisory Group
- Federal Agency Working Group

Private Sector Resource Group

This group will be responsible for identifying problems facing smaller, technology-based businesses and for developing potential solutions to such problems. The following private sector groups should be represented:

- Inventors (i.e., individuals and smaller businesses)
- Entrepreneurs/founders of smaller, technology-based businesses
- Patent Lawyers
- Investors of the following types: venture capitalists doing start-ups in early stages; those forming R&D limited partnerships; commercial bankers; SBICs; individuals syndicating deals
- Invention brokers
- New product development specialists
- Corporate licensing division managers
- Founders/managers of small R&D companies

Members of this group would meet annually or biannually with the public sector resource group in order to apprise it of changes occurring in the smaller business community within the last six to 12 months. It would be more regularly

(perhaps quarterly) with the federal agency working group in order to provide input regarding the operation of such programs and to help solve specific problems put to it by that group. The reader is reminded that this group should be composed of individuals who are willing to work on problems and solutions rather than those with a touch of "Potomac Fever."

Public Sector Agency Advisory Group

This group will be responsible for providing the mechanism with visibility, credibility and clout. It will be composed of agency deputies or assistant deputy secretaries and will meet with biannually or annually unless it has reason to meet more frequently (e.g., the working group is not making sufficient progress or needs help solving a specific problem). It will be a formal mechanism to promote informal contacts and cooperation among agencies dealing with smaller, technology-based businesses and will have the ability to oversee the results of the working group, increase the interest of others at the member's level of government, and enforce implementation of the working groups recommendations. Agencies which should be represented on this group include:

- National Science Foundation
- Small Business Administration
- Department of Commerce
- Department of Energy
- Department of Defense
- General Accounting Office/Policy Analysis Division

This group should be kept small and should be composed of individuals with a history of interest and involvement in technology development and commercialization.

National Agency Council Group

This group will be responsible for solving problems involved in implementing programs and policy impact on smaller, technology-based businesses. The group should be constituted of individuals who are currently program officers administering programs in innovation, technology transfer and technology commercialization. Selection criteria should include 3-5 years active experience with such programs and, if possible, private sector experience. Individuals to be included in this group are:

- Jerry Feigen, Small Business Administration, Office of Advocacy (specialist in venture capital)
- Ted Lettes, Department of Commerce, Technology Commercialization Program (brokering specialist)
- Roland Tibbels, National Science Foundation, Small Business Innovation Research Program (high risk, sophisticated technology specialist)
- George Levett, Department of Commerce, National Bureau of Standards (technology evaluation specialist)
- Naddy Stephens, Department of Energy, Energy-Related Inventions Program (inventor specialist)

The primary task of this small group would be to identify problems in the smaller, technology-based business community in cooperation with the Private Sector Resource Group (e.g., regulatory, procurement, information dissemination, investment/financing), articulate them and frame them within agency operating parameters and then attempt to solve them using the resources currently at hand in the private and public sectors.

Each program officer has already established informal networks in the

private as well as public sectors because of their unique objectives as well as their individual modes of operation. Providing this formal mechanism for cooperative problem solving and discussion of important issues will leverage individual networks and resources to the benefit of all involved.

Members of this group will report progress periodically directly to a deputy secretary or assistant deputy secretary appointed to the public sector agency advisory group. This method of informing the agencies of the working group's activities will open direct lines of communication among program officers and agency officials responsible for technology-related programs. It appears that many of the program's management problems stem from inability to reach interested, higher level officials with appropriate information in a timely manner. Thus, this direct line of communication is likely to avoid misunderstandings and to provide an incentive for the program officer to continue his daily battle for survival.

An Operating Example

If investing/financing re-starts and prototype development is identified as the most critical problem facing the smaller, technology-based business community, then the investors in the private sector resource group would be asked what would entice them to make such investments. At the same time, members of the working group would be asked what, if any, federal resources could be brought to bear on this problem. If a solution is identified, the appropriate group member(s) would be asked to go to work on implementing the recommendation. If that doesn't work, the public sector agency advisory group would be asked the same question to determine if a policy solution is appropriate.

SUMMARY

There are a few federal programs and several agencies involved in providing

assistance, in various forms, to smaller, technology-based businesses which could and should be exchanging information and solving problems in a cooperative manner. In addition, the gap between the public and private sector smaller firms could be narrowed by establishing a group to work directly with the public sector in solving such problems at working levels rather than at policy-making levels which has been attempted and proven ineffective in the past. This effort should be supported and reinforced by a group of interested public agency officials who are willing to exert their authority, if and when necessary, to ensure the implementation of solutions.