MR. IRA PETKER

PRESIDENT

RELATED EXPERIENCE:

1974-Present — Composites Horizons, Pomona, California

Founded Composites Horizons with the intent that the Company be a significant producer of high quality structures based on Advanced Composite Materials and a significant contributor to the technology of Composites. Although his primary concerns are with the overall direction and growth of the Company, he continues to be deeply involved in the day to day operations.

1971-1974 — Structural Composites Ind., Azusa, California, Vice President, Operations

Founded the company with two other principals as a spinoff from Aerojet-General Corporation. Second in command within the Company. Supervised up to 30 Engineers, technicians and manufacturing personnel. Responsible for the execution of all programs both technically and financially. Involved in all aspects of management and administration of the Company. Member of the Board of Directors and Secretary of the Corporation.

1966-1971 — Aerojet General Corporation, Azusa, California, Manager, Advanced Composites and Laboratory

Responsible for the development and application of structural composite materials with primary efforts devoted towards the utilization of advanced filaments such as boron and graphite and high temperature matrices. This work resulted in the development of the first essentially void free composites with polyimide resins and a variety of reinforcements. Aside from the technical duties, responsibilities included market development, proposal preparation and customer liaison as well as Program Manager of several Programs.

1965-1966

Israel Aircraft Industries
LOD, Israel
Foreign Specialist in Materials

As a foreign specialist in Israel, Mr. Petker was a consultant on non-metallic materials to a large local company, (employment in excess of 5,000), engaged in aircraft maintenance and repair, electronics, reinforced plastics and other special projects, such as planning for the production of aircraft. In addition, initiated the formation of a non-metallic Engineering group including the training of personnel, creation of fiscal and technical management procedures and planning of specific development programs.

1961-1965

Aerojet General Corporation
Azusa, California
Manager, Materials and
Process Engineering Group

Supervised over 40 scientist, engineers, and technicians engaged in the development of structural and ablative composites. Major programs included the development and studies in the behavior of materials for the POLARIS A-3 filament-wound rocket motor and deep submergence vehicles. Areas of concentration included the development of manufacturing processes, studies of preimpregnation process and preimpregnated materials, matrix development and identification of the role of the resin in composite structural performance, environmental behavior and the development of structural, chemical and physical test methods.

1957-1961

Zenith Plastics Company
Gardena, California
Senior Engineer

As a materials and process Engineer, Mr. Petker was responsible for the choice and development of materials for numerous airborne reinforced plastic structures including solid laminates, sandwiches, and matched-die moldings. Processes in which directly involved included low pressure and autoclave laminating, preforming, compression molding of a variety of molding compounds, and adhesive bonding. As head, Preplan group, was in charge of reviewing all RFP's, preparing proposals and quotes, determining initial manufacturing schemes and planning.

1952-1957 Jet Propulsion Laboratory
Pasadena, California
Research Chemist

Conducted laboratory investigations, including planning and reporting of liquid and solid rocket propellants. Primary concentrations were on the measurements and modifications of the physico-chemical and thermal properties of fuels and oxidizers and the storagability of these materials.

EDUCATION:

B.S., Chemistry, University of California at Los Angeles, 1952.

PUBLICATIONS:

A partial list of papers

1.) "Resin Systems for Filament-Wound High External Load Bearing Structures" Proceedings 19th Annual SPI Technical and Management Conference on Reinforced Plastics, February 1, 1964.

2.) "Combined Effects of Prestress and Humidity Cycling upon Filament-Wound Internal Pressure Vessels", SPE Journal, September 1964.

3.) "The Kinetics of Epoxy Polymerization", Proceedings American Chemical Society Annual Meeting, September 1964.

4.) "Relationships between Matrix and Composite Mechanical Properties", Proceedings American Chemical Society Annual Meeting, September 1964.

5.) "The Shear Properties of Reinforced Plastics", presented at American Ordance Society Annual Meeting, Dayton, Ohio, October 1964.

6.) "The Influence of Resin Strength and Defects on the Interlaminar Shear Strength of Filament-Wound Composites", Engineering and Polymer Science (from SPE transactions) January 1965.

7.) "The Influence of Preimpregnated Roving Processability on the Strength of Filament-Wound Composites", Proceedings 20th Annual SPI Technical and Management Conference on Reinforced Plastics, February 1965.

8.) "The Application of Infrared Spectrophotometry to the Reactivity and Cure State Determination of Epoxy Resins", Engineering and Polymer Science (from SPE transactions) April, 1965.

9.) "Factors in Strength Measurements of Glass Roving Strands", ASTM Materials Research and Standards, August 1965.

10.) "Processability of Preimpregnated Materials, Parts One and Two", Modern Plastics, September and October 1965.

11.) "Environmental Effects on the Structural Performance of Filament-Wound Composites", presented at JANAF Conference on Solid Propellants, 1966.

12.) "Boron Broadgoods", presented at AFML Advanced Composites Symposium, Washington, D.C., September 1966.

13.) "Fabrication Effects and Environmental Interaction of Filament-Wound Composites", International Conference on the Mechanics of Composite Materials, May 1967.

14.) "Processing Advanced Composites", presented at SAE Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, California, October 1967.

15.) "Low Void Content Polyimide Composites", proceedings 23rd Annual SPI Technical and Management Conference on Reinforced Plastics, February 1968.

16.) "Boron/Polyimide Fan Blades", A Fabrication Study SAE Aeronautic and Space Engineering and Manufacturing Meeting Paper No. 710772, Los Angeles, 1971.

17.) "The Status of Organic Matrices in Advanced Composites, A Personalized View", SAMPE Quarterly, January 1972.

18.) "A Unified View of the Processing of Organic Matrices into Structural Composites", Applied Polymer Symposia, No. 22, 1973.

19.) "Polyimide Resins in Advanced Composites--A Current Assessment", SAMPE Volume 21, National Symposium, April 1976.

20.) "Manufacture of Ribs for the A7D Composite Outer Wing", SAMPE Technical Conference Volume 8, October 1976.

COMPOSITES HORIZONS
2303 WEST VALLEY BOULEVARD • POMONA, CALIFORNIA 91768
[714] 623-6902

STATEMENT PRESENTED TO THE
HOUSE, SCIENCE AND TECHNOLOGY SUB-COMMITTEE
ON
INVESTIGATIONS AND OVERSIGHT
FOR THEIR HEARINGS HELD IN
POMONA, CALIFORNIA
ON
APRIL 10, 1980
by
Ira Petker
President
Composites Horizons

I believe that just as there is much diversity in technologies and companies, there are also different kinds of problems for small, high technology companies based upon different technologies. I do not know, the exact degree to which the experience of my company is universal or specific.

In the text that follows, therefore, I will be drawing upon my personal experiences and those of my company. When I am presenting ideas or beliefs which have evolved from this experience I will try to remember to alert the reader that these are my ideas and my beliefs. I hope that they have merit and be appropriate. For these reasons and others the text is written in a highly personal manner.

I am a technologist, a businessman and I have been an innovator, and after many years, I feel comfortable characterizing myself as a Humanist. Since the creation of technology is an activity unique to human beings, since it is people who innovate and it is people who produce, it seems to me that an interest and a concern for human beings is intimately involved in the issues before this committee.

If we want an innovative society, I believe that we must understand the qualities in human beings and there environment that produce innovation. If we want a productive society, then we must understand the qualities in human beings and their environment that make people want to produce. And I believe that a great contribution towards these understandings will come from the study of individual people rather than statistical samplings.

Technology, innovation and productivity have been important to me for a long time now. In part it was these very issues that led me to found my own company, when I was already in my middle forty's. I had been a technologist since graduating from college as a Chemist in 1952. Since 1957, I have specialized in the Technology of Composite Materials. Technology and particularly Composite Technology has been a central focus of my life for many, many years. Since the entire history of composites is encompassed by little more than thirty years, I have been a worker and a witness to it for a large part of this time. When I talk of composites, it is from a deep reservoir of knowledge and experience.

Creativity has been a part of my life going back to High School where strong interests in Science and Art developed. In my late twenties and early thirties I was engrossed in Painting as an avocation that almost became a career. At a later time I seriously considered becoming an Architect which seemed to be a nice way to combine my knowledge and interests. I mention these things because I have experienced the creative process in a variety of ways and also because creativity is more popularly associated with Art than it is with Technology. Creativity, however, is the basis of all important technological innovation and creativity is not so much a "team" quality as it is a quality of individuals. It is an error to give companies credit for new innovation when it is really certain individuals within the company who are responsible.

It has been natural to me, therefore, to have had an active curiosity about technological innovation. I have observed that among my most innovative co-workers, there were many who did not function well within the highly systematized environment of a large company. Also, they often had personalities that did not fit pre-conceived molds.

I also found that the companies that I worked for and the companies that professional friends of mine worked for did not provide rewards consistent with contribution. These were all large companies that depended very heavily upon technology and technological innovation. Yet they did not seem to realize how important recognition and rewards are to their innovative people. Of course, these things are important to most people.

I had the idea that if a company selected it's people carefully and provided a working environment that allowed for individuality within a larger compatible group, that provided recognition and rewards appropriate to contribution, such a company might produce practical innovation in technology far above the average. Provided that they were sufficient resouces.

It is not surprising, therefore, that productivity has been a personal interest of mine for many years. Productivity is now a daily vital concern of mine, since it has great impact within my company, and my company is a deep concern of mine. But even before the company's founding it was an interest and an issue for me.

Certainly new machines and new processes and new materials are responsible for major advances in productivity, but every company employs people, and I have observed wide variation in the productivity of people in different companies. I believe that a particular, humanized working environment can stimulate productivity among workers responsible for innovation. I also believe that there are working environments that stimulate productivity among workers in general.

This latter issue is a very important one to my company. The particular segment of the composites industry with which Composites Horizons specializes is Advanced Composites and Aerospace structures. It happens that there is no appropriate machinery existent that can replace people in the manufacture of this kind of product. It is doubtful that for many years to come will certain critical, hands-on operations be performed better by machines, than by people.

I will digress for a moment to emphasize this aspect of Advanced Composites. I believe it has certain important implication concerning the use of human resources, and I do not believe that the relation has been generally appreciated. I will expand on this later.

I hope it has become clear, why I am so pleased with this opportunity to submit these writings. It happens that when I finally had developed the courage and had the opportunity to start my own company, it was the very issues which concern this Committee that were foremost in my mind. I had decided that the only way to find out if there was merit in these ideas would be to start my own Company, Composites Horizons.

Composites is the name of a broad family of materials, which are comprised of fibers bonded together by plastics and, to a much lesser extend, by metals. Therefore, the term "fiber-reinforced plastics" has also been applied to these materials.

The high interest in these materials is based primarily on their structural properties combined with their low density. There are certain composite materials which are as strong and stiff as steel at one-fifth the weight or as strong and stiff as aluminum at one-half the weight. There is the potential in these materials to build airplanes that are forty percent lighter, or automobiles that are seventy percent lighter than current vehicles.

The most obvious benefit of the widespread exploitation of composite materials in airborne and ground transportation are dramatic savings in the cost of fuel. I am not familiar with any other class of relatively mature structural materials which have this inherent potential.

This has been recognized by the government for many years, particularly by the Department of Defense and also NASA. These agencies have been a primary source of support for Advanced Composites for many years. It has also been recognized by all producers of military and commercial airplanes and helicopters. All have worked at building in-house capability in Advanced Composites for five to fifteen years. Automobile companies have devoted significant resources to the development and eventual use of Advanced Composites.

Chemical companies, who produce the basic raw materials for Advanced Composites, have been buying up composite and composite related companies. We compete directly with a well-financed subsidiary of Exxon, devoted exclusively to Advanced Composites. There were three inquiries about the availability for purchase of Composites Horizons in the last half of last year.

Advanced Composites is a very important technology to America. It could become of major importance in the future and America is currently recognized as the world leader, mainly because of government support through the years.

As I noted earlier Composites Horizons specializes in a segment of Composite Technology that is known as "Advanced Composites". The name is appropriate since this segment is based on the stiff fibers like boron and graphite, which is where the big payoffs are in airplanes and automobiles. This is the segment of most important potential commercial interest and the one where explosive growth may take place in the 80's.

Another degree of specialization of the company is that it has worked almost exclusively on Aerospace applications of Advanced Composites. A recent example of the kind of work that we do is the structural design and fabrication of flaps and spoilers for Cessna's new Citation III executive jet. These are the introductory structures utilizing Advanced Composites in the General Aviation Industry. We expect to begin production of these components later this year. It will be our first real production program after five years in business.

We are also working with Pratt & Whitney on the development of a graphite fiber air foil for their jet engines which will power the new Boeing 767 Airplanes. We hope it goes into production for this engine. If it does, it will be the first use of Advanced Composites on one of their commercial jet engines. We have also designed and fabricated nozzle flaps for the F-100 military jet engine produced by Pratt & Whitney. These will be tested soon.

Composites Horizons is a small company, but, as is characteristic of small, high technology companies, they often work on products with high potential commercial value. Each one of the applications which I noted above can be worth more than the total sales of my company during it's life so far.

When Composites Horizons was founded, there was a primary interest to evolve it into a production source of componentry. It was in the fabrication of hardware and our understanding of the materials where our greatest strength resided. The only likely path by which this bootstrapping company might stabilize itself and provide a firm basis for growth was through production. It has taken over five years, much longer than I anticipated. The technology has developed slowly and there is hardly any Advanced Composite structures in production, except for limited production within a few large military airplane companies. However, there are indicators of important change now taking place, just as society in general is undergoing rapid change. Composites Horizons began in the recession year of 1974, at a time when the cost of Advanced Composite structure appeared to make it impractical in most applications. Also, there had already been disappointments in the application of the technology so that there was much caution on the part of potential users. This of course, is heightened by the native conservatism, (for which I am grateful) that is inherent in the Aviation Industry.

During the last five years we have survived previously on technology programs. In a business environment where technology support was scarce and with hesitant users, survival was very difficult and continues to be very difficult.

For about a year now I have been noticing important changes in the status of Composite Technology. Advanced Composites are being considered and developed for a growing variety of applications in military, commercial and general aviation. There is a dramatic change going on that could produce major change in Aviation. The cost of energy is the driver.

I should like to note that as I view the overall situation today, I find if conceivable that the major breakthrough in composite utilization may come from General Aviation. If this were to occur, it would be a major event signalling change. General Aviation has for many, many years been the last, not the first segment of the Aviation Industry to incorporate new and innovative technology. However, I believe that in specific regard to composites, a small company with excellent technological and financial resources is better suited to advance the technology quickly towards widespread practical utilization than are large ones.

The choice that was made from the beginning in our company was to emphasize the fabrication of hardware and pursue a path towards production. This had the peculiar result of putting us in a direct competition with many of our most natural customers.

Until recently the major government support for Advanced Composites has been for military and secondarily for commercial aviation. This support has gone almost exclusively to the large companies that manufacture airplanes. This is also an important group of companies to Composites Horizons. We hope that all will become customers, as some have. The government is rightly

interested in developing practical utilization of technology and in a practical technology like composites, it is natural that most support will go to companies who can utilize the technology most directly. Since all of these companies have decided to build in-house capabilities in composites, both in engineering and production, very little of it has trickled down from the large companies to small companies like Composites Horizons.

Our major competition has been from the giant in-house sources rather than from other smaller companies. Actually in most direct government procurements for which we have competed, it has been these same large, sometimes customer companies that have been our competition. These are difficult circumstances within which to grow a company.

Here the experience of Composites Horizons begins to have direct implications for the stated interests of the committee. At this moment there are many defense systems considering Advanced Composite applications. Therefore the major government support for composites, and it is substantial, goes to the company developing the system. Since almost all of these companies have an aggressive attitude towards continuing to build in-house capability, advanced composite structures, if at all, are seldom, or are the last parts to be subcontracted. In addition, most of the subcontracting is between those same large companies. The situation is not much different from the earlier years in metal working sub-contracts. Very little of this support trickles down to a small company like Composites Horizons, even though it would make very good business sense. None the less, we have proven it can cost less with our small business sub-contracting and give equal or even better quality production.

One of the results of this set of circumstances is that there is a great deal of uniformity in the practice of composites by the Aerospace Industry. There has been very little important new innovation in recent years in composite materials, in composite manufacturing methods, and in design practices. If there have been important innovations, then I am simply unaware of them, and we do keep up on developments in our industry, as well as contribute to them.

Composites Horizons is a very real and specific instance in which a small technology company has developed a different view, an alternative view, and a real innovation on the practice of technology. Because of this new approach, we have different ideas about how the technology can be most effectively developed and exploited. We have also, therefore, followed a somewhat unique path in our evolution of the technology. I wonder if there are parallel situations in other technologies?

At Composites Horizons, many of us believe deeply in the work that we do and in our technological positions. I suspect that this is a common quality among small, high technology companies. We believe that we represent an alternative for the industry which we also believe could ultimately provide much more practical

technology and many products of high value and lower cost. Whether or not we will have the opportunity to prove sufficiently, this is still unclear.

I will give one illustration of how our somewhat different view of the technology leads to a dramatically different manner of organizing and allocating resources internally as we work towards establishing a production capability. In this there are some implications which are unexpected and I believe of interest to the Government.

A great deal of emphasis has been placed for many years now in developing manufacturing methods for composite structures. Considerable emphasis has been placed on finding ways to mechanize and automate fabrication. It is a fact that if there is an "Achilles Heal" in composites that could limit it's growth and might confound it's achieving commercial maturity, it is in fabrication and in the failure to successfully develop certain improvements in the materials themselves. That is because we actually make the composite material, building in the results. Thus, it is the individual production worker - not machines that are critical.

The issue of fabrication and, therefore, of production methods is of the highest importance. In contrast to the mainstream opinion, it is our position that because of the inherent nature of those composite materials most applicable to Aerospace structure, human labor will be more cost effective and produce better quality than machinery, at least for the foreseeable future. This is particularly true of airplane and helicopter structure because of the relatively small number of vehicles produced by this industry yearly. High production of airplanes is ten (10) to twenty (20) a month. Therefore people, not robots, are more important in this technology.

Large companies with a tradition of manufacturing with metals have difficulties with this view. These companies expend much effort tying to increase productivity by developing automation. Those efforts often result in lower labor content and lesser vulnerability to human error. Both of these are beneficial results. However, we do not believe that this prior experience with other materials is generally applicable to Advanced Composites at this stage of their evolution. Ours is still a hand process. Composites production is quiet, not the noise of metal stamping or machining.

It is true that it is more difficult to organize manufacturing with people than it is with machines. We have experienced many "bloody noses" at our Company. However, on the other hand I find some interesting consequences that result from our view which can be very beneficial.

The nature of the manufacture of structures with composite materials has certain specific qualities. The materials are lightweight. They do not require a great deal of strength to lift and move them. Even the tools with which structures are molded from composites can be very lightweight. Therefore, women can work

beside men in a really equal manner and capacity.

The skills required of the worker in the fabrication of composite structures are really very few and surprisingly easily learned. It is possible to take an unskilled person off the street without any prior experience and have that person productive within days. Although there are a great variety of things for a worker to learn in composite manufacture, almost any one of the individual, specific tasks can be learned quickly and reproduced easily. The main qualities that are important for a worker are manual dexterity, alertness, interest and motivation. Therefore, composites can employ relatively large numbers of people who otherwize would be identified as unskilled and make these people productive relatively fast.

Another quality of a company manufacturing composites, especially for the airplane industry, is that the quantities of any specific structure or specific product are relatively small. However there are a great variety of different things that must be done in the construction of each. Therefore, rather than the development of highly specialized workers with the boredom of a production line, there is a relatively high degree of potential variety for the worker. This is true even in a plant with high production.

Another quality is that the products produced by this company would be of a high dollar value, among the most advanced in the highly technological industry of aviation. There is an opportunity therefore, for workers, even with modest income, to have pride in what they are doing because of what their making. The products are of high value and of relatively high labor content and, yet, composite structures produced in this manner can be of a lighter weight, higher quality and consistency and cost less. Also a composite factory is quiet. It is air-conditioned and well-lighted. Therefore, in a variety of ways it can be a nice environment in which, people can and want to work.

It seems to me that this is a happy and unusual circumstance. It is the coming together on the one hand of a new and advanced technology and a natural opportunity to employ people effectively, productively and humanely. Considering the growing population, the greater requirements for education and skills in order to be employable in industry, that a new industry requiring a large number of semi-skilled workers could be looked upon as a king of blessing.

I would like to suggest that a modification of certain procurement policies could assist companies like Composites Horizons to grow to be viable and productive. I believe that current procurement policies often define a certain percentage of prime contract funds be sub-contracted to small business. The policy almost automatically eliminates the sub-contracting in technologies for which the prime has a position or a desire for capability.

A solution might begin with the government identifying technologies whose development it clearly wants to support because of their value, both real and potential, to society. If all or portions of the work of a given contract involve one of these technologies, then a certain portion of this work could be automatically set aside for small businesses. A criteria, of course, would have to be that a small company existed that could perform the work well and successfully. A direct procurement to small business for a high technology requirement, will give a better return for the dollars and not risk the diversion or even stoppage of the intended flow-through.

Personally, I understand the compulsion and even the need for large companies to build in-house capability in certain technologies. However, my position is that this can go on concurrently with support for small technology companies. There are potential benefits for all parties, not the least of these are objective opportunities to counter the Not Invented Here, NIH factor which seems to be prevalent almost everywhere. Not of lesser importance are the opportunities for large companies to assess objectively their own level of efficiency and accomplishment.

It is true to my experience, however, that it is often more difficult for the government to do business with a small company than with a large company. It is also often similarly true of companies doing business with other companies. It is especially true of situations where the nature of the product being processed is such that it is an essential part of a much larger system. If the sources for the product are few and small, then there is a vulnerability because of the higher likelihood of instabilities of a small as compared to a larger company. Again this is an area of opportunity.

I would like to note here that it is often more difficult for the Government to do business with a small company that it is with a large company. The sources of these difficulties are in the very nature of small companies and especially young, high technology companies. My company has chosen to be independent because it believes that in this manner it will develop with the maximum vitality in innovation and productivity. As a consequence it has always been under-financed and presents higher apparent risk to customers.

There are other sources of potential risk.. In it's professional personnel, my company is quite strong in each of the capabilities required of us. However, we are not deep in all catagories of skill, and frequently individuals are required to have a variety of skills and perform a variety of tasks which in larger companies are performed by different, individual people. The loss of a key individual can be a potential cause for lost time and other losses.

Because our financial resources have been thin and because technology is the basis for our company, our buildup of capability is favored towards the technology rather than resources. We have not been able to afford to hire specialists in accounting and contracts and procurement. However, we still must perform these functions according to the same standards and requirements of much larger companies. This is a real source of burden which is disproportionately high for a small business.

Because of this situation we can be very bothersome to a Contracting Officer or a Project Monitor and others. We have a tendency to be less timely in the submission of reports, data and information, for example. Unfortunately, when these mishaps occur the specific government individuals with direct responsibility for the execution of the procurement are vulnerable to reprimand and penalty.

This question of risk and the consequences of risk is one which deserves more consideration. There should be mechanisms whereby risk is recognized, accepted, and lifted from the responsibilities of those for whom there is little reward from risk-taking.

Because of these experiences and many others I have come to appreciate that it can actually be a greater burden for the government to do business with my company than the reverse. No matter how difficult it has been for us to be responsive to government regulations and procurement policies, the value of the business for my company has far outweighed the burdens, and we are one small business that is appreciative of the business, and even the burdens.

Composites Horizons would not exist today if not for government support. About one-half of the sales of my company have been either directly to the government or on sub-contracts on prime government procurements. In the prior years of my career, when the basis for Composites Horizons was established, government procurements were a vital ingredient.

Since 1963, I have met, been associated with and worked with literally hundreds of government employees. I have found this group of people to be a group with special problems, but also to be a group that rates very well with their counter-parts from industry years. The sector of government workers with which I am most familiar have generally been college-educated with degrees in engineering or science. They are an intelligent group of people. They have tended to be serious about their work, very frequently quite serious about their work and often overburdened by it. Usually, they have been courteous, fair, honest, and have had high integrity. I have found this also to be true of administrative personnel. I have found that doing business with the government can be very productive and satisfying.

The poor availability of financing for Composites Horizons has been a major source of difficulty throughout the life of the company. It is a company that has depended upon contracts with other companies and the government rather than a company with developed products that it markets.

It is more difficult to assess the merit and capabilities of such a company. It was not until the Small Business Administration granted Composites Horizons a loan about a year and a half ago that it ever had solid financing. During the last year we have grown in employment level by about eighty percent. In a very direct way the Small Business Administration has contributed to this growth. It has helped in other ways. In one instance where we were being disqualified due to a question of financial stability, it was the direct intervention of the Small Business Administration in an appeal procedure which resulted in a resolution of the problem favorably to us.

The Small Business Administration has shown special sensitivity and understanding to our problem. Not only does it deserve much credit, but I would like to see it's abilities to work with and assist small companies expanded. It would be a healthy step if it were to have expanded funding and flexibility in working with small high technology companies. We can again double our employment within a year and a half with additional funding on the SBA loan which is now much more secure. Even so we still cannot obtain normal bank credit for expanding working capital requirements, so we are very grateful for the SBA it's helpful administration and support.

Recently, a significant event took place in our small company that may give this Committee another important insight. A prominant senior engineer in advanced composites left his secure job as a program head in one of the largest aerospace contractors to come to work with us. He was within a few years of qualifying for an early retirement at a comfortable income. I worked with him twenty years ago at another major aerospace contractor where we developed some important breakthroughs in filament winding for missile cases.

You might well ask why would a top man at the prime of his mental and professional abilities risk it to come work with us. It was not the lack of importance of his prior work - certainly the space shuttle is significant. I asked him and his answer should be noted in this inquiry. He wanted to work more as an individual within a creative flexibility and on a variety of commercial as well as military applications. In short he said, that he wanted to accomplish more and saw the opportunity to do it here in this small company, even with the risks and lesser levels of support and comfort.

Every professional person and others who work at Composites Horizons have accepted risks without guarantees that rewards will be forthcoming. They have accepted risks. They work harder. They work under greater pressures than their counter-parts in large companies. I believe it is reasonable for the Government in such a situation also to take more risk. If there is a desire on the part of the government to encourage innovation in America and if small, high technology companies have the best record, then I think that risk should be part of government policy and the rules for doing business with small, high technology companies should reflect this consideration.

Mr. LLOYD. Mr. Schlosser.

By the way, I understand we should congratulate you. I understand you have just won an election and are presumably the next mayor of the growing city of Rancho Cucamonga; is that right?

STATEMENT OF PHILLIP D. SCHLOSSER

Mr. SCHLOSSER. Thank you.

I am not even sure why you would call a blacksmith here in the first place, but I will give you my bit on productivity and innovation.

After many years of saving our money my wife and I bought six acres of land and proceeded to build a small forging company. We physically pulled the grapes out of the ground, had a building built and purchased some used forging machinery. On November 13, 1970, with four men and myself, we started in business.

I had found out in the years before that three very important things were necessary for success. They were ability, discipline, and persistence.

With the application of these principles and many long hours we were able to succeed quite well. Our operation is producing forgings for the aerospace industry. We do some missile work, but most of the forgings are for the commercial and military jet engines, engines used like on the 707, the 747's, the DC–10, and the F–15's, F–16 fighter planes for the military.

These forgings are produced on steam hammers, hydraulic presses and seamless ring rolling mechines.

For the benefit of anyone who has not seen a forge shop lately, it is a tremendous advancement from the typical village blacksmith as I described it. It requires very sophisticated machinery that is computerized and programed. In fact, the last piece of equipment that we put in cost nearly $3 million, and we had to go all the way to Germany to buy it, because our Yankee ingenuity can't even produce one like it in this country.

The material that we forge is very high exotic metals, such as cobalt, titanium, magnesium, base alloys. These materials require extremely close control in heating and forging, and require many chemical, metallurgical and mechanical engineers to control this process all through the operation.

Forgings make up the main support and critical structural or backbone members of any missile or aircraft. It is essential that these are manufactured with the highest degree of integrity, and really to succeed in this business, starting from a vineyard, you must do something better. This is where innovativeness and hard work come together. As each new day dawns the old cliche "work smarter, not harder" is fine, but if you work both smarter and harder success is assured.

We have orders that we receive from the major manufacturers. We receive these orders on the basis of three things: price, quality, and delivery. All orders are competitively bid, and the best combination of the above requirements is the winner.

We then manufacture the forgings in hope of satisfying our customers and making a profit. To do this we must run a competitive shop, produce a good product, employ workers of all ranges and

skills and pay them a fair salary with all the fringe benefits and pay a proportionate amount of taxes to our local, State and Federal Governments. This doesn't bother me, because I feel the country needs roads, schools, police protection, flood protection, military protection from our enemies, and other necessary things, and if you look at it at this point it looks great. The free enterprise system is working. The harder we work the more efficient we become, the more profit after taxes we can make. The feeling is let's innovate, invent, think up new ways to make forgings better, quicker, and of better quality so we can build a better life for ourselves, our employees, and a stronger community and country. Good competition makes all the other companies try harder thereby raising the standard and quality as we know it.

We then have a dark cloud cover the scene. The U.S. Government in its wisdom feels anyone making a profit by being productive, competitive and innovative is certainly someone that cannot be tolerated, as he is un-American. They quickly investigate this man, make him produce all sorts of documentations of each and every job. This causes a huge expense in installing a cost control system and people to implement it. We are burdened with the unnecessary paperwork of itemizing all costs of the job for the U.S. Government to the tune of approximately $200,000 a year, every year.

After investigation and going through all this, you are told that even though you invested your lifetime earnings in starting a business, helping people to work in respectable employment, competing in a fierce marketplace and raising the level of quality in that marketplace, took risks with undeveloped metals and alloys, you should be penalized, because you and your aggressive attitude took an unfair advantage of everyone by making a profit.

The Renegotiation Act of 1951 and the Vinceent-Trammel Act which took its place will deal with people who make a profit and continue to think that motherhood and apple pie and the free enterprise system is good.

The benefits of doing Government business do not justify the cost. We small firms, business firms, provide over half of the jobs in this country. We create over 70 percent of all new products in the Nation. The public is paying over 20 percent more for products simply because our Government has hammered the small business to the wall with costly and unnecessary regulations and paperwork.

The whole system is being attacked by many forces. We have made it easy for a man not to work. That is by unemployment and welfare benefits. We must reduce the welfare for able-bodied men and women.

Let me examine the words self-respecting employment. These are codes by which our forefathers lived rigidly. As a boy on the farm, I took pride in the fact that I could plow so many acres or cut so much wood. Think back to your first job, receiving that first pay or paycheck, how high you held your head, how proud you were that you had been of some use to the world. Some segments of our society have deteriorated where it has become an honor to become unemployed or to be on welfare or to cheat your employer out of an honest day's work by purposely laggard actions or to have stolen something from the store or tools from your employer. The thing that should worry us all is the statement heard when an individual is caught. Everyone else

is doing it, or besides it is only company property, or it is Government property, or he is rich, or he won't miss it, or he owes it to me. Just think about those comments. That is what you hear.

We need to establish new goals and reinstitute the need for constructive employment. We need to encourage competition, inventions and new innovative ideas. We must sell at levels of the community the idea that education and work is still honorable and anything else is a poor substitute and disgraceful. Somehow we must convince the system that business is good, and we all must encourage the creation of new inventions providing new jobs and doing our part for the country we love.

Let us get down to specific. Our company fills out at least 18 forms, not including the payroll forms and so on, for the Government—17 of these reports cost anywhere from $75 to $600 to complete.

This on first glance doesn't seem very much, but the real cost comes in the compliance with the regulations.

The costs incurred to comply and compile with No. 18, the Vincent Tramell Act, and its predecessor, the Renegotiation Act of 1951, like I said before, costs our company in excess of $200,000 per year every year in hard dollars.

In addition to this yearly cost if we make a profit by efficient productivity we are penalized, and the profit is taken away from us.

This type of regulation is counterproductive to what our free enterprise system stands for. We must examine all regulations, what is there, their value. Are they cost effective. I do not object to our quality control system controlled by a federally mandated quality control manual. To implement this system at last count our company has at least 22 forms of paper. The paper does not make that jet engine run any better or that wingspan any stronger, but the quality is assured. I really feel we would have chaos if we did not have qualified producers with thorough quality control systems that are monitored. I feel absolutely confident when I am in a 747 and the captain pushes those throttles forward calling for 200,000 horsepowers to come alive that they will perform, and I was listening to Jim the other day telling about flying a Bonanza over Colorado. The weather was a little rough, and I am sure he wasn't concerned about some of the small things on the thing failing, but he was concerned about the forgings. Like the forging in that crankshaft in that engine and that forged propeller out front, the fact that it would keep turning and the fact that that big main spar that was forged was holding those wings on. All other things didn't mean very much but those forgings meant one awful lot, the fact he was going to get through and put it back down on forged landing wheels, gave him a confident feeling.

In summary we feel we should examine our system and do all we can to encourage efficiency, innovation, and productivity. I don't believe it is all doom and gloom. With a little bit of communication and cooperation on the part of business, industry, and our elected officials and the bureaucratic part of our Government we can hammer out a viable, working solution to our problems. I think legitimate, competitive bids should definitely not be subject to negotiation, and the level of subcontracts that are examined should certainly re raised from the level that is right now $10,000.

At the White House conference I brought this particular subject up, and I was told by one of the Government officials there that in order to get around the Renegotiation Act and the Vincent Trammel Act start another company, channel off some of your funds and profits that way, hide them. To me that is cheating. It should be right out in front. I don't think that having another company to hide anything is right.

I still think that small business ought to be encouraged to perform hard work. Because of the hard work being done the country is stronger. We have good businessmen that are strong. I am not really asking for your help, however the man that does make a profit I really think we ought to reward.

Thank you very much.

[The prepared statement of Mr. Scholosser follows:]

SMALL BUSINESS INNOVATION AND PRODUCTIVITY

After many years of saving our money, my wife and I bought six acres of land and proceeded to build a small forging shop in Cucamonga. We physically pulled the grapes out of the ground, had a building built, bought some used forging machinery and on November 13th (Friday) 1970, with five men (four and myself) started in business.

I had found out years before that three very important things are necessary for success: 1) Ability, 2) Discipline, and 3) Persistence. With the application of these principles and many long hours, we were able to succeed quite well.

Our operation is producing forgings for the aerospace industry. We do some missile work, but most of the forgings are for commercial and military jet engines. Engines used in the 707s, 727s, 747s, DC8s and DC10s and for the fighter planes for the military.

These forgings are produced on hammers, steam and hydraulic presses and seamless ring rolling machines. For the benefit of anyone who has not seen a forge shop, it is tremendous advancement from the typical village blacksmith. It requires very sophisticated machinery that is computerized and programmed. The material is all very high exotic metals such as cobalt, nickel, chromium, titanium, magnesium and aluminum base alloy. This material requires extremely close control on heating and through the forging operation. Many electrical, chemical, mechanical and metallurgical engineers are required for this highly technological operation.

Forgings make up the main support and critical structural member of any missile or aircraft. It is essential that these are manufactured with the highest degree of integrity and reliability possible. To suceed in this business, starting from a vineyard, you must do something better. This is where innovativeness and hard work come together as each new day dawns. The old cliche, work smarter not harder is fine, but if you work both smarter and harder, success is assured.

We receive orders from the major aircraft and aircraft engine manufacturers. We receive these orders on the basis of price, quality and delivery. All orders are competitively bid and the best combination of the above requirements is the winner. We then manufacture the forgings in hopes of satisfying our customers and making a profit. To do this, we must run a competitive shop, produce a good product, employ workers of all ranges of skills, and pay them a fair salary with all the fringe benefits and pay a proportionate amount of taxes to our local, state and federal governments.

This doesn't bother me as I feel the country needs roads, schools, police protection, flood protection and military protection from our enemies. If you look at things at this point, it looks great, the free enterprise system is working, the harder we work the more efficient we become, the more profit after taxes we can make. The feeling is, let's innovate, invent, think up new ways to make forgings better, quicker and better quality, so we can build a better life for ourselves, our employees and a stronger community and country. Good competition makes all the other companies try harder, thereby raising the standards and quality as we know it.

We then have a dark cloud cover the scene. The U.S. Government, in its inimitable wisdom feels that anyone making a profit by being productive, competitive and innovative, is certainly someone that cannot be tolerated as he is unamerican. They quickly investigate this man, make him produce all sorts of documentation of each and every job. This causes a huge expense in

installing a cost control system and the people to implement it. We are burdened with unnecessary paperwork of itemizing all costs of the job for U.S. Government to the tune of approximately $200,000 a year.

After investigation, you are told that even though you invested your life time earnings in starting a business, helping people to work in respectable employment, competing in a fierce market place and raising the level of quality in that market, took risks with undeveloped metals and alloys, you should be penalized because you and your aggressive attitude took an unfair advantage of everyone by making a profit. The Renegotiation Act of 1951 and the Vinson Trammell Act will deal with subversive people who dare make a profit and continue to think that motherhood, apple pie and the free enterprise system is good for this country.

The benefits of doing government business do not justify the cost. "We small business firms provide over half of the jobs in this country...we create over 70% of all new products in the nation...the public is paying over 20% more for products simply because our own government has nailed the small business man to the wall with costly and unnecessary regulations and paperwork." The whole system is being attacked by many forces. We have made it as easy for a man not to work, i.e. unemployment and welfare benefits, as it is to hold a self respecting job. We must reduce the welfare for able bodied men and women.

Let us examine the words "self respecting employment." These were codes by which our forefethers lived rigidly. As a boy I took pride in the fact that I could plow so many acres or cut so much wood, etc. Think back to your first job, receiving the first pay or paycheck, how high you held your head, how proud you were that you had been of some use to the world.

Some segments of our society have deteriorated whereby it is becoming an honor to be unemployed or on welfare or to cheat your employer out of an honest days work by purposely laggard actions, or to have stolen something from a store or tools from an employer. The thing that should worry us all is that statement heard when an individual is caught, "everybody else is doing it, and besides it's only company property, or he's rich, he won't miss it, or he owes it to me."

We need to establish new goals and reinstitute the need for constructive employment. We must encourage competition, inventions and new innovative ideas. We must sell, at all levels of communication, the idea that education and work is honorable and anything else is a poor substitute and disgraceful.

Somehow, we must convince the system that business is good, and we all must encourage the creation of new inventions, providing new jobs and doing our part for the country we love.

Let us get down to specifics: Our company fills out at least 18 government reports. Seventeen of these reports cost anywhere from $75 to $600 to complete. This on first glance doesn't seem very much, but the real cost comes in the compliance with the regulations. The costs incurred to compile and comply with #18 the Vinson Trammell Act and its predecessor, the Renegotiation Act of 1951, cost our company in excess of $200,000 per year every year in real hard dollars. In addition to this yearly cost, and if we make a profit by being efficient, innovative and productive, we could be penalized and the profits taken away from us.

This type of regulation is counterproductive to what our free enterprise system stands for and has done to build our country strong. We must examine all regulations; what is their value, are they counterproductive, and are they cost effective?

I do not object to our quality control system controlled by a federally mandated quality control manual. To implement this system requires at last count 22 forms of paper. The paperwork does not make that jet engine run any better or wing span any stronger, but the quality is assured.

I really feel we would have chaos if we did not have qualified producers with thorough quality control systems that are monitored. I feel absolutely confident when I'm in a 747 and the captain pushes those throttles forward calling for 200,000 horses to come alive that they will perform.

In summary, I feel we should examine our systems and do all we can to encourage efficiency, innovativeness and productivity. I don't believe it is all doom and gloom. With a little communication and cooperation on the part of business, industry, our elected officials, and the bureaucratic part of our government, we can hammer out a viable working solution to our problems.

GOVERNMENT REPORTS COMPLETED DURING A YEAR AND ASSOCIATED COSTS

CURRENT INDUSTRIAL REPORT	Bureau of the Census	annual	$250
FINANCIAL REPORT	Federal Trade Commission	quarterly	$100
PRODUCT NATURE OF BUSINESS REPORT	Federal Trade Commission	annual	$ 25
CONSTRUCTION PROJECT REPORT	Bureau of the Census	monthly (during the project)	$ 75
FEDERAL USE TAX RETURN ON CIVIL AIRCRAFT	Internal Revenue Service	annual	$ 25
EQUAL OPPORTUNITY COMPLIANCE REPORT	Small Business Administration	annual	$100
SALES AND USE TAX	California State Board of Equalization	quarterly	$ 50
LABOR STATISTICS	California Bureau of Labor	monthly	$ 50
UNSECURED PROPERTY ASSESSMENT	County of San Bernardino	annual	$600
ANNUAL SURVEY OF MANUFACTURERS	Bureau of the Census	annual	$150
CAL/OSHA FORM 200	State of California	maintained daily	$400
CAL/OSHA REGULATIONS -COMPLIANCE	State of California		$25,000
OSHA FORM 200-S	U.S. Department of Labor	annual	$ 75
EQUAL EMPLOYMENT OPPORTUNITY FORM 1 EEO ACT - COMPLIANCE	EEO Commission	annual	$600 $8,000
ANNUAL REPORT OF EMPLOYEE BENEFIT PLAN-FORM 5500	Internal Revenue Service	annual	$500
SOUTHCOAST AIR POLLUTION CONTROL BOARD	County of San Bernardino	annual	$1,100
STATEMENT BY DOMESTIC STOCK CORPORATION	State of California	annual	$100
BUSINESS LICENSE	City of Rancho Cucamonga	annual	$650
VINSON-TRAMMELL ACT	Department of Defense and Internal Revenue Service	Ongoing daily activity	
	Maintenance of Cost Accounting system		$100,000
	Outside Professional Services		8,000
	Management Involvement		74,000
CORPORATE INCOME TAX	Internal Revenue Service and California Franchise Tax Board		
Compliance with the prescribed accounting policies			$15,000

Because of Defense Acquisition Regulations, numerous reports regarding size of business, number of minority employees, etc., are completed for our customers. The annual cost of completing these forms is $550.

Mr. LLOYD. Thank you very much, Mr. Schlosser. I appreciate your comments.

Mr. Singer?

STATEMENT OF STEWART SINGER

Mr. SINGER. Thank you. I want to thank you for inviting me to be present at the hearing. I am going to address my comments on the problems of financing the small business, specifically the high technology company.

I think I bring a somewhat unique background to this area of concern, so that while I have submitted comments for the record I would like to review my own background.

Mr. LLOYD. Yes. We will accept them for the record without objection.

Mr. SINGER. I bring a technical background including training in the combined fields of chemistry and physics at Harvard University and a graduate work and a degree from John Hopkins. I also hold an MDA in the field of finance from the Harvard Business School.

When I ended my academic career, I went into the specific field or commercial and in corporate development with large companies either in new product development internally or attempting to revitalize patents or other technological properties that existed within the firms and bring them into commercial format. I believe I was the youngest person in the country to ever hold the title director of corporate development for a New York Stock Exchange firm, functioned as corporate deal maker and developer of dormant technology.

I left that role in late 1968 and set up an independent business doing capital financing for companies as management consultant for those firms. My practical experiece therefore fell into many areas you heard witnesses relate to earlier both in the management and in the problems of fundraising, probably dealt with 50 odd companies over the following 12 years, got deeply involved with about 12 different levels of success, in some cases achieving results, achieving financing, some cases not, some cases watching companies proceeding in a reasonable aggressive manner, in others finding management or outside management, terminating business.

That experience ranged from, as I say, forwarding straightforward business propositions to one company that was forced out of business in the classical position of having achieved financing from a large firm with a great deal of support up to a certain stage in their technological development, at which the larger firm decided not to go forward, and that effectively closed the doors to alternate financing, because now a supposedly qualified entity had said no more.

Over the period from 1976 I entered into a situation which let me in 1978 buy up the assets of a small local business which had developed technology in the areas of pyrotechnics, which I spent 6 years effectively hanging on and going nowhere with an interesting product group but not enough money to do anything with it. A subsequent transaction resulted in the company that in the last 18 months has gone from 6 employees to 20, is deeply involved in the growth pattern in commercial sales that indicated potential to multiply the employment by maybe a factor of two or three more within this calendar year.

The company because of its particular area of involvement is deeply involved in the whole regulatory procedure both from an area of Government in which requirements and regulations are being augmented that affect directly ourselves, our business opportunity and on the other side from the control operations from the department such as OSHA, local fire and other regulations, shipping and other requirements relating to our products, all of which are regulated functions in this business.

So I believe we have had a fairly intensive involvement in both the Government and the regulatory procedures all out of proportion to the size and depth of the business.

We have had aggressively positive experiences in working with Government agencies, and we have had good support, exceedingly good support at both congressional and within the departmental activities in regulatory procedures.

However, I venture to say that I bring a somewhat unique background to this effect, and the average person would not have succeded to many of the levels we did if not only because they wouldn't have tried.

Specific examples we have a product that was formerly and specifically not allowed for mail shipment. We achieved a clearance from the Postmaster General, and we now have our products cleared for U.S. mail shipment, and that was going in against a formal, hard-written copy.

We have been active in certain regulations by the Coast Guard and have many of our ideas and thoughts incorporated in the original regulations as published. We were facing some other thoughts and ideas from large companies in the multibillion-dollar level and yet found we were given a fair and equitable hearing.

However, none of this would be possible and one of this will continue to be possible if we don't have the financial resources to support the physical cost of doing these various operations, whether it involves myself or somebody representing us in Washington or the testing or other data accumulation necessary to make a rational case for regulatory change or at this point the much tougher problem and one that I think people just on the panels find unique and agree to if you start to succeed in financing, your success getting the funds to support the manufacture of product, the shipment of the product, the sustaining of the receivable growth, all of which will be many times the dollar amounts of our previous needs and those needs that we have been able to accomplish to today.

I should also say we have achieved an SBA loan. That has made a significant difference in our ability over the short term but we asked for and got certain provisos on that loan which I think are not provided typically and affect our opportunity for future liquidity. We arranged the loan with a commitment on our part to the banker and from him through the SBA that let us restrict certain assets from inclusion in the loans so they would be available for future utilization if we needed additional funds. We also were able to work with the SBA in setting up a proviso that would allow receivables to be separated from the existing commitment at such a time that the bank felt we needed additional funds from that resource.

The classic problem is the encumbrance of assets at a given level and refusal to let those assets go out when they are no longer necessary for future financing but are now part of bureaucratic package, if you will, in which if any error occurs with the release of an asset the person has to release it has nothing to win and everything to lose in his position within the SBA organization.

The experience that I have had and I think you would find comparable to others in the panel and by others here earlier is that whatever the motivation, whatever the reward, the ultimate element of success of the business is the ability to develop financing, both equity capital and the debt structure to carry it. We do get deeply involved with speaking of motivations and incentives, rewards. We tend to speak of our society as a capitalistic society. We tend to compare it to socialist or controlled societies. I see the difference as being the existence of incentives so heavily referred to by Mr. Schlosser as opposed to a preplanned and controlled environment.

However the incentives come down, whether they are intellectual satisfaction or financial reward, neither will have an opportunity for fulfillment unless you have the opportunity for capital availability and capital development, and that availability and development is ultimately contingent on Government policy. Policy will reflect on the rewards available, and your negotiating for the placement of equity capital it reflects on tax conditions that affect the corporate ability to recover on your expenditures and your early development phases, and it is obviously involved with debt formulation through the use of the SBA.

It is my opinion that in today's environment equity capital is a noncompetitive investment. This is a result of a climate relating to both tax policy, realistic assessment of the time frame for reward on an equity investment, and the effective inflationary depreciation of the value of funds placed in any equity investment.

I would estimate and I think I am probably very optimistic on this that it is almost impossible to see a small business equity returned in less than 5 years, and more likely you are looking at a 10 to 15-year horizon. I do not see how an investor can rationally involve himself in an equity involvement yielding no return for an extensive period as that in a small company especially facing the risk elements involved.

We feel, though, that things can be done specifically by Government in action that dramatically would change that investment and make it competitive with other sources of investment and return available today.

I would like to make a recommendation or two. I would like to recommend that the placement of equity funds either in restricted stock or 1244 startup stock have a proviso that the investor can depreciate that investment over a time horizon thereby at least receiving return on his investment comparable to his own tax rate and reducing the net value of the investment. If he is successful in that investment, the recovery of his investment will allow a tax on the income achieved from the lower base and Government will not stand to lose in a significant manner.

I believe we had earlier comments today and on some other approaches with capital gains situation, but that alone does not justify an

equity investment in a business as opposed to a real estate investment where you do get that type of depreciation on your going in costs and you may generate a tax cash free flow out of the investment. You will generate a capital gain on the ultimate gain on the investment, but I am really suggesting very little difference from a comparable structure, not a major shift in the thinking we have applied to hard assets, and by the way, the hard asset, the real estate, is at least liquid, and you have a potential for sale, but the stock is restricted, and very unlikely you will find a secondary purchaser.

We need to create a more comparable risk reward pattern if we are to see funds move in this direction.

We would also like to see a change internal to the corporation, small company, especially in high technology, in early months or years is very often operating almost without revenue. It may or may not be under Government contract. It very often will be a group of technical people spending money, spending money on salaries, maybe on some lab and other equipment, and seeing no income. They will develop a substantial tax loss.

Under today's accounting and tax loss recovery conditions you are forced to write most of that loss off, therefore reducing the equity base of the company, on the assumption that the startup point you can achieve an equity investment to get rolling.

If I am realistic on my time estimates of recovery in a small business I believe the tax law conditions say they will let you have a 7-year carryforward. You find most of this equity writedown, because it expires before you can recover. It is very heavily true in Government contracts when your rate of return on the contract is going to be limited, and you may have spent many millions of dollars developing the product or concept to the point at which it can be sold.

We would like to see the entire carry forward loss be extended indefinitely, and we would also like to see it be transferrable. Transferrable has a double effect. Right now you basically can't buy a loss unless you are in the same area of business. So loss is realistically not transferrable. You have an asset now, a realizable package asset within the company, because if nothing worked out and the product potential ties that loss has a saleable value. This would have the effect of increasing potential for lending and would allow again the further opportunity for recovery and perhaps even some cash recovery through the depreciated investment of your equity participants. Right now these losses simply run out. They do not result in a tax reduction. The Government is not losing any funds revenue from the expiration of the loss, and, in fact, if it was carried forward, you would probably generate a net increase in tax, as there would be ultimately some purchase value contract involved.

With respect to debt financing I think if you look across the board and evaluating return on equity you seldom see companies achieving much over 20 percent return. When we deal as we have done SBA on what effectively is an equity type of long-term loan with today's interest rates we will be doing well to recover funds on that loan adequate to simply meet interest. Thinking of SBA money as a form of equity financing in the climate of interest rates of 20 percent is basically buying a short-term strangulation. The funds are only viable in what

I call above the line financing, that is, namely, financing receivable and inventory when you can generate a high annual return because of the turnover of the total amount of the debt.

This again further emphasizes the equity requirement and need in today's small business environment. We would like to see some changes made in the SBA structures. I think we have a problem again in that SBA financing looks on the ma and pa storefront with the small approach as it looks on the technology company, which is people intensive. They want the principals to make a heavy enough commitment, namely, their houses, their future revenue potentials, such that the SBA feels that they have the safe commitment of intensity of your effort. Perhaps at the storefront level this makes sense. My experience has been in the technology company the same principal who has guaranteed to take the risk probably put in all or most of his personal worth anyway to get the equity portion of the business involved, sits there on a daily basis in which he is more worried about meeting the payroll of his cohorts and his production people because those people have to be kept going than enjoying his own pay, and on top of that realizes that after that sacrifice if it turns out not to work he loses whatever home security he has hopefully attempted to achieve over the years.

I think we create a negative psychological environment for those actions needed to bring the business forward by overstructuring the risk.

We would like to suggest that the SBA structure its asset encumbrance in line with the recommendations of the banks participating on bank finance loan. The banker has, one, different view from the SBA officer in regulating the loan. He has an incentive to make money out of the business and out of the loan, not simply an incentive not to lose money or minimize his risk, and I believe will present a more reasonable though seldomly overgenerous set of conditions in structuring the protective clauses under the SBA lending.

Mr. LLOYD. Could I get you, Mr. Singer, to summarize? We are running out of time. We have to be out of here within the next 10 minutes.

Mr. SINGER. OK.

Mr. LLOYD. Mr. Lawrence hasn't even had a chance to speak.

Mr. SINGER. I will summarize very quickly.

The only additional recommendation we would like to make is that capital gains be adjusted by a depreciation factor reflecting inflation, again trying to deal on a real value investment.

We are concerned with I think the various steps I have just related, and it would dramatically change the availability of private capital, strongly support the effort to get the innovative environment into a workable posture and provide a very large improvement in the incentive it takes to make the risk of entering into your own innovative business practical. Thank you.

[The biographical sketch and prepared statement of Mr. Singer follows:]

COMMENTS ON THE PROBLEMS OF FINANCING SMALL BUSINESS, SPECIFICALLY THE HIGH TECHNOLOGY COMPANY.

STEWART M. SINGER
SIGMA SCIENTIFIC INC.
1830 S. Baker Avenue
Ontario, California, 91761

REPORT TO:

THE HOUSE SCIENCE AND TECHNOLOGY SUB-COMMITTEE ON INVESTIGATIONS AND OVERSIGHT.

April 10, 1980

SUMMARY.

The development of equity capital and the availability of debt financing are the two governing factors in the growth of any small business.

A fundamental motivation of our society under the common definition of capitalism, and in contrast to socialism, is the availability of an incentive approach as compared to planned development. These incentives ultimately come down to the personal rewards of the principals in any development. This reward is contingent upon the availability of working capital to develop the company.

Capital development in turn is heavily contingent upon government policy. Policy effects the reward available for the placement of equity capital. Policy effects the availability of debt capital through supportative programs by the SBA.

Equity capital is non competitive in today's investment climate as a result of tax policy, time for payout, and the inflationary depreciation of funds. Time horizons for rewards from small businesses are typically in the five to ten year cycle or greater. Investors cannot rationally involve themselves on an equity basis in this type of environment. The government must take action to provide a more realistic return.

We recommend; Depreciation of the capital investment in start-up companies, specifically, restricted stocks or 1244 stock; and indefinite carryforward of loss accumulation within the company, so that early losses become sources of equity development as the company moves into profitable programs.

We recommend; Further SBA development of its ability to provide debt capacity on a short term basis, unencumbered by many of the bureaucratic structures of SBA term debt. SBA debt should focus toward the guarantee program with banks, with the bankers developing restrictions and conditions consistent with standard proceedures.

We recommend; That capital gains be adjusted to represent a depreciation factor related to inflation, so that effective real capital available for reinvestment is protected for the investor.

We recommend; That small companies be allowed to bid on large follow on contracts after initial work with the proviso from the contracting office that the small company must subcontract with a major for fulfillment of contract. We recommend that SBA guarantees of contract financing be made available, thereby allowing companies to attain working capital on a short term basis from conventional lending sources.

We believe the above steps would vastly increase the opportunity for technological development by providing the working tools for growth.

COMMENTS ON THE PROBLEMS OF FINANCING SMALL BUSINESS, SPECIFICALLY THE SMALL HIGH TECHNOLOGY COMPANY.

Resume of Commentator.

Stewart M. Singer
1800 Elsinore Road
Riverside, California 92505

Education.

B.A. Degree, 1962 Harvard University, Chemistry and Physics.

M.A. Degree, 1964 Johns Hopkins University, Atomic and Molecular Physics, Chemical Physics.

M.B.A. Degree, 1966 Harvard Graduate School of Business Administration, Finance.

1966-1969 Corporate Positions in Commercial Development and Corporate Development. Youngest person ever to hold the title "Director of Corporate Development" for a New York Stock Exchange firm. Functional as corporate deal maker and developer of dormant technology.

1969-Present Indepenent consultant; active in new company financing and development. Directly responsible for over $6,000,000. of private placements. Developed new ventures, helped finance businesses typically involving high technology ranging from electronics to pyrotechnics. Provided management consulting for these companies as well as arranging financial placements. Purchased control of SIGMA SCIENTIFIC INC., financed same. Active in lobbying with the Coast Guard in development of Visual Distress Signal Carriage Requirement for pleasure craft. Organized international marketing effort, organized and facilitated staffing of rapidly growing company.

COMMENTS ON DIFFICULTIES OF SMALL BUSINESS DEVELOPMENT AND FINANCE.

The bedrock of any business, whether your corner store or the most sophisticated thinktank, is the invested capital which supports the operation. The brightest idea, the most competent marketing organization, the most efficient internal financial management, is still left powerless and impotent if the business does not have available to it the capital resources to carry on operations; and, even more important, that needed to support growth when initial efforts result in success.

The best of ideas will come up as a whopping zero if the company is without the necessary dollars to support its ongoing efforts. Even the best of management cannot operate without adequate financial support. The best of contracts cannot he serviced unless money can be raised to meet payrolls, and produce parts. The best products cannot be brought to market, delivered, and resupplied unless funds are available which allow the company to carry overall operating needs between concept, purchase, work in process, and delivery of the final product. This is true whether the final product is either paper or hard goods.

These needs grow larger, and the difficulty of supporting them greater, as success follows success. It is almost a truism that the more successful the business, the greater the problems it will create. Two men in a garage can survive for quite a while with very little expense. Initial success, an increase in payroll, ten people, and the dollar needs on a weekly and daily basis grow substantial. A major contract, heavy production, delivery requirements, whether paper or hard goods, and dollar needs grow geometrically. In addition, in looking for further growth, especially where government contracts are concerned, the governing factor becomes the dollar basis of the company, it's capital worth and resources. These will be the measure of the size of contracts that can be awarded. Wherever the company turns, opportunities reflect the same need, capital, always more capital. Ae the company grows, the ability of management to utilize its personal resources to meet these financial needs goes down just as the magnitude of financial requirements go up.

The effort of small business, the motivation for its effort, and the extention by individuals of their time, energy and risk; is all aimed at a key baserock of our social premise; the incentive for reward. We speak of a capitalistic system, especially compared with a socialist system. We claim that people respond best under the capitalistic approach, but when we distill the labels we find that what we are really saying is that people respond to incentives. In building a business, the incentive is ultimately financial reward. This is not to deny the secondary effects of satisfaction in achievement and growth; but all of these, if successful, will return the incentive, financial reward. Hence, we have as a fundamental condition of both our social and technological objective, the creation of opportunity to fulfill the incentive. But the incentive can only be fulfilled if we provide the tools for capital formation, for without those tools management will neither succeed technically nor financially, because their options will be restricted by conditions beyond their control.

It thus appears that the key incentive, the bedrock, the underlying foundation for success in the development of small business as a technological resource, is to create an environment in which this type of business can effectively succeed at the objective of capital formation. It is in these areas that major steps can be taken by government to create a climate and program which supports the incentive for technological success.

Historically, all approaches by government in this direction have gone back to encouraging two basic resources; 1) the investor, the individual or firm which can ultimately put equity capital into a firm, and 2) the development of growth through borrowed capital. (specifically and most often through the incentives and abilities supplied by the SBA). Both of these approaches or resources are valid and both can or may provide the necessary ability to create development capital. However, changes in our society, specifically today relating to our inflationary rate, raises serious questions about the viability of either resource.

First, for the individual investor, the motivation is return. He places his investment in a small company, because sometime in the distant future he convinces himself, or is convinced by the selling management, that the stock he bought will be worth many, many times the investment. However,

the facts come differently. The success rate is relatively small, and the large payouts, the ones that turns peoples attention, the IBM'S, the XEROX'S, the POLAROIDS, the many other special situations with small companies, all the really big successes invariably take many years. Very few investors remain long enough to benefit from the major wins with a small company, those companies that eventually are bought out or go public. An analysis will reveal that outside the garbage stock era of the 1960's, most firms successful enough to ultimately realize a return on capital for investors have required a minimum of five, and more likely ten to fifteen years of operating history and growth before this occurs. This means that an investor has placed his funds in a non yielding environment, zero yield, for a very long period. Whatever the return he achieves, after tax he may have a very small net gain. Especially when alocated against other opportunities for return, other investments may appear much more intelligent.

As an example, money placed in real estate is covered by deductions allowed by government tax policy, protected by hard assets against which borrowing can occur, and ultimately returns to the investor a chance for both recapping his original investment, and on top of that proceeding to a capital gain. All the while, he has drawn protected cash as tax free income and experienced relative liquidity. This type of opportunity creates a conflict with any motivation to place funds in a small business.

Also, while sources tend to speak of institutional and other investments, in reality today that type of investment does not occur until a firm has established a fairly substantial record, and so significant dollars are seldom available during the most critical periods in the initial opening of a small business and its development to the one to five million dollar sales level. It is in this very high risk, highly complicated period of development and growth that most of your creativity takes place, and yet it is a period in which the investor, if he has any common sense, is most likely to stay away. This leaves us with an analysis of alternate sources. Conventional banks are not going to lend to a small company. They may lend to the individual management if their own worth or estate can support certain

levels of lending. But these are limited. Further, as the company grows, the banks comment will usually be, "very nice, we wish you well, but if you are only one or two years old, you don't have a long enough track record to provide banking." Further, the banks are really not lenders of development funds, but are lenders for working capital. Namely, they provide an appropriate mechanism for expediting funds flows against receivables and perhaps inventory. Long term debt is not a part of this configuration. But even these areas are restricted for young companies.

To fill this gap, the SBA is empowered to guarantee to the lending institution against the risk of making long term loans to developing business, in effect, providing a form of equity formation by a debt vehicle. However, at todays rates, the viability of this approach becomes very questionable. Historically, a very satisfactory level of return on equity would be in the 20% - 30% range. With interest rates for smaller companies today reaching 22% - 24%, the company would be doing extremely well to simply support their SBA loan and, effectively, the generation of this capital is at best a break even proposition if not to a very large degree a heavy drag and drain on the company. In addition, broader analysis shows that the smaller company carries a burden of debt much higher in relation to its sales than a larger company, so that both the risk and the exposure are very great when overly leveraged by debt, whether SBA guaranteed or otherwise.

The lending capability available through SBA support is, at least at todays interest rates highly questionable as an effective means of creating a growth environment. Even at historically lower rates, SBA debt poses a significant risk. In addition, the secondary elements of an SBA loan, restrictions on management freedom, and the incumbrance of an individuals personal property, may, at least where the technology company is concerned, especially where a great number of other employees are involved, be contrary to the incentive we are trying to create in the business. It appears that we confuse the motivation of SBA lending of a relatively small amount to an individual to open a local neighborhood business, a store,

a retail outlet; with the funding of a business with a large number of individuals equally participating, where the owner/manager is placed at great personal risk, while trying to support salaries and income for a large number of employees. The stress and concern created by some of the conditions of these loan placements, may be ineffective in achieving the ultimate goal, the effective administration of the business, and the proper financing for its growth. We need to address the problem of how do we resolve these terms and conditions. We need to balance the risk exposure versus oppressive rigidity in seeking security.

RECOMMENDATIONS.

I would like to make the following recommendations;

To create an incentive for investment in small businesses we would recommend that the outside investor purchasing equity securities, namely stock, be allowed to depreciate his investment over a relatively short period, perhaps five years. In so doing, subject to his personal tax rate, he would automatically receive a return on this investment over a fixed period of time. He could evaluate the investment against other alternatives that offer comparable mechanisms. The concept is not foreign, it is effectively what we allow in real estate, and the motivation would create a massive pool of venture funds that today are highly restricted. If the securities are ultimately sold and a capital gain had occurred, the government would be receiving additional income because the basis would be reduced by the depreciation. If the business investment succeeds, everyhody wins.

Many conversations are going on today relating to the capital gains issue, and taxing thereon. We think all of those other considerations should be considered with respect to this investment, but specifically, from the individual's point of view, the initial depreciation of his cost would probably be more significant for the small and developing company than any other action that could be incurred.

Within the company, two changes in tax law could be equally significant. Today the company is allowed to deduct its development costs. These become typically a source of losses in the early years, and a reduction of net

worth. For tax purposes, the incentive is to turn the company around, make a profit, and use the tax loss to help turn that profit to equity for the business. Conceptually, it makes sense, but the time limits imposed on recouping operating losses hinder the small company. A large company with a profitable division can take advantage of its tax base in profitable divisions to absorb the losses of the development. The net cost to the company is reduced by possibly 50 - 60% of its effective expense. For a small start-up company with no income and no carryback provision, none of these returns apply.

We would like to suggest that a small business be allowed to carry forward any net loss accumulated until it is recovered. The investor would see a greater opportunity for the company to develop the equity it needs by recovering this loss, and see for the company an improved chance to foster its own growth as it swings from a development entity to a developing entity. Also, the management of the company would be able to carry the development costs as an asset on the argument that once the company had developed its business to a profitable level, the loss represents a cash potential. The start-up loss would be a real and valuable asset, not one that decreases with time. At very little cost to the government, and great value to the business, this shelter would provide a resource to further develop the equity of a company. This provides a double benefit in that this equity development would increase the value of the balance sheet, giving the company's bankers a better position from which to provide working capital for supporting the future growth.

We would also like to specifically recommend that capital gains to the investor should be depreciated by an inflationary factor, so that a person who puts his money aside on a long term basis will be able to return a realistic value on his investment, not a false value in which he receives a return which is effectively reduced in value by inflationary factors. If we can act in this direction, the incentives to the investor will be great, and the pool of funds available to support the very activity this committee is seeking will grow to a very substantial and positive degree.

Another area of change can substantially improve the reward for a new company. The historical pattern of a small business working in R & D for government is they develop a contract for a new item. The item is successful and now it gets assigned to a big company because a small company cannot provide financial support for the contract. Everything in the government contracting proceedure creates an effort in this direction. The contract officers can only be faulted if they place a major contract with a weak source. A weak source will of itself provide risk in the development of strategically important products. The big company has the team and effort to carry the program on, and also whereas the early contract may have nothing more than prototype considerations, the later stages will involve production and other efforts. We face a question of can a small company raise money to support such a contract. We are back to the capital formation question. Also, does the small firm have the competence to act.

We would like to venture a proposal which might facilitate money raising and answer the management question. We would suggest that a small company be placed in a position where a contracting officer can award a contract for subcontracting, namely, specifying that a contract is awarded with the condition that is be placed with a major. Such an effort would allow the officer to place the contract with a small company that may have questionable production capacity, but obviously having won the early phases be quite competent on the technical elements. The small company would then be in a position to itself negotiate with the major in placing the contract. It would then 1) pass the revenue through itself, 2) make income off the larger contract, even if only in an overriding advisory role, and 3) be in control of negotiating for its own benefit.

All of these considerations are consistent with the concept which says a small company which has initially developed a technology should, as a result of that, be the best one to judge whether final developments are in a proper and technically supportive manner. Remember, we have suggested that the contracting officer can require subcontracting of a major portion, so that he can act to protect the financial liability. We would also like to

suggest that here is an area where the SBA could be the lever to support final results. In that direction, SBA funds should be made available to cover working capital needs under the combined contract, subcontract program. The smaller company acting as contractor would be able to provide its own financial security with SBA support during the time of delayed funds flow of the contract.

Also, in general, an SBA program which can guarantee large, single source receivables on technical products - even when non government, would substantially increase a bankers ability to work with young companies and support rapid growth.

In summary, we recommend that major steps be taken to facilitate capital formation for small business. We recommend tax changes to encourage equity investment. We recommend that the ability of the SBA ability to support small business be inhanced by both conceptual and proceedural changes which will allow the funding provided by that instrument to be (more) effective in promoting the businesses development and less of a threat to the operating security of the principals. We also recommend contracting changes designed to facilitate the opportunity of the company to grow and control its technical expertise. It is reasonable that positive motivation is the objective of this program, and that a person who has already subjected himself to the risk of this program, and has made a very strong statement as to his motivation.

Mr. LLOYD. Thank you very much.

Mr. Lawrence, I apologize. We have to roll along.

STATEMENT OF JIM LAWRENCE

Mr. LAWRENCE. Following all of this testimony and all of these experts I feel somewhat like that fellow that died in the Johnstown flood, and then, considering himself an expert in flood safety, he asked St. Peter to appeal to the Heavenly Host, and St. Peter consented, and just as a guy was about to be introduced to go on stage, St. Peter reminded him, he said, watch out what you say, fellow, Noah is out there.

So with that being the case, I am glad to be here today.

The Pioneer spacecraft, which encountered the planet Saturn last summer after years in space, contained instruments which Analog Technology Corp. had designed, developed, and fabricated as part of its main thrust in the high technology aerospace business.

It is ironic that these and other instruments which the company built during the first 10 years of its 15-year existence continue to generate material for Ph. D. dissertations, while the organization that created them almost disappeared and the majority of the large technical cadre has diffused into industries, many of which are totally unrelated to space technology.

However, the volatility of small companies and the migration of experienced personnel who transfuse Government-sponsored technology into other fields of endeavor is one of the principal and unsung benefits resulting from the Government-small business relationship.

Since ATC is no longer concentrating its energies in the Government-sponsored R. & D. arena, there was a certain reluctance on my part to appear before this committee.

That ATC has survived is due in large measure to the fact that we are still selling and exploiting technology and abilities honed on Government-funded projects, and in acknowledgement and appreciation of that support, I decided to appear. The story of the successes and problems faced by ATC in its tempestuous 15-year history are certainly relevant to the quest of this committee.

ATC was founded in 1965 by three principals, all filled with idealism, enthusiasm, and motivation to succeed and prosper.

While not isolated among small business, these virtues are among the underlying reasons why small companies generally accomplish far more with a given R. & D. dollar than large, established firms. We had left the Cal-Tech Jet Propulsion Laboratory after almost a decade of work in guided-missile systems and key participation in the fledgling space-science instrument field. Large business pressures to force intrument development activities out of JPL and into industry were among the reasons for our startup.

In the first year we functioned successfully as consultants to major aerospace corporations, and after building our reputation by designing exotic power supplies, custom signal-processing electronics and specialized data systems under contracts from various universities and NASA centers, we attained our goal as first-tier contractors for the design, development and fabrication of complete scientific instruments. A partial list of these accomplishments is attached to this statement.

In 1968 we had profitable sales of almost $1.5 million. It should be realized that while the overall NASA budget was still building during this period, the majority of funds were going into the Apollo program, and the number of small unmanned scientific spacecraft programs were already declining.

This reduction in spacecraft contracts reduced opportunities for small companies and caused many large companies to refocus their attention on space-instrument development programs which, while fewer in number, were increasing in complexity and cost.

In 1969 with a staff of approximately 65 seasoned people, we competed against the combined team of TRW-Perkin-Elmer-Beckman for the privilege of developing the JPL Viking Mars Lander gas chromatograph-mass spectrometer. Due to the high technical nature of the RFP, the fortitude of the JPL technical officers and source evaluation board, we won the contract. While the RFP statement of work called for a subsequent single-source contract for the build of the flight hardware, the resulting contract did not.

In this period, through personally guaranteed bank loans, we acquired equipment and immediately increased the technical staff to a peak of 230 people.

Within 2 months of contract award, Congress slipped the Viking program 2 years, the funding was drastically reduced, and our role as system contractor was altered to that of design support for JPL.

We reduced the staff to about 170 people, and in the next 2 years under JPL direction we designed 90 percent of the GC/MS electronics four times.

In early 1971 under pressure from the NASA Langley Viking Project Office and, in contrast to the original RFP work statement, JPL let an RFP for the build of the flight hardware, and at this time ATC faced the team of Litton-Perkin Elmer-Beckman.

Although we formed a team with some major companies, after repeated cost proposal submissions, we lost the job. At this time an extensive review of the GC/MS project was conducted and the review board concluded that the project schedule could not be successfully attained without ATC's participation in the GC/MS electronics design.

Overnight we were under contract to Litton to complete the design and packaging of all the GC/MS electronics.

In the post-award negotiations between JPL, NASA, and Litton, Litton's costs started to escalate from $14 million to $19 million. NASA Langley canceled the first prototype units to reduce costs, and our subcontract with Litton was immediately terminated.

Although we were accused of lacking management depth, it is a matter of record that ex-ATC employees subsequently assumed the majority of key management and design roles at all of our competition's companies. The GC/MS project actuals ran out to an incredible and unnecessary $44 million.

Our efforts to obtain a contract to build the Viking tape recorder electronics were also fruitless with the Source Evaluation Board making the conflicting statements that our electronic design concept was too sophisticated and advanced to be committed to a mission-oriented program, yet criticizing us for lack of understanding since we had

not built "Flight Tape Recorder Electronics." We were told at this time to stay away from the big ones.

At the urging of Martin-Marietta Corp., who became the prime contractor for the Viking bus and lander vehicles, we submitted several proposals for other scientific instruments. These instruments were contracted in a package deal for an undisclosed price to our former GC/MS phase II team member, Bendix Aerospace.

As we hear news reports this week of Viking II's batteries finally giving up, our company, for all its problems, is still paying off a $50,000 settlement on facility leases that were incurred in the performance of the Viking GC/MS project. When the final value of the obligation became known in 1974, JPL refused all responsibility for the debt, and invited us to challenge the law firm of O'Melveney & Myers to establish the legality of the claim.

In the years following 1971 we sold a commercial product line to pay off our bank debt, reduced our staff to about 35 people, and searched for funds to further develop our technology.

In writing coproposals with the UCLA Medical Center and the city of Hope, the proposals were judged by NSF as being too engineering-oriented, and by NIH as too research-oriented.

When we were finally about to receive an award for a revised proposal from NIH, the Nixon administration impounded their funds, and the contract did not materialize.

In 1975 we wrote our last major space-science proposal to a former customer, who finally told us that although the proposal was technically superior and the price was competitive, they were going with a big company in the hope that that organization would absorb the cost overruns on the fixed-price contract.

We then attempted to attract private venture capital to provide development capital to enter the analytical-instrument marketplace.

With depleted incentives for small business investment and the bad market experiences of the late 1960's and the fact that virtually no new small, high-technology stocks were issued in California between 1971 and 1975, this search was useless.

We then turned to the banks and obtained $325,000 in two stages of SBA-guaranteed loans collateralized by the company's assets and the real estate holdings of the two principal shareholders, company officers.

We simultaneously continued to seek Government funding to commercialize our mass spectrometer technology, and with the help of seed money from the NASA Technology Utilization Office and the assistance of personnel from NASA Langley Research Center, we received a contract to develop and build an automated trace-gas analyzer, an air pollution analyzer.

This contract, funded by four different Government agencies and a larger number of offices, proved to be the most interesting of all the contracts fulfilled by our company.

As the contract definition and costs expended due to requirements of the different agencies, NASA found itself exposed to a significant portion of the project costs when it had originally started out with a seed contribution.

Needless to say, ATC became very visible at NASA headquarters and among top-level NASA Langley management.

66-228 O - 81 - 37

When NASA Langley realized our financial problems, they assigned some firstrate talent to break loose our contract withholds and resolve our short-term cash-flow problems.

The contract provided for development of the entire automated mass spectrometer system and delivery of six complete systems in addition to the prototype for a cost, total cost, of about $1.8 million.

Its technology impact on the commercial market is only now being realized, but will still be a significance when the Viking GC/MS is long forgotten. I should point out that this technology was also due to an investment of $375,000 based on ATC's retained earnings and bank loans.

Through the 1976–77 period, and coincident with the NASA Langley contract, we were experiencing marked success with one of our products and partial success with another.

The marketplace dictated some further development expenses of the latter product, and we again attempt to obtain private venture capital to meet our commercial backlog—about $170,000—and to complete this project. We could not factor the purchase orders because of the SBA assignments and private venture people were concerned that their capital would be preempted by the SBA.

In October 1977, when we obtained the support of a private consortium and an SBIC who would immediately invest $330,000 combined with a means for further investment, the SBA refused to subordinate its debt position to the consortium on the premise that it was illegal because of the involvement of a federally chartered SBIC.

In the spring of 1978, as we were completing fabrication of the model 2001 mass spectrometers for NASA, the SBA started to withhold the contract progress payments that were coming from NASA and stated they would continue this practice.

In desperation we initiated contacts to sell our commercial product lines to prevent the imminent foreclosure.

We sold our electron-capture detector product line to Valco Instruments of Houston, and, most significantly, our mass-spectrometer technology to UTI of Sunnyvale, Calif., with whom we have an ongoing business relationship.

When informed of the details of the sale to UTI and UTI's willingness to assume ATC's SBA loan, the SBA agreed to the terms and stated they would release ATC and the second trust deeds of the ATC principals; however, when the final documents were signed in August 1978, they altered their position, and as a result, they still retain second-trust deeds on our homes as collateral on the loan which UTI assumed. Interestingly, the terms of this loan have been renegotiated with UTI once and are about to change again, without consentf rom the guarantors.

The sales to Valco and UTI paid off the loans and creditors and left ATC as a clean company with positive net worth and residual technology. The trauma of the events over the preceding years had severed a 20-year relationship with my former partner, and in late 1979 I raised equity capital and bought him out.

ATC today is still a high-technology company and is focusing its energy and capabilities in contracting development services to companies in the analytical instrument industry and in direct OEM product sales to the same types of firms.

The paperwork, preparation and expense to accomplish this is far less than dealing with the Government and is aided by our customers' acknowledgement that we must make a profit.

We are also working on application of our technology base to other analytical instrument disciplines and to custom industrial control systems utilizing our data system and mass spectrometer experience. We are still generating new product ideas, fulfilling requirements that the major instrument companies are passing by.

Why aren't we still pursuing Government contracts? The vigorous accomplishments of ATC were due in large measure to Government sponsorship and to an extent, we are grateful. The small company must always face the transfer-of-responsibility syndrome when trying to obtain major Government contracts. Let's face it, very few Government administrators bucking for the next GS grade which may determine their future and/or retirement benefits are going to risk exposure to themselves and their superiors in the event a major contract let to a small company goes awry. If the same contract goes afoul with a major contractor, it is more credible to say if that contractor, with his infinite resources, couldn't accomplish it, who could?

The very concept of the word "set-asides" denotes what it is: the leftovers. In many cases the proposal preparation costs are not much less on $100,000 jobs than on $12 million jobs. After disallowances and contract cost-withholds—at times the Government was holding $100,000 or better of our money and interest is not an allowable expense—our typical yield was about 1.8 percent after tax on gross sales, which was a typical industry experience in the early and mid-1970's. While there are some good profits to be made on fixed-price development, it is a risk beyond the ability of the small company. Well-financed larger companies statistically gamble on the fixed-price development contracts with the knowledge that what they lose on one, they'll recapture on another, and they will certainly get well on the follow-on manufacturing contracts.

Another problem with high-technology contracts, certainly in aerospace, is the requirement for maintaining considerable staffs of people whose duties center on various types of reporting, quality assurance, and parts reliability.

The cost of these activities runs from 25 percent to 60 percent of direct product cost, depending upon what agency you're working for. These reporting requirements grow out of the necessity to protect everybody within the system and stem from the transfer-of-responsibility syndrome. Nobody ever wants to admit what they cost. If you don't maintain these personnel on your staff, the Government considers you unqualified, and yet everybody balks at your overhead costs if you maintain them between contracts.

In a preface remark to my recommendations offer, I would submit that this country built up a technology bank account due to the Government-sponsored development that occurred because of the aerospace requirements.

The Government-induced acceleration in the development of electronics, and materiels technology gave us a leading edge which for some time contributed toward a reduction in our country's balance of payments.

While this may not seem relevant to small business, I am aware of many companies in the $3 to $20 million range who are doing more than half their annual sales ovrseas.

The lack of investment incentives and decrease in Government-aided technology development have vastly depleted this technology account, and this will impact our economy even more in the next few years. Germany, France, England, and Japan are highly involved with stimulating their technology companies. It is time that we heed this and redirect our efforts to stimulate technology. Aid to the small companies will yield the fastest results.

My recommendations are as follows:

1. Do everything possible to encourage the formation of venture capital for small companies. This would involve or include immediate direct-tax credits upon investment, reduced capital-gains tax and a total tax moratorium on subsequent profits which are reinvested. The fledging companies' profits might be tax free for the first 8 years. In the event of infant mortality of a new enterprise, an additional tax credit might be allowed to ease the losses and encourage further investment.

2. The set-aside program must be expanded to have real meaning. Small companies should be encouraged to bid on major Government contracts and efforts made to lessen the responsibility-of-transfer syndrome. This might be aided by pre-RFP surveys which establish the validity of a company's technical capability before expensive proposals are generated. The SBA could be used as a direct source of low-interest funds to provide equipment acquisition, working capital, et cetera. While this has been done for minority-owned enterprises, it has been nonexistent for other small high-technology companies.

3. Reduce cash-flow requirements of small companies by providing advances on contract payments. The Government cycle time on progress payments typically runs 90–120 days, and we always had to borrow to bridge the gap. With short-term money at rates in excess of 20 percent, this is even more important.

4. While stock-option plans may have been wildly misused in the new technology growth craze of the 1960's, they were nevertheless a key factor in the acquisition of the sharp and eager capability required for staffing a new enterprise. The tax-law restrictions have obliterated this incentive and should be rescinded for small companies.

5. Give the small companies rights in Government-sponsored technology for a 10-year period following disclosure. The Government can't do anything with it, and the entrepreneurs and their prospective investors will be encouraged to move the technology to the commercial marketplace. ATC was able to sell its mass spectrometer technology because it declared its patents going into the NASA Technology Utilization contract. Expand the scope of effort and amounts of money available to organizations such as the NASA Technology Utilization Office.

6. Keep trying in all of the above efforts and persevere. I will pray for your success.

[The prepared statement of Mr. Lawrence follows:]

Analog
Technology
Corporation

STATEMENT OF

JAMES L. LAWRENCE, JR.

PRESIDENT

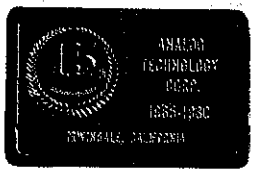
ANALOG TECHNOLOGY CORPORATION

AT A FIELD HEARING OF THE

HOUSE SCIENCE AND TECHNOLOGY SUBCOMMITTEE

AT POMONA, CALIFORNIA

APRIL 10, 1980



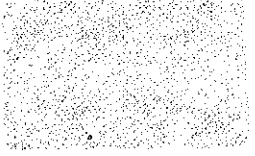
15859 East Edna Place, Irwindale, California 91706. Telephone: (213) 960-4004

The Pioneer Spacecraft, which encountered the planet Saturn last summer after years in space, contained instruments which Analog Technology Corporation (ATC) had designed, developed and fabricated as part of its main thrust in the high-technology aerospace business. It is ironic that these and other instruments which the company built during the first ten years of its fifteen-year existence continue to generate material for Ph.D. dissertations, while the organization that created them almost disappeared and the majority of the large technical cadre has diffused into industries, many of which are totally unrelated to space technology. However, the volatility of small companies and the migration of experienced personnel who transfuse Government-sponsored technology into other fields of endeavor is one of the principal and unsung benefits resulting from the Government-small business relationship.

Since ATC is no longer concentrating its energies in the Government-sponsored R and D arena, there was a certain reluctance on my part to appear before this committee. That ATC has survived is due in large measure to the fact that we are still selling and exploiting technology and abilities honed on Government-funded projects, and in acknowledgement and appreciation of that support, I decided to appear. The story of the successes and problems faced by ATC in its tempestuous fifteen-year history are certainly relevant to the quest of this committee.

ATC was founded in 1965 by three principals, all filled with idealism, enthusiasm and motivation to succeed and prosper. While not isolated among small business, these virtues are among the underlying reasons why small companies generally accomplish far more with a given R and D dollar than large, established firms. We had left the Cal-Tech Jet Propulsion Laboratory after almost a decade of work in guided missile systems and key participation in the fledgeling space-science instrument field. Large business pressures to force instrument development activities out of JPL and into industry were among the reasons for our startup.

In the first year we functioned successfully as consultants to major aerospace corporations, and after building our reputation by designing exotic power supplies, custom signal-processing electronics and specialized data systems under contracts from various universities and NASA centers, we attained our goal as first-tier contractors for the design, development and fabrication of complete scientific instruments. A partial list of these accomplishments is attached to this statement.



The Pioneer Spacecraft, which encountered the planet Saturn last summer after years in space, contained instruments which Analog Technology Corporation (ATC) had designed, developed and fabricated as part of its main thrust in the high-technology aerospace business. It is ironic that these and other instruments which the company built during the first ten years of its fifteen-year existence continue to generate material for Ph.D. dissertations, while the organization that created them almost disappeared and the majority of the large technical cadre has diffused into industries, many of which are totally unrelated to space technology. However, the volatility of small companies and the migration of experienced personnel who transfuse Government-sponsored technology into other fields of endeavor is one of the principal and unsung benefits resulting from the Government-small business relationship.

Since ATC is no longer concentrating its energies in the Government-sponsored R and D arena, there was a certain reluctance on my part to appear before this committee. That ATC has survived is due in large measure to the fact that we are still selling and exploiting technology and abilities honed on Government-funded projects, and in acknowledgement and appreciation of that support, I decided to appear. The story of the successes and problems faced by ATC in its tempestuous fifteen-year history are certainly relevant to the quest of this committee.

ATC was founded in 1965 by three principals, all filled with idealism, enthusiasm and motivation to succeed and prosper. While not isolated among small business, these virtues are among the underlying reasons why small companies generally accomplish far more with a given R and D dollar than large, established firms. We had left the Cal-Tech Jet Propulsion Laboratory after almost a decade of work in guided missile systems and key participation in the fledgeling space-science instrument field. Large business pressures to force instrument development activities out of JPL and into industry were among the reasons for our startup.

In the first year we functioned successfully as consultants to major aerospace corporations, and after building our reputation by designing exotic power supplies, custom signal-processing electronics and specialized data systems under contracts from various universities and NASA centers, we attained our goal as first-tier contractors for the design, development and fabrication of complete scientific instruments. A partial list of these accomplishments is attached to this statement.

In 1968, we had profitable sales of almost $1.5 million. It should be realized that while the overall NASA budget was still building during this period, the majority of funds were going into the Apollo Program, and the number of small unmanned scientific spacecraft programs were already declining. This reduction in spacecraft contracts reduced opportunities for small companies and caused many large companies to refocus their attention on space-instrument development programs which, while fewer in number, were increasing in complexity and cost.

In 1969, with a staff of approximately 65 seasoned people, we competed against the combined team of TRW-Perkin Elmer-Beckman for the privilege of developing the JPL Viking Mars Lander gas chromatograph/mass spectrometer (GC/MS). Due to the highly technical nature of the RFP, the fortitude of the JPL technical officers and Source Evaluation Board, we won the contract. While the RFP Statement of Work called for a subsequent single-source contract for the build of the flight hardware, the resulting contract did not.

In this period, through personally guaranteed bank loans, we acquired equipment and immediately increased the technical staff to a peak of 230 people. Within two months of contract award, Congress slipped the Viking Program two years, the funding was drastically reduced, and our role as system contractor was altered to that of design support for JPL. We reduced the staff to about 170 people, and in the next two years, under JPL direction, we designed 90% of the GC/MS electronics four times. In early 1971, under pressure from the NASA Langley Viking Project office and, in contrast to the original RFP Work Statement, JPL let an RFP for the build of the flight hardware, and this time ATC faced the team of Litton-Perkin Elmer-Beckman. Although we formed a team with some major companies, after repeated cost proposal submissions, we lost the job. At this time, an extensive review of the GC/MS project was conducted and the Review Board concluded that the project schedule could not be successfully attained without ATC's participation in the GC/MS electronics design. Overnight, we were under contract to Litton to complete the design and packaging of all the GC/MS electronics. In the post-award negotiations between JPL, NASA and Litton, Litton's costs started to escalate from $14 million to $19 million. NASA Langley cancelled the first prototype units to reduce costs, and our subcontract with Litton was immediately terminated. Although we were accused of lacking management depth, it is a matter of record that ex-ATC employees subsequently assumed the majority of key management and design roles at all of our competitors' companies. The GC/MS project actuals ran out to an incredible and unnecessary $44 million.

Our efforts to obtain a contract to build the Viking tape-recorder electronics were also fruitless with the Source Evaluation Board making the conflicting statements that our electronicc design concept was too sophisticated and advanced to be committed to a mission-oriented program, yet criticizing us for lack of understanding since we had not built "Flight Tape Recorder Electronics". We were told at this time to stay away from the big ones.

At the urging of Martin-Marietta Corporation, who became the prime contractor for the Viking Bus and Lander Vehicles, we submitted several proposals for other scientific instruments. These instruments were contracted in a package deal for an undisclosed price to our former GC/MS Phase II team member, Bendix Aerospace.

As we hear news reports this week of Viking II's batteries finally giving up, our company, for all its problems, is still paying off a $50,000 settlement on facility leases that were incurred in the performance of the Viking GC/MS project. When the final value of the obligation became known in 1974, JPL refused all responsibility for the debt, and invited us to challenge the law firm of O'Melveney and Myers to establish the legality of the claim.

In the years following 1971, we sold a commercial product line to pay off our bank debt, reduced our staff to about 35 people, and searched for funds to further develop our technology. In writing co-proposals with the UCLA Medical Center and the City of Hope, the proposals were judged by NSF as being too engineering-oriented, and by NIH as too research-oriented. When we were finally about to receive an award for a revised proposal from NIH, the Nixon administration impounded their funds, and the contract did not materialize. In 1975, we wrote our last major space-science proposal to a former customer, who finally told us that although the proposal was technically superior and the price was competitive, they were going with a big company in the hope that that organization would absorb the cost overruns on the fixed-price contract. HA!

We then attempted to attract private venture capital to provide development capital to enter the analytical-instrument marketplace. With depleted incentives for small business investment and the bad market experiences of the late 60's and the fact that virtually no new small, high-technology stocks were issued in California between 1971 and 1975, this search was useless. We then turned to the banks and obtained $325,000 in two stages of SBA-guaranteed loans collateralized by the company's assets and the real-estate holdings of the two principal shareholders, company officers.

We simultaneously continued to seek Government funding to commercialize our mass spectrometer technology, and with the help of seed money from the NASA Technology Utilization Office and the assistance of personnel from NASA Langley Research Center, we received a contract to develop and build an Automated Trace-Gas Analyzer, an Air Pollution Analyzer. This contract, funded by four different Government agencies and a larger number of offices, proved to be the most interesting of all the contracts fulfilled by our company. As the contract definition and costs expanded due to requirements of the different agencies, NASA found itself exposed to a significant portion of the project costs when it had originally started out with a seed contribution. Needless to say, ATC became very visible at NASA headquarters and among top-level NASA Langley management. When NASA Langley realized our financial problems, they assigned some first-rate talent to break loose our contract withholds and resolve our short-term cash-flow problems. The contract provided for development of the entire automated mass spectrometer system and delivery of six (6) complete systems in addition to the prototype, for a total cost of $1.8 million. Its technology impact on the commercial market is only now being realized, but will still be of significance when the Viking GC/MS is long forgotten. I should point out that this technology was also due to an investment of $375,000 based on ATC's retained earnings and bank loans.

Through the 1976-77 period, and coincident with the NASA Langley contract, we were experiencing marked success with one of our products and partial success with another. The marketplace dictated some further development expenses of the latter product, and we again attempted to obtain private venture capital to meet our commercial backlog (about $170,000) and to complete this product. We could not factor the purchase orders because of the SBA assignments and private venture people were concerned that their capital would be pre-empted by the SBA. In October 1977, when we obtained the support of a private consortium and an SBIC who would immediately invest $330,000 combined with a means for further investment, the SBA refused to subordinate its debt position to the consortium on the premise that it was illegal because of the involvement of a federally chartered SBIC.

In the spring of 1978, as we were completing fabrication of the Model 2001 Mass Spectrometers for NASA, the SBA started to withhold the contract progress payments that were coming from NASA and stated they would continue this practice. In desparation, we initiated contacts to sell our commercial product lines to prevent the imminent foreclosure. We sold our Electron-Capture Detector product line to Valco Instruments of Houston, and, most significantly, our Mass-Spectrometer technology to UTI of Sunnyvale, California, with whom we have an ongoing business relationship.

When informed of the details of the sale to UTI and UTI's willingness to assume ATC's SBA loan, the SBA agreed to the terms and stated they would release ATC and the second trust deeds of the ATC principals; however, when the final documents were signed in August 1978, they altered their position, and as a result, they still retain second trust deeds on our homes as collateral on the loan which UTI assumed. Interestingly, the terms of this loan have been renegotiated with UTI once and are about to change again, without consent from the guarantors.

The sales to Valco and UTI paid off the loans and creditors and left ATC as a clean company with positive net worth and residual technology. The trauma of the events over the preceding years had severed a 20-year relationship with my former partner, and in late 1979 I raised equity capital and bought him out.

ATC today is still a high-technology company and is focussing its energy and capabilities in contracting development services to companies in the analytical-instrument industry and in direct OEM product sales to the same types of firms. The paperwork, preparation, and expense to accomplish this is far less than dealing with the Government and is aided by our customers' acknowledgement that we must make a profit. We are also working on application of our technology base to other analytical-instrument disciplines and to custom industrial control systems utilizing our data system and mass spectrometer experience. We are still generating new product ideas, fulfilling requirements that the major instrument companies are passing by.

Why aren't we still pursuing Government contracts? The vigorous accomplishments of ATC were due in large measure to Government sponsorship and to an extent, we are grateful. The small company must always face the "Transfer of Responsibility" (my term) syndrome when trying to obtain major Government contracts. Let's face it, very few Government administrators bucking for the next GS grade which may determine their future and/or retirement benefits are going to risk exposure to themselves and their superiors in the event a major contract let to a small company goes awry. If the same contract goes afoul with a major contractor, it is more credible to say if that contractor, with his infinite resources, couldn't accomplish it, who could?

The very concept of the word "setasides" denotes what it is: the leftovers. In many cases, the proposal preparation costs are not much less on $100,000 jobs than on $12 million jobs. After disallowances and contract cost-withholds (at times the Government was holding $100,000 or better of our money and interest is not an allowable expense), our typical yield was about 1.8%

after tax on gross sales, which was a typical industry experience in the early and mid-70's. While there are some good profits to be made on fixed-price development, it is a risk beyond the ability of the small company. Well-financed larger companies statistically gamble on the fixed-price development contracts with the knowledge that what they lose on one, they'll recapture on another, and they will certainly get well on the follow-on manufacturing contracts.

Another problem with high-technology contracts, certainly in aerospace, is the requirement for maintaining considerable staffs of people whose duties center on various types of reporting, quality assurance, and parts reliability. The cost of these activities runs from 25% to 60% of direct product cost, depending upon what agency you're working for. These reporting requirements grow out of the necessity to "protect" everybody within the system and stem from the "Transfer of Responsibility" syndrome. Nobody ever wants to admit what they cost. If you don't maintain these personnel on your staff, the Government considers you unqualified, and yet everybody balks at your overhead costs if you maintain them between contracts.

In a preface remark to my recommendations offer, I would submit that this country built up a technology bank account due to the Government-sponsored development that occurred because of the aerospace requirements. The Government induced acceleration in the development of electronics, and materiels technology gave us a leading edge which for some time contributed toward a reduction in our country's balance of payments. While this may not seem relevant to small business, I am aware of many companies in the $3-$20 million range who are doing more than half their annual sales overseas. The lack of investment incentives and decrease in Government-aided technology development have vastly depleted this technology account, and this will impact our economy even more in the next few years. Germany, France, England, and Japan are highly involved with stimulating their technology companies. It is time that we heed this and redirect our efforts to stimulate technology. Aid to the small companies will yield the fastest results.

My recommendations are as follows:

1) Do everything possible to encourage the formation of venture capital for small companies. This would include immediate direct tax credits upon investment, reduced capital gains tax and a total tax moratorium on subsequent profits which are reinvested. The fledgling companies' profits might be tax free for the first

eight years. In the event of infant mortality of a new enterprise, an additional tax credit might be allowed to ease the losses and encourage further investment.

2. The "set aside" program must be expanded to have real meaning. Small companies should be encouraged to bid on major Government contracts and efforts made to lessen the "Responsibility Transfer" syndrome. This might be aided by pre-RFP surveys which establish the validity of a company's technical capability before expensive proposals are generated. The SBA could be used as a direct source of low-interest funds to provide equipment acquisition, working capital, etc. While this has been done for "Minority Owned" Enterprises, it has been non-existent for other small high-technology companies.

3. Reduce cash-flow requirements of small companies by providing advances on contract payments. The Governmant cycle time on progress payments typically runs 90-120 days, and we always had to borrow to bridge the gap. With short-term money at rates in excess of 20%, this is even more important.

4. While stock-option plans may have been wildly misused in the new-technology growth craze of the 60's, they were nevertheless a key factor in the acquisition of the sharp and eager capability required for staffing a new enterprise. The tax-law restrictions have obliterated this incentive and should be rescinded for small companies.

5. Give the small companies rights in Government-sponsered technology for a ten year period following disclosure. The Government can't do anything with it, and the entrepreneurs and their prospective investors will be encouraged to move the technology to the commercial marketplace. ATC was able to sell its mass spectrometer technology because it declared its patents going into the NASA Technology Utilization contract. Expand the scope of effort and amounts of money available to organizations such as the NASA Technology Utilization Office.

6. Keep trying in all of the above efforts and persevere. I will pray for your success.

JAMES L. LAWRENCE, JR., P.E.
PRESIDENT
ANALOG TECHNOLOGY CORPORATION

Jim is a founder of ATC and was Executive Vice President and General Manager from the Corporation's inception in 1965 until May 1979 and in that position was responsible for all engineering and manufacturing projects. During this period he managed the Company's growth to sales in excess of $4 million a year and a peak employment level of 230 people. Jim designed and instituted many effective cost-performance evaluation systems, managed many of the successful proposals that were vital to business acquisition, and was responsible for all project cost estimates. He established contract definitions and participated in all the companies contract negotiations. As President of ATC, Jim is responsible for the overall conduct and profitability of the business. His primary duties currently include customer contact, generation of new business opportunities to insure the companies growth and acquisition of capital to sustain that growth.

A research engineer with an extensive backround in space instrumentation and missile systems, Mr. Lawrence has been associated with all of the Company's programs. For a significant part of the Company history he specialized in circuit design of programmable, closed-loop high-voltage power supply systems. He is often requested to provide consultation on scientific instrument programs by outside companies and laboratories, and was a co-experimenter with Dr. Conway Snyder and Marcia Neugebauer of JPL on a plasma spectrometer for the OGO-E spacecraft. Most recently, as Program Manager, Mr. Lawrence led the development of the ATC Model 2001 Mass Spectrometer System and made significant contributions to the electronic designs and system mechanization in addition to innovative methods for fabrication of the Mass Filter which led to several patents. He also led the design and integration effort that allows ATC's Control and Data System to function as a plug in addition to all existing UTI 100C Mass Spectrometers.

Jim was previously at Jet Propulsion Laboratory for 8 years, as Engineering Supervisor of the Interplanetary Instruments Group, he directed the development of low-energy plasma instruments and low-field magnetometers. Among them was the vector helium magnetometer that successfully measured the interplanetary magnetic field traversed by the route to Venus and Mars. Earlier, as Senior Research Engineer, he developed a solid state electrometer and automatic scale factor device for linear compression of seven decades. He was also co-developer of the solar plasma instrument for Rangers 1 and 11. For several years Mr. Lawrence was with the Guidance and Control Division of JPL. He developed analog guidance and warhead arming computers for various missiles and over a 2 year period, supervised the guidance computer integration and R&D firings of the Sergeant Missile.

Jim received a B.S.E.E. from the University of Illinois (1957) and did graduate work in engineering at UCLA. He has since completed many business and management courses at UCLA and at the California Institute of Technology. He has three patents to his credit with a fourth pending and is a registered professional engineer in California.

He has authored several papers and articles on space instrument design and application. His avocational interests include music, flying, skiing and automotive restoration. Mr. Lawrence is a veteran of four years service in the U.S. Navy from June 1948 to May 1952. He is a member of the La Canada United Methodist Church Sanctuary Choir and a trustee of that church. He is also active in the Glendale Community Chorale.

A PARTIAL LIST OF PUBLICATIONS AND ORAL PRESENTATIONS

1. C. Josias, J. Lawrence, "An Electrometer For Use With Scientific Space Instruments", IEEE Transactions on Nuclear Science, NS-13 No. 5, 25-36 (1966).

2. D. Lawrence, T. Harrington, J. Lawrence, C. Josias, "An Instrument for Measurements of Auroral Electrons and Protons", IEEE Transactions on Nuclear Science, NS-10, (1), February 1971, pp. 237-248.

3. J. Lawrence, D. Norris, J. Bunn, "An Absolute Magnetometer for the Measurement of Interplanetary Magnetic Fields", Journal of Geophysical Research, 1964.

4. J. Lawrence, "Surveyor A Plasma Detector", SPS 37-13 Vol. II, March, 1962. Jet Propulsion Laboratory.

5. J. Lawrence, "Solar Corpuscular Radiation Electrostatis Analyzer", SPS 37-11, Vol. I, October 1961. Jet Propulsion Laboratory.

6. J. Lawrence, "Mariner B. Plasma Probe:, SPS 37-14, Vol. I, March 1962. Jet Propulsion Laboratory.

7. C. Josias, J. Lawrence, F. Schutz, P. Smith, "Electronics for the nimbus 4 Backscatter Ultraviolet Instrument".

8. C. Josias, J. Lawrence et al, "An Experimenter's Handbook for Space Instrument Design", June 15, 1966. Prepared for Hughes Aircraft Company, Space Systems Division.

9. C. Josias, L. D. Bowman, J.A. Collins, J.L. Lawrence, F. Schutz, "A Study of Instrumentation for a Gas Chromatograph Using Flame Ionization Detection" - Final Report, submitted to NASA Ames Research Center, December 5, 1966.

10. C. Josias, J. Lawrence et al, "Operating and Maintenance Manual for the ATC Model 112 Leak Detector (Gas Chromatograph)", September 1965.

11. C. Josias, T. Harrington, J. Jodele, D. Lawrence, J. Lawrence, J. H. Marshall, "Handbook for the ATS-E Auroral Electrons and Protons Experiment", prepared for the University of California at San Diego, 1968.

12. J. Lawrence, J. H. Marshall, T. M. Harrington, "Experiment Requirements Document For The A-IMP H & J Electron Isotope Spectrometer", prepared for the California Institute of Technology, 23 September 1969.

13. J. Lawrence, J. H. Marshall, T. M. Harrington, "Operation and Maintenance Manual for the Apollo 15 and 16 Gamma-Ray Spectrometer", prepared for Manned Space Flight Center, 1970.

14. J. Lawrence, C. Josias, "ALSEP Study Report: Magnetic Control, Power Distribution, Seismometer Evaluation, Long-Line Pulse Transmission, Science-System Interfaces", prepared for Space General Corporation, November 1965.

15. J. Lawrence, "MAD, A Dedicated Computer-Controlled System For The Acquisition, Analysis and Display of Data From Laboratory Instruments", paper presented to American Chemical Society, Florida Section, July 1976.

16. J. Lawrence, "A New and Unique Current-to-Frequency Converter", paper presented to American Chemical Society, Florida Section, July 1976.

17. C. M. Judson, C. S. Josias, and J. L. Lawrence, Jr., "A Small Computerized Mass Spectrometer For The Automatic Determination of Trace Constituents in Gas", presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, February 1977.

18. J. L. Lawrence, Jr., J. J. Baum, "Operating and Maintenance Manual For The ATC Model 140 Wide-Range Electron-Capture Detector", Analog Technology Corporation, November 1974.

19. J. L. Lawrence, Jr., and J. J. Baum, "Operating Manual For The ATC Model-160A Memory, Analyzer and Display (MAD)", Analog Technology Corporation, December 1975.

20. C. Snyder, M. Neugebauer, J. Lawrence, "A Plasma Spectrometer for the OGO-E Spacecraft" Proposal accepted and funded by the National Aeronautics and Space Administration, 1964.

21. C.M. Judson, James L. Lawrence, Jr., Conrad S. Josias, and Richard A. Suchter, "Mass Spectrometer For Trace Analysis", Annual Conference on Mass Spectrometry, 1978.

SOME PAST PROJECTS OF ATC

System Cust./Govt. Agency Starting Date	Cont. No. Type Value	Technology	ATC Responsibilities	Status	QA & R Requirements
Nimbus Cloud-Top Altitude Radiometer (CAR) Beckman/ESSA(NESC) (1967)	809381 CPFF $450 K DO-A7	Electronics for a Near-IR Grating Spectrometer to measure cloud heights using 3 wavelengths	• System analysis • Elec. des., fab. & test • Inst. packaging design • Bench test equipment • Field support SUCCESSFULLY FLOWN IN NASA CONVAIR 990.	Complete On sched.	NESC 67-240001 NPC 200-2 NPC 250-1 S-450-P-3 S-450-P-4
Nimbus-4 Back-scatter Ultraviolet Instrument (BUV) Beckman/NASA-GSFC (1967)	809385 CPFF $990 K DO-A7	Electronics for a Dual-Grating Spectrophotometer & Filter Photometer which is used to measure the spatial distribution of atmospheric ozone.	• System analysis • Elec. des., fab. & test • Bench test equipment • Elec. packaging LAUNCHED 4-8-70 ON NIMBUS-4, OPERATION NORMAL	Complete Delivery delayed due to 40 formal changes to contract.	NPC 200-2, -3, -4 MIL-Q-9858A MIL-C-45662 NPC 250-1 MIL-STD-441 MIL-STD-721A MIL-STD-757A
ATS-5 Auroral Electrons & Protons Instrument (3DLE) U. of Calif., San Diego/NASA-GSFC (1967)	70-70368 CPFF $405 K	Instrument system to measure low-energy electrons & protons using 4 curved-plate electrostatic analyzers to focus particles of the proper polarity, direction and energy/unit charge. Contains digital energy peak-seeking servo.	• System design • Inst. des., fab. & test • Bench test equipment • Inst. packaging LAUNCHED 7/69 ON ATS-5, OPERATION NORMAL	Complete Delivery delayed due to numerous contract changes	NPC-250-1 NPC 200-2, -4
OGO-6 Cosmic Ray Instrument & Power Supplies Caltech/NASA-GSFC (1966)	43-88266Z 43-87661Z 43-87578Z 43-87418 43-87322Z FFP $144 K	Digital Data Processor & instrument power supplies (high & low voltage) having variable data formatting, redundant data readouts, combined shift counters, & timed overflow accumulations.	• System des., fab. & test • Elec. packaging LAUNCHED 5/69 ON OGO-6, OPERATION NORMAL	Complete (0.5 mo. early)	Parts screen. NPC 200-4
OSO-7 Solar X-Ray Instrument U. of Calif., San Diego/NASA-GSFC (1968)	Subcontract under NAS5-11081 CPFF $1.3 M	Instrument to measure solar x-rays in the 2.0-300 keV range using 4 individual detectors.	• System design & analysis • Inst. des., fab. & test • Elec. packaging • Bench test equipment • Field support • Data reduction LAUNCHED 10/71 ON OSO-7, OPERATION NORMAL	Launched on sched.	Parts screen. NPC 200-4 MSFC-STD-271 NHB 5300.4

System Cust./Govt. Agency Starting Date	Cont. No. Type Value	Technology	ATC Responsibilities	Status	QA & R Requirements
Viking-75 Gas Chromatograph/Mass Spectrometer Phase I JPL/NASA (1969)	952576 CPFF $2.5 M DO-A2	Instrument to measure soil and atmospheric samples from a Mars landing capsule.	• System design • Inst. design/ design support • Elec. des., fab. & test • Packaging des. • Software devel.	Initial phase complete	NPC 200-2, -3 NHB 5300.4(3a)
Pioneer F&G Extreme Ultraviolet (XUV) Filter Photometer USC/NASA-ARC Prin. Investigators Drs. D. Judge & R. Carlson (1969)	PO 53085 under NAS2-5608 $604 K DO-A2	Photometric measurement system of extreme UV radiation of He(I), He(II) and Lyman alpha between earth and the vicinity of Jupiter.	• System analysis & design • Inst. des., fab & test • Inst. packaging • Bench test equipment • Field support at ARC • Field support at KSC PIONEER F LAUNCHED IN 1972. INSTRUMENT OPERATED SUCCESSFULLY.	Complete On sched.	NPC 200-2, -3, -4 NHB 5300.4(3a)
Gamma Ray Airborne Spectrometer System a. Pulse height analyzer b. Digital incremental tape recorder c. Dewar-cryostat system d. 4-K memory (developed for JPL) USAF (1968)	F33657-69-C-0458 CPFF $600 K DO-C9	Airborne data storage is provided thru the utilization of a cassette-loaded incremental tape recorder, which was developed by ATC. The model DR10 provides 556-bpi packing density at 250 characters/sec (which can be doubled). The DR10 is part of a classified airborne system. Complete system also contains a Dewar-cryostat solid state detector 4096-bit memory, power supply, signal processor and programmer in addition to the tape recorder.	• System analysis & design • Inst. des., fab & test • Inst. packaging • Comp. bench test equipment • System software • Operator train. • Field support	Complete On sched.	Meets MIL-E-5400M for Class 1 equipment Meets MIL-STD-461A RFI requirements
Pioneer F&G Particle Detector Signal Processor System U of Iowa/NASA-ARC (1970)	T08533C FFP $57 K DO-A7	Signal processor provides interface between s/c & detectors. System packaged into two 10-layer multilayer PC boards.	• Multilayer (10) PC boards & data processor pack. design • Data system fab & test PIONEER F LAUNCHED IN 1972. INSTRUMENT OPERATED SUCCESSFULLY	Complete On sched.	NPC 200-2, -3, -4 NHB 5300.4(3a)

System Cust./Govt. Agency Starting Date	Cont. No. Type Value	Technology	ATC Responsibilities	Status	QA & R Requirements
IMP H, J Electron-Isotope Spectrometer Caltech/NASA-GSFC (1969)	80000-A CPFF $641 K DO-A7 84900-B FFP $200 K	Instrument measures differential energy spectrum of electrons from 0.16 to 2.8 MeV and isotopes of H, He, Li, & Br from 0.5 to 40 MeV/nucleon. Contains 8 1024 and 2 4096 pulse height analyzers. Priority event logic is used to control data processing & on-board analysis.	• System design • Elec. des., fab. & test • Inst. packaging • Comp. bench test equipment	Complete; Operated Successfully	NPC 250-1 NPC 200-2
Astronaut Breath Analyzer NASA-MSC (1970)	NAS9-11307 FFP $160 K DO-A2	Instrument provides in-situ analysis of breath gases thru the use of a quadrupole mass spectrometer. The MS is small enough to fit into the astronaut's helmet just below his chin.	• Inst. analysis & design • Inst. des., fab. & test • Mass spectrometer des., fab. & test • Display equip. des., fab. & test	Delivered 1974; Used as basis for Model-2001 Design	N/A
Lunar Atmospheric Mass Analyzer JPL/NASA (1970)	952835 CPFF $155 K DO-A2	Instrument design to monitor lunar atmosphere using a tandem quadrupole mass filter. One section was a straight quadrupole and the other was contained in curved rods.	• System design • Inst. fab. & test • Mass analyzer des., fab. & test	Final Report complete (2 mo. late)	N/A
Apollo-15, -16 Particles Instrument & Subsatellite Power Supply System TRW/NASA-MSC U of Calif., Berkeley Experimenters (1970)	CG332SC CPIF $1.3 M DO-A2	Subsystem monitors low & high energy particles & provides power to all other s/c subsystems. Contains quadraspherical electrostatic analyzers & solid state telescopes.	• System design • Inst. des., fab. & test • Inst. packaging • Bench test equipment OPERATED SUCCESSFULLY IN LUNAR ORBIT ON APOLLO-15 and 16	Flew successfully on Apollo 15 and 16	NHB 5300.4(3a) NPC 200-2, -3
Leakage Tester, Protective Mask (PMLT) USA-Edgewood Arsenal (1970)	DAAA15-70-K-0537 FFP $7.2 K DO-C9	System based on SF_6 leak detector and used to provide production line tests of gas masks.	• System design & analysis • Inst. des., fab. & test • Inst. packaging • Instruction manual • Test accessory development	Complete (1 mo. early)	N/A

System Cust./Govt. Agency Starting Date	Cont. No. Type Value	Technology	Responsibilities	Status	QA & R Requirements
Portable Ultra-sensitive Leak Detector Edwards AFB (1967)	F04611-68-C-0071 FFP $37 K DO-A2	Modification of an ATC developed system to measure leak rates at much lower levels (leak rates of 10^{-11} std-atmos-cc's) than previously possible. The system is based on gas chromatographic techniques and uses a proprietary pulsed mode electron capture detector.	• System design • Detector des. • Inst. des., fab. & test • Inst. packaging • Field training ATC HAS SINCE DEVELOPED A CLASS OF INSTRUMENTS USING THESE PRINCIPLES FOR BOTH GOVERNMENT AND COMMERCIAL CUSTOMERS	Complete on sched	N/A
Pyrolysis/Hydrogen Flame Detector System NASA-ARC/NASA-HQ. (1968)	NAS2-5608 NASW-1805 CPFF $60 K DO-A7	Development & optimization of a pyrolysis/hydrogen flame ionization detector (HYFID) to be used to measure organic carbon on Mars. First HYFID to operate at Mars atmospheric pressure and to be free of orientation induced problems.	• System analysis • Detector design & evaluation • Inst. des., fab. & test • Inst. packaging	Complete 1 mo. late	NPC 200-2, -4
Wide Dynamic-Range Electron Capture Detector ATC sponsored (1973)	---	Development of a wide dynamic range electron capture detector for the commercial gas chromatographic market. Presently available commercial detectors have ranges of 2 decades versus 6 for ATC's proprietary device.	• System analysis • Detector design & evaluation • Inst. des., fab. & test • Packaging design • Production	---	N/A
Apollo-15, -16 Gamma-Ray Spectrometer JPL/NASA (1969)	952574 CPFF $1.3 M	Instrument to measure the energy spectrum of gamma rays between 100 keV & 10 MeV thru the use of a NaI(Tl) crystal surrounded by a plastic scintillator. System contains a 512-channel pulse height analyzer with differential linearity of ±0.1% above channel 7, a gain stability of ±0.1%, and an offset stability of $I_{0.25}$ channels.	• System design • Elec. des., fab. & test • Inst. packaging • Field support at JPL • Field support at KSC • Comp. bench test equip. • Software develop OPERATED SUCCESSFULLY ON APOLLO-15 & -16	Complete On sched	NHB 5300.4(3a) NPC 200-2, -3, -4

System / Cust./Govt. Agency / Starting Date	Cont. No. / Type / Value	Technology	ATC Responsibilities	Status	QA & R Requirements
Ion Source E.I. Du Pont (1970)	--- FFP $20 K	Ion source development for commercial mass spectrometers based upon ATC GCMS ion source.	• Sensor des., fab. & test	On sched.	N/A
High Speed Data/ Wide Band Data Input/Output JPL/NASA (1971)	953155 FFP $42 K	Fabrication, assembly & test of HSD/WBD I/O assemblies for use in DSN.	• Fab. & test • Test fixture des, fab. & test	Complete On sched.	DMO-50190GEN DOS-8913GEN GMO-50139GEN
Nimbus-E Microwave Radiometer Power Supply System JPL/NASA-GSFC (1969)	952681 FFP $205 K	Design, fabrication & test of a 75% efficient 40 W power supply containing 11 dc-dc converters followed by 34 series fold-back regulators & organized into 6 separate power supplies. Five of these supplies were used for the superheterodyne receivers and the sixth was used to operate the data system.	• System design • System fab. & test • System pack. • Spares provisioning OPERATED SUCCESSFULLY ON NIMBUS-E IN 1973	2 mo. late	NHB 5300.4 (3a) NPC 200-2, -3
Power Supplies Mass. Inst. of Tech. (MIT) (1971)	SC155592 FFP $50 K	Design, development, fabrication & test of several different power supplies for spacecraft applications.	• Elec. design • Fabrication • Test		NHB 5300.4 (3a) NPC 200-2, -3
Power Supplies NASA-GSFC (1971)	NASS-23059 FFP $29 K	Design, development, fabrication & test of low power, light weight, high-density packaged power supplies for spacecraft applications.	• Design • Package • Develop • Fabricate • Test		NHB 5300.4 (3a) NPC 200-2, -3
Channeltron Amplifier/ Discriminator Systems NASA-GSFC (1972)	NASS-23132 FP	Develop hybrid Channeltron Amplifier/Discriminator Circuit and produce 40 units for Atmospheric Explorer Satellite (LEE Instrument)	• Design • Develop • Package • Fabricate in quantity 40 Units • Test Flown Successfully	Complete	

System Cust./Govt. Agency Starting Date	Cont. No Type Value	Technology	ATC Responsibilities	Status	QA & R Requirments
Molecular Leak Valve and Miniature Quadrupole Mass Spectrometer Martin Marietta Co. (1972)	RC2-250306 F.P.	Construct leak and quadupole Mass spectrometer for use on advanced Viking Instrument (Bessel-Kok Experiment)	• Package • Fabricate • Test	Complete	N/A
Mass Analyzer and Vacuum System NASA LaRC (1975)	NAS1-13843 CPFF $235K	Develop a Mass Analyzer and Vacuum System for use in Environmental Monitoring	• Design • Fabricate • Test	Complete 1976	N/A
Computerized Mass Spectrometer NASA LaRC (1976)	NAS1-14398 CPFF $1.6M	Develop and Manufacture a Computerized Mass Spectrometer for Monitoring Air and other Complex Gas Mixtures	• Design • Develop • Package • Fabricate in quantity • Test	Complete 1978	Survive Airplane Crash Loads
Mars Atmospheric Water Detector (MAWD) JPL (1971)	952574 CPFF $600K	Instrument to measure water concentration in Martian Atmosphere during Viking I and II operations	• Design • Development • Qual. Testing • Mfr. Flt. Hardware OPERATED SUCCESSFULLY ON VIKINGS I & II	Complete	All Viking Flt. Spec.
Gemini Plasma Wake Instrument EOS/NASA MSC (1965)	58171 T&M	Instrument to measure the energy and density of positive ions and electrons of the ionosphere plasma	• Concept Study • Design • Development • Test OPERATED SUCCESSFULLY ON GEMINIS X & XI	Complete	N/A

System Cust./Govt. Agency Starting Date	Cont. No Type Value	Technology	ATC Responsibilities	Status	QA & R Requirments
Switchable Proton-Electron Channeltron High-Voltage Supplies Rice University /NASA (1966)	51966-07/08	Instrument power conditioner and programmable High Voltage Supply -3500 to +3500V. 4-ms rise and fall times, 1watt power consumption	• Design • Development • Qual. Test. • Production (27 Units) OPERATED SUCCESSFULLY ON SATELLITES (NAVY & NASA)	Complete	

Mr. LLOYD. Yes. Thank you very much, Jim.

Let me ask you a question, and I am sorry we are out of time, because I am interested in the areas you are talking about. Do you think that part of the problem, though, lies in the fact that the big corporations, the Littons, whoever it may be in the aerospace industry, that they tend to keep complexity into the system in order to keep you out? Is that possibly the situation?

Mr. LAWRENCE. Well, if one sees and reads the boilerplate in the proposals and things we responded to, I think a lot of it was contrived to make it harder for the small company.

As to big company capability I consulted for places like TRW and Xerox and Aerojet General. When you got down to the base of the project, you had one or two guys maybe 1½ years out of school in the backroom surrounded by an administrative staff of the project of orders of magnitude of people, and there is no more capability in many cases within those companies, and they can't really touch.

Mr. LLOYD. I understand that, but do you think there is a direct attempt on the part of the management of these large corporations to stifle companies such as yours by way of Government regulations, people who deal directly with the contract people in the bureaucracy, taking them out to dinner, whatever it may be, and eventually influencing them not to consider other companies. In other words, to influence them on area. I think the regulation should be changed. So that you have to have x number of dollars, x number of pages, and this and that, and pretty soon when the stack gets so high you are buried and are unable to compete, and they are still competing, although in reality they are not competing unfairly because they are not guaranteed the contract. It is just by process of elimination. The person who has the most money in the poker game eventually wins.

Is that correct?

Mr. LAWRENCE. You are absolutely correct. In both phase 1 Viking—there have been other contracts I could talk about, some that recently went on with some equipment for the Navy—but many of those elements that you identify are all there. They are all there.

Mr. LLOYD. Do you think that perhaps we should have some sort of a law or contractual situation which says that you must identify and see, then we get into the bureaucratic situation, identify every involvement that you have. In other words, we have now a deal I think it is $100 or $35 or $50—I don't know what it is—if the contractor takes you out and spends more than 25 bucks—you can't even go to dinner in Washington, D.C. on 25 bucks—but if he does, then he is supposed to make a revelation of that. Does that mitigate against people like yourself?

Mr. LAWRENCE. I don't really believe in this. If you can buy a man with a steak dinner he is not worth having. In my years of experience I have found that, you can get out, you can talk to people, you can meet them. As big as bureaucratic as Washington there is still an individual in a room somewhere you can go and talk to if you have the patience to find him. However, there is little doubt that the heads of major Government agencies are willing to converse directly with representatives of big companies, whereas they wouldn't bother with the president of small firms.

Mr. LLOYD. Maybe we need that data bank they were talking about.

Mr. LAWRENCE. I do feel that there are requirements that are laid down in structuring the capabilities that people must have to do the job that are restrictive to small technology companies getting into those areas, and they are very clear. There were things that happened in the course of this proposal that would curl your hair, but I don't know. I think primarily what legislation can do, the biggest thing that we can promote is capital formation so that small companies can get into that marketplace and get the help they need to get there. That is probably the thing that would help us most, access to money and access to funds to do the development that must be done.

Mr. LLOYD. Mr. Lujan?

Mr. LUJAN. I have no questions.

Mr. LAWRENCE. Thank you very much. We appreciate all being here today.

The meeting is declared adjourned until a call of the Chair.

[Whereupon at 1 p.m. the hearing was concluded.]

SMALL, HIGH TECHNOLOGY FIRMS AND INNOVATION

TUESDAY, JUNE 10, 1980

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY,
Washington, D.C.

The subcommittee met, pursuant to notice, at 1:20 p.m., in room 2318, Rayburn House Office Building, Hon. Jim Lloyd (chairman) presiding.

Mr. LLOYD. We will come to order.

I welcome you this afternoon to discuss a very important subject, namely, small, high technology firms and innovation. I particularly would like to welcome my fellow colleague, George Brown, the chairman of the Subcommittee on Science, Research, and Technology, who has joined me in these important hearings.

I remind you that, in my opinion, the expert in Congress happens to be Mr. Brown.

I am sorry, but I think we have to leave and vote again—but let's finish this.

This is the first day of 2 days of hearings in which we will discuss some of the conclusions and recommendations of the report entitled "Small, High Technology Firms and Innovation." That was prepared by my Subcommittee on Investigations and Oversight.

These conclusions and recommendations were the result of five field hearings held in Appleton, Wis.; Long Island, N.Y.; Patrick Air Force Base, Fla.; Albuquerque, N.M.; and Pomona, Calif.

I am pleased to say this report has just been published and is available at the tables in the back of the room. We have found that small, high technology firms have compiled an enviable record of innovation. Small firms produce about 24 times as many innovations per R. & D. dollar as do large firms. Yet they receive only 3.5 percent of the total Federal R. & D. obligations.

These small firms have higher rates or productivity and create new jobs at far greater rates than new firms. We have also found that Government agencies do not take small firms seriously, and do not give them fair consideration for Government contracts. In fact, manmade barriers are the greatest inhibition to innovation.

Some of these barriers are lack of effective participation by small, high technology firms in Federal R. & D. procurement; a patent policy that is costly, time consuming, and encourages litigation; management, technical, and financial assistance programs that do not adequately

provide the "hands-on" in-depth assistance that small, high technology firms need; tax policies that discourage innovation by making it difficult to secure needed capital, attract talented management and retain sufficient earnings; and excessive regulations that divert needed research funds into costly and time-consuming regulatory compliance.

Our subcommittee has made definite recommendations to alleviate these barriers, and it is imperative, not only for Congress, but for the administration to take definite steps to foster the development of small, high technology firms.

Today, we will be hearing from five witnesses who will discuss management, technical, and financial assistance programs. One of the reasons for the failure of small firms is the lack of managerial expertise. Another reason is the lack of access to technical information services. And, of course, there is the ever-present reason due to a firm's inability to secure needed capital.

If appropriate and timely assistance is provided to small firms, it will greatly improve the capabilities of these firms.

I look forward to these hearings, and again, I welcome all of you here today.

Mr. Brown, would you care to make a statement?

Mr. BROWN. Let me abbreviate my statement considerably.

First of all, I think you are to be congratulated for initiating this series of hearings, which has been extremely useful, I think, to the full committee as well as to both of the subcommittees.

The recent editorial in the Washington Post noted, and I quote: "American productivity dropped like a stone last year—and no one has yet been entirely able to explain it." I cannot offer, nor do I think there are, any simple solutions to this dilemma.

But I can say with assurances that investment in innovative technologies and high productivity industries can serve as a framework for increased productivity and a buffer against inflation and some of our other economic ills. Our country's record of technological innovation over the past several decades and the resulting national economic and social benefits derived from our innovative talents are accurate testimony to this.

Those of us who have participated in hearings and symposia on innovation and productivity are aware of the many significant and innovative contributions high-technology small businesses have made in advancing our national economic goals.

Unfortunately, not everyone has recognized this relatively untapped potential in the entrepreneurial spirit and in the technical strengths of our Nation's small firms.

Mr. Chairman, the importance of innovative small business in maintaining our economic vitality, improving our social welfare, and assuring our national security cannot be understated.

You are to be congratulated for your foresight and leadership in highlighting small business. I look forward to our continued cooperation in this area.

Mr. LLOYD. Your complete statement will be made part of the record, without objection.

[The prepared statement of Hon. George E. Brown, Jr., is as follows:]

OPENING STATEMENT BY
HONORABLE GEORGE E. BROWN, JR.
CHAIRMAN, SUBCOMMITTEE ON SCIENCE,
RESEARCH AND TECHNOLOGY
JUNE 10, 1980
SMALL HIGH TECHNOLOGY FIRMS
AND INNOVATION

I WANT FIRST TO THANK JIM LLOYD, CHAIRMAN OF THE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT FOR THIS OPPORTUNITY TO COOPERATE ON INNOVATION AND HIGH-TECHNOLOGY SMALL BUSINESS. MY SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY HAS BEEN CONCERNED WITH ALL ASPECTS OF INNOVATION AND PRODUCTIVITY, AND YOUR FOCUS ON HIGH-TECHNOLOGY SMALL BUSINESS THROUGH A SERIES OF FIELD HEARINGS AND A REPORT IS A WELCOME COMPLEMENT TO OUR ACTIVITIES.

A RECENT EDITORIAL IN THE WASHINGTON POST NOTED, AND I QUOTE, "AMERICAN PRODUCTIVITY DROPPED LIKE A STONE LAST YEAR -- AND NO ONE HAS YET BEEN ENTIRELY ABLE TO EXPLAIN IT".* I CANNOT OFFER, NOR DO I THINK THERE ARE ANY SIMPLE SOLUTIONS TO THIS DILEMMA. WHAT I CAN SAY WITH ASSURANCE IS THAT INVESTMENT IN INNOVATIVE TECHNOLOGIES AND HIGH PRODUCTIVITY INDUSTRIES CAN SERVE AS A FRAMEWORK FOR INCREASED PRODUCTIVITY, AND A BUFFER AGAINST INFLATION AND SOME OF OUR OTHER ECONOMIC ILLS. OUR COUNTRY'S RECORD OF TECHNOLOGICAL INNOVATION OVER THE PAST

---

* WASHINGTON POST, JANUARY 31, 1980, A-20.

SEVERAL DECADES AND THE RESULTING NATIONAL ECONOMIC AND SOCIAL BENEFITS DERIVED FROM OUR INNOVATIVE TALENTS, ARE ACCURATE TESTIMONY TO THIS.

THOSE OF US WHO HAVE PARTICIPATED IN HEARINGS AND SYMPOSIA ON INNOVATION AND PRODUCTIVITY ARE AWARE OF THE MANY SIGNIFICANT AND INNOVATIVE CONTRIBUTIONS HIGH TECHNOLOGY SMALL BUSINESSES HAVE MADE IN ADVANCING OUR NATIONAL ECONOMIC GOALS. UNFORTUNATELY, NOT EVERYONE HAS RECOGNIZED THIS RELATIVELY UNTAPPED POTENTIAL IN THE ENTREPRENEURIAL SPIRIT AND IN THE TECHNICAL STRENGTHS OF OUR NATION'S SMALL FIRMS.

FOR EXAMPLE, A STRIKING DISPARITY APPEARS TO EXIST BETWEEN THE CAPABILITIES OF HIGH-TECHNOLOGY SMALL BUSINESSES AND THEIR UTILIZATION BY FEDERAL AGENCIES. SMALL BUSINESSES RECEIVE A RELATIVELY MINOR PROPORTION OF FEDERAL R&D FUNDS -- ONLY 3½ PERCENT, WHILE ABOUT 64 PERCENT OF GOVERNMENT R&D FUNDS GO FOR DEVELOPMENT, USUALLY, INVOLVING LARGE INDUSTRIAL FIRMS.* ALSO FEDERAL PROCUREMENT POLICIES AND PROCEDURES DIRECTLY OR INDIRECTLY RESTRICT THE USE OF HIGH-TECHNOLOGY SMALL FIRMS IN CARRYING OUT FEDERAL AGENCY MISSION R&D REQUIREMENTS.

ADDITIONAL PROBLEMS CONFRONTING HIGH TECHNOLOGY SMALL BUSINESS, PARTICULARLY DURING THE CRITICAL START-UP PHASES, WERE DISCUSSED DURING A JOINT MEETING OF THE SENATE SELECT COMMITTEE ON SMALL BUSINESS, HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY AND HOUSE COMMITTEE ON SMALL BUSINESS ON NOVEMBER 1,

---

* "SMALL FIRMS AND FEDERAL RESEARCH AND DEVELOPMENT". AN AD HOC INTERAGENCY PANEL REPORT TO THE OFFICE OF FEDERAL PROCUREMENT POLICY, OFFICE OF MANAGEMENT AND BUDGET, MARCH 1977.

1979. THESE PROBLEMS WHICH WITNESSES IDENTIFIED INCLUDED: THE RECENT ELIMINATION OF FORMERLY QUALIFIED STOCK OPTION PLANS; HIGH TAX RATES ON CAPITAL GAINS; OTHER TAX BURDERN ON SMALL BUSINESSES DURING THE START-UP PERIOD; AND AVAILABILITY OF VENTURE CAPITAL IN THE EARLY R&D PHASES.

ONLY RECENTLY HAS THE FEDERAL GOVERNMENT BEEN WAKING UP TO THE IMPORTANCE OF HIGH TECHNOLOGY SMALL FIRMS. RECOMMENDATIONS MADE LAST FALL BY THE PRESIDENT AS PART OF HIS INDUSTRIAL INNOVATION INITIATIVES DEMONSTRATE HIS AWARENESS OF, AND SENSITIVITY TO, IMPEDIMENTS FACING INNOVATIVE SMALL BUSINESS. THESE INCLUDED: INCREASING FEDERAL AGENCY-WIDE SUPPORT FOR SMALL R&D FIRMS; DEVELOPING SIMPLIFIED AND MORE UNIFORM FEDERAL PROCUREMENT POLICIES AND PRACTICES AS A SPUR TO INNOVATION; ESTABLISHING STATE OR REGIONAL CORPORATIONS FOR INNOVATION DEVELOPMENT TO ASSIST ENTREPRENEURS AND INNOVATIVE SMALL FIRMS IN OBTAINING START-UP CAPITAL; CHANGING SMALL BUSINESS ADMINISTRATION REGULATIONS TO PERMIT SMALL BUSINESS INVESTMENT COMPANIES AND PRIVATE SECTOR VENTURE CAPITAL FIRMS TO INVEST IN SMALL BUSINESS; PROVIDING UNIFORMITY TO FEDERAL PATENT OWNERSHIP BY BUSINESS AND UNIVERSITIES AS INCENTIVES TO COMMERCIALIZE INNOVATIVE IDEAS; AND EXPANDING NSF'S HIGHLY SUCCESSFUL SMALL BUSINESS INNOVATION PROGRAM IN FY 1981 AND EXTENDING THIS PROGRAM TO OTHER FEDERAL AGENCIES. THE PRESIDENT ALSO SOUGHT RECOMMENDATIONS FROM THE SMALL BUSINESS COMMUNITY AT THE WHITE HOUSE CONFERENCE ON SMALL BUSINESS HELD IN JANUARY.

IN ADDITION, A NUMBER OF HOUSE AND SENATE COMMITTEES ARE ACTIVELY WORKING ON LEGISLATION TO PROMOTE SMALL BUSINESS*, AND THE SMALL BUSINESS ADMINISTRATION MAY BE BEGINNING TO REORIENT ITSELF TOWARDS HIGH TECHNOLOGY.

---

* FOR EXAMPLE:

- H.R. 5607 (SMITH, IOWA) - "SMALL BUSINESS INNOVATION ACT OF 1979"
  (ENTIRE OMNIBUS BILL REPORTED OUT BY HOUSE SMALL BUSINESS COMMITTEE; BILL REFERRED ALSO TO HOUSE WAYS AND MEANS -- TITLE II IRS CODE AMENDMENTS AND TO HOUSE JUDICIARY -- TITLE III PATENT POLICY)
- H.R. 7250 (SMITH, IOWA) - "SMALL BUSINESS DEVELOPMENT CENTER ACT OF 1980" (S. 918)
  (REPORTED OUT OF HOUSE SMALL BUSINESS COMMITTEE, PLAN TO GET ON CALENDAR; S. 918 INCORPORATED INTO S. 2698 -- SBA AUTHORIZATION BILL -- FOR CONFERENCE ON JUNE 10)
- S. 1860 (NELSON, FLORIDA) - "SMALL BUSINESS INNOVATION ACT OF 1979"
  (TITLE I (R&D CONTRACTS) AND TITLE II (PATENTS) SAME AS HOUSE VERSIONS (H.R. 5607) HAVE PASSED SENATE; TITLE III (AMENDMENT TO IRS CODE) REFERRED TO SENATE WAYS AND MEANS AND TITLE IV (REGULATORY FLEXIBILITY) REFERRED TO SENATE JUDICIARY)
- S. 604 - "SMALL BUSINESS PAPERWORK COST REIMBURSEMENT ACT OF 1979"
- H. R. 3011 - "SMALL BUSINESS BUREAU PAPERWORK COST PARTICIPATION ACT OF 1979"
  (NO ACTION YET)
- H.R. 5313 - "SMALL BUSINESS R&D INCENTIVE ACT" (S. 419)
  (NO ACTION YET)
- H.R. 2962 - "SMALL BUSINESS CAPITAL INVESTMENT AND OPPORTUNITY ACT OF 1979"
  (NO ACTION YET)
- H.R. 4660 - "SMALLER ENTERPRISE REGULATORY IMPROVEMENT"
  (REPORTED OUT OF HOUSE SMALL BUSINESS COMMITTEE; BEING CONSIDERED BY HOUSE JUDICIARY COMMITTEE)

- H.R. 2447 - "Small Business Procurement Reform Act of 1979" (H.R. 5330)
  (NO ACTION YET)

- H.R. 5612 - "Extension of 8-A Pilot Program" (Amendment to Section 8-A of Small Business Act)
  (DISCUSSED ON HOUSE FLOOR ON JUNE 9)

- Export Trading Companies and Export Promotion
  Subcommittee on International Economic Policy and Trade held hearings on June 4 and plans additional hearing on several related bills (H.R. 5601, H.R. 7230, H.R. 7310, H.R. 7364, H.R. 7436, and H.R. 7463).

  S. 2620 reported by Senate Select Committee on Small Business.

MY OWN SUBCOMMITTEE, AS PART OF ITS INNOVATION AND PRODUCTIVITY EFFORTS, HAS BEEN ACTIVE IN ADVANCING SMALL BUSINESS INITIATIVES. WE RECENTLY REPORTED AN NSF AUTHORIZATION BILL WHICH INCLUDES A $7 MILLION EXPANSION OVER LAST YEAR IN THE SMALL BUSINESS INNOVATION PROGRAM, AND A NEW $5 MILLION PROGRAM TO ESTABLISH A CENTER FOR INNOVATION DEVELOPMENT. THE FUNCTIONS OF THE CENTER WOULD INCLUDE: (1) DIRECT EQUITY FUNDING FOR THE START-UP OF FIRMS WISHING TO DEVELOP AND BRING TO MARKET PROMISING INNOVATIONS; (2) GUIDANCE TO SMALL BUSINESS IN UTILIZING FEDERAL ASSISTANCE PROGRAMS; AND (3) MANAGERIAL AND TECHNICAL ASSISTANCE TO FIRMS THAT ARE FUNDED.

THE SUBCOMMITTEE ALSO SHARES LEGISLATIVE JURISDICTION OVER FEDERAL PATENT POLICY, AND WE RECENTLY REPORTED H.R. 5715, A PATENT POLICY BILL. IT HAS, AS A STIMULUS FOR INVENTION UTILIZATION, THE PROVISION THAT FULL TITLE TO INVENTIONS DEVELOPED UNDER FEDERAL R&D CONTRACT SHOULD GO TO THE CONTRACTOR -- SMALL BUSINESS INCLUDED.

FINALLY, ON MARCH 25 I INTRODUCED H.R. 6910, THE "NATIONAL TECHNOLOGY FOUNDATION ACT". THIS ACT WOULD ESTABLISH AN INDEPENDENT AGENCY TO PROMOTE THE DEVELOPMENT OF TECHNOLOGY FOR THE NATIONAL WELFARE. ONE OF THE MAIN BRANCHES OF THE AGENCY WOULD BE DEVOTED TO FOSTERING HIGH-TECHNOLOGY SMALL BUSINESS. WE INTEND TO HOLD HEARINGS ON THAT BILL LATER THIS YEAR.

I AM LOOKING FORWARD TO THE DISCUSSION AT TODAY'S AND THURSDAY'S HEARINGS. I AM PARTICULARLY INTERESTED IN TWO AREAS. FIRST, THE STEPS NOW BEING TAKEN BY FEDERAL AGENCIES TO IMPLEMENT THE PRESIDENT'S AND OTHER RECOMMENDATIONS ON HIGH TECHNOLOGY SMALL BUSINESS. SECOND, THE SMALL BUSINESS COMMUNITY'S REACTIONS TO AND SUGGESTIONS ON THE RECOMMENDATIONS OF THE INVESTIGATIONS AND OVERSIGHT SUBCOMMITTEE'S REPORT RESULTING FROM THE FIELD HEARINGS.

THE IMPORTANCE OF INNOVATIVE SMALL BUSINESSES IN MAINTAINING OUR ECONOMIC VITALITY, IN IMPROVING OUR SOCIAL WELFARE, AND IN ASSURING OUR NATIONAL SECURITY CANNOT BE UNDERSTATED. MR. LLOYD IS TO BE CONGRATULATED FOR HIS FORESIGHT AND LEADERSHIP IN HIGHLIGHTING SMALL BUSINESS. I LOOK FORWARD TO CONTINUED COOPERATION BETWEEN OUR SUBCOMMITTEES IN THIS AREA.

THANK YOU.

Mr. LLOYD. Before we begin with the witnesses, we do have a vote. We have a quorum call.

Mr. BROWN. Yes.

Mr. LLOYD. Mr. Brown will answer the quorum call, and in about 5 minutes, I will leave to do the same, and he will come back, and that way we can keep the hearing moving.

We will begin today with Mr. Paul M. Kelley, manager of Venture Development, Massachusetts Technology Development Corp , Boston, Mass.

No; we will start with Mr. King. I will point out that Mr. King and some of the others today have appeared in the course of the hearings that we have already held, and we appreciate your returning to give us the benefit of your expertise and insights into what we can do to solve some of these problems.

STATEMENT OF RADFORD G. KING, DIRECTOR, WESTERN RESEARCH APPLICATIONS CENTER, UNIVERSITY OF SOUTHERN CALIFORNIA

Mr. KING. Thank you, Mr. Chairman. I wish to thank you for this opportunity to appear here today and to have participated in the infield hearing on this important issue concerning small, high technology firms and their impact on innovation and productivity.

I am currently the director of technology and business assistance programs at the University of Southern California. There, programs are comprised of various centers involved in technology transfer, technical information services, business assistance, and economic development activities.

The major centers are the NASA Industrial Applications Center, supported by: the NASA technology transfer division; the Urban University Center; and the Western Trade Adjustment Assistance Center, supported by the Economic Development Administration, U.S. Department of Commerce. Additional programs are supported by the Small Business Administration and various city, county, and State groups.

The programs cover a 10-State area and provide direct services to over 1,000 businesses per year. Most of the businesses would be classified as "small business" and are in the manufacturing sector.

I strongly support the conclusions and recommendations contained in the report issued by the Investigations and Oversight Subcommittee. Although I am concerned about patent policy, tax policies and Government regulations, I will restrict my remarks to the areas of technical, management, and financial assistance.

During the past 3 years, the NASA industrial applications center at USC has been conducting a cost-benefit analysis of technical information services provided to its industrial clients during the years 1976 through 1979. The analysis was based on a telephone interview and reporting technique developed by the Denver Research Institute.

A comparison of the results of the survey from two separate periods, 1976 through 1977, and 1978 through 1979, have indicated some interesting trends. In both surveys, the sample size was approximately 150 firms. Information was gathered on the numbers of firms that re-

ceived a quantifiable benefit from services provided by the Industrial Applications Center; the distribution of those benefits by new product, old product, and time-saved categories; and the estimated dollar value of the benefit in the above-mentioned categories.

Ninety percent of the firms reported a benefit from the 1978 to 1979 period. This reflects a substantial increase from the 55-percent benefits from the 1976 to 1977 period.

The distribution by categories was:

	In percent	
	1976–77	*1978–79*
New products	15	55
Old products	10	12
Time saved	30	23
Total		90

The dollar benefits also increased radically from an average of $3,700 per client served in 1976 to 1977, to $64,000 per client served in the 1978 to 1979 period.

The R. & D. type of firms had an even higher return, with 94 percent reporting a benefit.

It is our opinion that these increases have been brought about by the following major factors:

One, increased number of computerized data basis available;

Two, the development of the technical coordinator network for retrieving nonpublished information; and

Three, the increased competence of the staff.

Invariably, in these studies what we are seeing is one or two cases in which the dollar benefit is extremely high. As such, the average goes up, and the medium benefit then would be reduced slightly from the number.

I would encourage the increased availability of these types of technical information services to small R. & D. firms. This can only be accomplished through increased financial support for the delivery systems, such as the NASA industrial applications centers and the NASA technology transfer division.

Mr. LLOYD. I am sorry to interrupt you, but in order to answer the bells, and I have 4 minutes to go, I will run over and Mr. Brown will be back shortly. We will then complete your presentation.

Mr. KING. That is fine.

Mr. LLOYD. Thank you.

Mr. BROWN [presiding]. Now, would you please continue, Mr. King?

Mr. KING. The failure of many small technology-based companies is brought about by inadequate management abilities. Unfortunately, the blame is usually directed elsewhere, such as the unavailability of capital, unfair procurement practices, or too much Government regulation. Although the above are contributors to the failure rate of major reduction of the number of failures and a corresponding increase in the number of success stories can be achieved through the provision of management assistance.

Programs such as EDA's university centers, and trade adjustment assistance centers should be looked to as models of effective management assistance services. These services should be available to the small firms on an as-needed basis. This can only be accomplished through increased support to those programs currently in existence.

I would take exception to one of the points which related to a mandatory requirement in furnishing assistance in the event of procurement for R. & D. services. I do not think management assistance can be made mandatory.

A major gap exists in our current financial assistance programs to support increased productivity and innovation. Programs are needed to finance startup companies based on new products and technologies. Major emphasis should be placed on the financing of product development costs. This is the transition between research and the commercialization of new technologies that is currently underfinanced.

The recommendation to allow small business investment corporations, or SBIC's, to make venture investments with the Small Business Administration guaranteeing 80 percent of any loan portion of the financial package should be implemented.

In addition, it must be recognized that the commercialization of innovations has a high degree of risk associated with it, and requirements for personal guarantees should be relaxed or eliminated.

The management and technical assistance programs currently in existence at agencies, such as NASA, EDA, Commerce, and SBA appear to be low on the priority list when it concerns budget allocations. This frequently occurs since it is difficult to quantify the results or return from such programs.

However, the benefits from increased innovation and productivity are both economic and social in nature. The contributions of increased employment, increased tax return, and decreased costs of unemployment and welfare programs are instrumental to the growth of the general welfare of our Nation.

A greater emphasis must be placed on the allocation of increased budget and effort directed toward the maintenance and growth of our small business sector.

Thank you again for this opportunity of being here today.

[The prepared statement of Mr. King follows:]