RESEARCH MANAGEMENT REVIEW

The Journal of the
National Council of University Research Administrators

Concerned with the broad range of issues affecting the administration of research, Research Management Review provides a forum for the dissemination of knowledge about the study and practice of the profession of research administration. Research Management Review is published semiannually by the National Council of University Research Administrators at One DuPont Circle, Suite 618, Washington, D.C. 20036.

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Editor's Preface

This is an occasion to celebrate, indeed a moment in NCURA's history to mark with pride and to accept as a challenge for the future. With this first issue of *Research Management Review, we* achieve an objective that has been a standard for recognition as a professional society: the publication of a peer-reviewed journal to disseminate new knowledge, assemble and evaluate past practices, review issues of mutual concern in studied and comprehensive -ways, and to share that knowledge with peers and interested colleagues. The appearance of the journal at this time reflects a deliberate and cautious assessment of the status and maturity of research administration as well as a confidence in the membership of NCURA to support, contribute to, benefit from, and generally sustain an intellectually and productively stimulating journal.

Three years ago, NCURA celebrated its 25th anniversary *as* an association formed to serve individuals with professional interests in the administration of sponsored programs primarily at colleges and universities. It seems appropriate, with the premier issue of the RMR to comment on research administration as a profession. We presume the designation "professional" not by curriculum or formal education, not by license or degree, but by recognition, within our diverse duties and responsibilities, of a shared purpose of service based on common expectation of knowledge, practice of skills, application of reasoning and judgment, commitment to continuing education and development of new knowledge. In my President's remarks last November at the 28th Annual NCURA Meeting, I reviewed some of the competencies and attitudes that others have used as benchmarks for professionals. Several of these characterizations bear directly on the necessity and purpose of a journal for the dissemination of knowledge about the study and practice of the profession.

Among the well recognized competencies of a professional is what others have termed "integrative competence" and what in plain language is recognized as *good judgment*. Research administrators are expected to meld fundamental knowledge, technical expertise, an awareness of environment and circumstances, and strong communication skills leading to informed judgments about consideration and selection of appropriate strategies in a given situation. We assume a professional identity with research administration as we develop and practice the services demanded. But professionalism in research administration also implies recognition of the need to generate new and effective ways to structure opportunities for learning and particularly to emphasize the development of communication among colleagues.

Research administrators serve a demanding clientele. We are continually challenged to be knowledgeable and accurate informants, artful problem solvers, skilled compromisers, predictors of the future, saviors from past errors, and above all, adaptive managers in changing environments. What are the specific processes that support these skills? First, sensing and detecting changing conditions in our internal or external environment that affect performance. Second, acknowledging the need to alter or adapt our mode of functioning. Third, taking steps to initiate changes, such as learning new skills, accepting new knowledge, refocusing to meet new demands. We have to be able to think about familiar problems in unfamiliar ways. We can learn from the perspectives and experiences of other practitioners of our trade. We also have to encourage the critical study of research management by those working in complementary or associated areas or disciplines whose research outcomes could be beneficially applied to research management.

Professional development builds on improvement, both on an improved knowledge base and the adaptation of practice to incorporate new findings into the profession. Management for research, as with research itself, is dynamic rather than static. That is one of this profession's most attractive elements and should be a source of satisfaction and stimulation. The services that the faculty, staff, and administrative colleagues of our institutions expect in research management can and should change with the times and in anticipation of the future. This is the motivation for continued learning, the desire to share evolving attitudes, to articulate questions, and to share conclusions on issues of mutual experience and interest.

For almost three decades NCURA has fostered the motivation for continued learning through national and regional meetings, workshops, national conferences with specialized topics for targeted audiences, and a variety of publications designed to serve members' needs. Research Management *Review* offers a new professional development opportunity. The ability to produce a journal presumes not only a strong and competent membership to generate articles, but also the ability to attract contributors and readers beyond the NCURA membership. The journal can and should demand the serious attention of those involved with research management, from the viewpoints of both researchers and practitioners. The journal will be evolving and maturing, as reputable and seasoned professional publications do, in content and subscribers.

We look forward to disseminating the knowledge and experience of our future contributors to this group.

This first issue features two components. First, the Keynote Addresses from the last two Annual Meetings. These presentations by Drs. Good and Schmitt, although a year apart, confirm the sustained national anxiety about the effect of international competition on the economic viability of the country. That these concerns have a direct and integrated relationship with the academic research enterprise is inevitable given the level of federal funding for research and development as well as growing private sector research funding in our institutions. For research administrators, these presentations construct an informed framework for understanding critical national policy issues.

The second component is comprised of three contributed papers from NCURA members. Each addresses a particular research management concern from an experienced eye and should be valuable not only now but as future references. These papers are derived from presentations of contributed papers at earlier NCURA annual meetings.

It is appropriate to recognize the considerable role Past President Earl Freise played in the creation of an NCURA journal. His initial efforts to determine the capability of NCURA to produce a professional journal, and the consideration of this venture by the Publications Committee during his tenure as President, laid the preliminary groundwork for the concept of this publication. The final deliberation and recommendation by the Publications Committee and Executive Committee to produce Research Management Review as the NCURA journal came about during my presidency last year; and, as the first Editor of RMR, I take considerable pride and satisfaction in the reality of this first issue. I welcome the comments of the readers. I particularly want to encourage NCURA members and others whose research interests are directed to the study of management of research policies to consider the journal for the dissemination of their work.

Mary Ellen Sheridan
Editor
March, 1987

World Competition in Technology Development: Can the U.S. Maintain a Leadership Position?

Mary L. Good

(Editor's note: This paper was presented as the Keynote Address at a Plenary Session of the 27th Annual NCURA Meeting, Washington, D.C., November 5, 1985).

The world has entered a new era: a global economy is developing where every country must compete in global markets if it wishes to sustain internal growth and economic stability. The developing nations sell low cost raw materials and commodity products where cheap labor costs provide an advantage. The developed, industrialized nations compete fiercely with each other for markets for their manufactured goods and agricultural products. The issues of tariffs, trade restraints, reciprocal trade agreements, and protectionist legislation are faced daily in the major capitals of the world.

For the United States, this climate brings to a close two major facets of American business. First, our home markets are being invaded by high quality, low cost products from all over the world; and second, our ability to sell competitively to global customers is eroding. Protectionist positions that were supported in the nineteenth century in the interest of protecting young American businesses are now being justified in terms of job preservation and the maintenance of our standard of living. The question of our international competitiveness has become a national issue, and the debate has accelerated since the early '80's. The issues of low cost natural resources in their countries of origin and the realities of cheap labor in the developing countries are now well understood and the consensus has arisen that technology-

Mary L. Good, Ph.D. is President of Engineered Materials Research, Allied *Signal Corporation,* Des Plaines, IL 60017-5016.

based products and services are our hope for remaining a leader and major player in world markets in the next few decades. The problem is that this same conclusion has been reached by our most worrisome competitors.

Within five months of each other, the following statements were made by three heads of state:

> "The Party views the acceleration of scientific and technical progress as the main direction of its economic strategy, as the main lever for the intensification of the national economy and for raising its efficiency, and hence for the solution of all other economic and social issues. These tasks. . . affect every collective, every Communist, every Soviet person:'
>
> Mikhail Gorbachev
> June 11, 1985

> "[Slcience and technology have emerged as a universal language for humankind and as a bridge linking different nations and spheres of civilization."
>
> Yasuhiro Nakasone
> June 3, 1985

> ". . . [N]o nation depends as much as we do on the science base. Our enviable standard of living, our national security, our ability to create millions of new jobs-more than 7 million over the last two years, in what the Europeans are calling an American miracle-all depend on new talent, knowledge, and our talent for making use of it."
>
> Ronald Reagan
> February 27, 1985

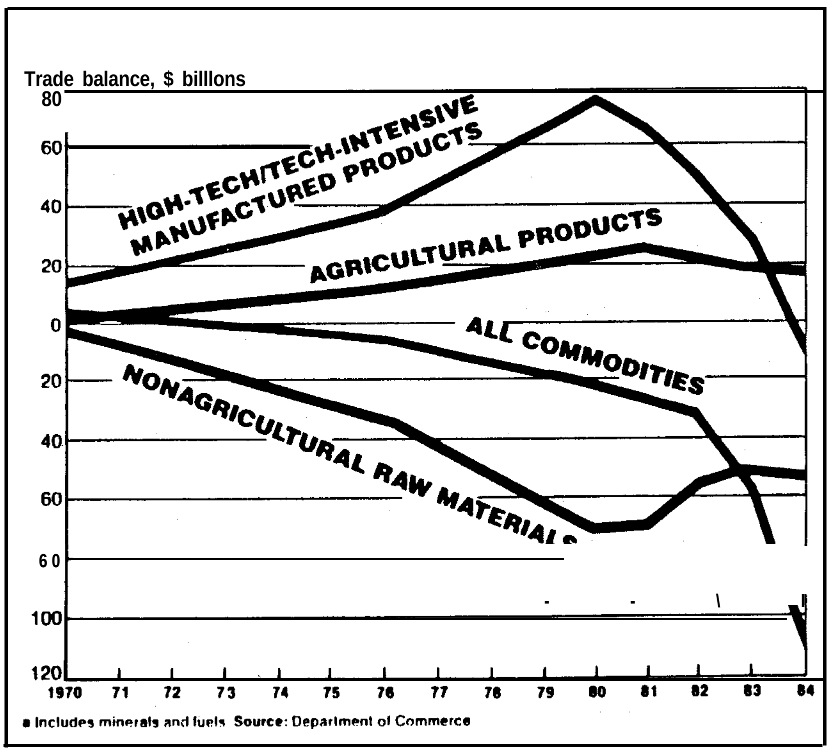
Thus, the race is on for industrial superiority and we must deal with the question of how does the United States gain and maintain a leadership position in this vital competition.

Let me first try to set the stage for where we are in a competitive sense and then we will look at some of the factors that have played a role in establishing that position. Second, I will review some of the actions we have taken to improve our position. I will close with my feelings about what more we will need to do to truly gain some distance on our competition.

Where are we? Figure 1 clearly illustrates our problem. The U.S. balance of trade has gone negative for almost all economic indicators. Non-agricultural raw materials and commodities have steadily declined since 1970, agricultural products have fallen since 1981, and high-tech products have plummeted since 1980.

Figure 1

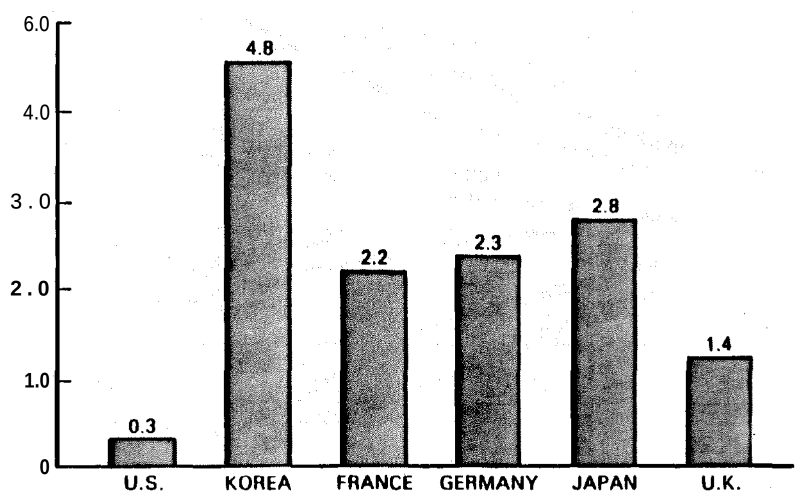
U.S. HAS LOST ADVANTAGE IN TRADE IN TECHNOLOGY SINCE 1980



The U.S. has also lost productivity relative to other industrialized nations in the '70's and '80's. During this period, U.S. productivity rose annually by 0.3%. Figure 2 indicates that the U.K.'s increase was almost 5 times greater than ours, France's and Germany's 7 times greater, Japan's 9 times greater, and Korea's was 16 times greater than ours.

Figure 2

AVERAGE ANNUAL PRODUCTIVITY GAINS, 1973-83

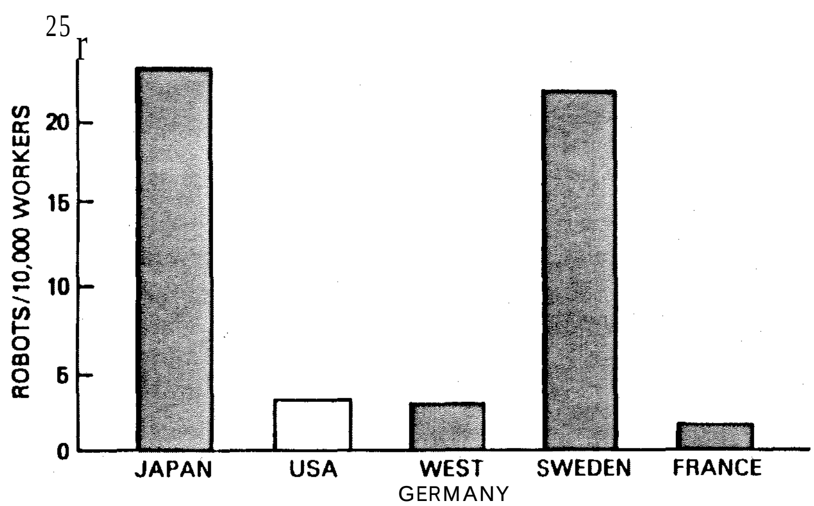


SOURCE: U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS, MAY 1984.

As Figure 3 shows, the U.S. lags startlingly behind Japan (and Sweden!) in the adoption of robots in the workplace. This is a significant measure of how quickly new industrial technologies are implemented in each country.

Figure 3

ADOPTION OF ROBOTS—1982



SOURCE: SOCIETY OF MANUFACTURING ENGINEERS, PREPARED FOR THE U.S. INTERNATIONAL TRADE COMMISSION, 1984.

What has caused, the devastating trade deficits we have sustained since 1980? Factors contributing to the loss of U.S. competitiveness are:

- High labor and capital costs
- Unfavorable exchange rates
- Regulatory constraints that affect concerted R&D efforts
- Patent and trademark infringement
- High budget deficits that threaten government support for R&D
- Educational system that does not meet human resource needs
- Lack of a cohesive science and technology policy

What factors are necessary for a competitive position?

- Human resources
- Innovation-mechanisms to stimulate it and reduce barriers to it
- Investment in science and technology
- National strategy

Let's look at human resources. All of us know about our problems in precollege education. We have some of the best and some of the worst schools in the world. Our best ones turn out qualified and motivated young people who can and will achieve the highest levels of performance in their college careers and in their professions. Our poorest ones, however, do not produce the literate, competent individual who can go to a first class technical school and provide the technology skills our industries will require from the next generation of technicians and support personnel. At the college level, we have had our ups and downs. It is in education that we see the clearest need for government involvement.

The impact of government policies on industrial competitiveness is perhaps at the most fundamental level in the area of science and engineering education. Historically, direct government involvement with industrial research began with the Land Grant College Act of 1862. The colleges set up under the Act were established as training centers in scientific agricultural methods and the mechanical arts. Further legislation provided for an integrated program of education, research, and technology transfer. We are all aware of the technological revolution in farming and agricultural businesses that resulted.

Other landmark governmental organizations impacting industrial research were the National Research Council created in 1916 to bring government, industry, and the universities together on military technology research for World War I, and the Federal Government itself which funded military technology research at "centers of excellence" based at major universities during World War II. After the war, government support for university research in science and engineering grew rapidly, becoming the major source of funding. This legacy of the land-grant colleges provides the current major support for training scientists and engineers at basic research institutions. Without this pool of trained technologists to draw upon, industry would have serious trouble doing competitive R&D. This resource was well recognized by industry and, before Sputnik and the rapid growth of government support to universities, industrial scholarships, fellowships, and study grants were common.

With the influx of direct federal dollars, university needs for direct industrial support declined and university-industry interactions became somewhat dormant during the late 1960's and 1970's. Again, the source and objectives of government funds to universities impacted industrial research in that they dictated the type of training received and in some measure regulated the supply of scientists and engineers. A case in point would be the skew toward energy-related sciences during the height of ERDA funding during the 1970's.

Recently, and particularly during the Reagan administration, government policy has again impacted directly on university-industry relationships and significantly on science and engineering education. TO leverage federal funds and to encourage cooperative activities, several educational support programs have been launched under the rubric of "industry matching programs!' The most visible of these programs are those funded by the National Science Foundation. Although the percentage of total R&D funding from NSF is small, the effect on graduate educational programs is large, since essentially all of the monies go to universities in the form of basic research funds which support research faculty and their graduate students. The breakdown of federal support for total R&D spending and for academic support is shown in Tables 1 and 2.

Table 1

Total Federal R&D Support—1985

Agency	%
DOD	**63.5**
NIH	**10.7**
NSF	**2.7**

SOURCE: NSF DIRECT ERICH BLOCH IN IEEE *TRANSACTIONS* **ONEDUCATION, SPRING 1986.**

Note: The President's proposed budget for FY1987 calls for $61.5 billion in Federal funds for R&D. Approximately 75% of this is slated for support of defense-related R&D. In 1977, about 50% of total Federal R&D funding went to defense activities. Federal R&D funding for the other mission agencies (NIH, NASA, DOE, NSF) is expected to remain flat through 1986. The President's FY1987 budget proposes an increase for funding of space research (NASA), a slight increase for general science (NSF, some DOE programs), a decrease for energy (DOE), and no change for NIH.

Table 2

Federal Support for Academic R&D—1985

Agency	%
DOD	16.3
NIH	**49.2**
NSF	**15.2**

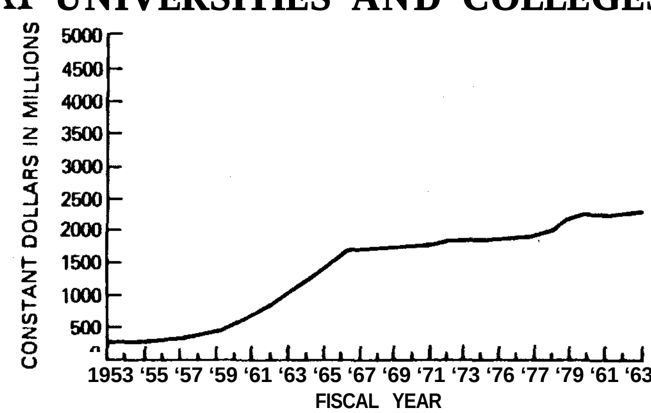
SOURCE: NSF DIRECTOR ERICH BLOCH IN IEEE TRANSACTIONS ON EDUCATION, MAY 1986.

The support from NIH is of particular interest to those industrial research organizations which support commercialization of pharmaceuticals, medical devices, health care products, and biotechnology. NIH funds are the support mechanism for a large percentage of the technical professionals we hire in these areas. DOD is an increasing influence and will make major impacts, particularly on graduate engineering education. NSF is unique in that funding is broadly distributed across the basic sciences and engineering and is the vehicle for many experimental "cost sharing" programs designed to strengthen the tie between industry and the universities. All of this infrastructure would suggest that we understand the crucial role of education at the college and post-graduate level in the development of a competitive work force. However, there are some problems.

- Federal funding of academic R&D has remained at essentially the same level for the past 20 years!

Figure 4

FEDERAL R&D EXPENDITURES AT UNIVERSITIES AND COLLEGES

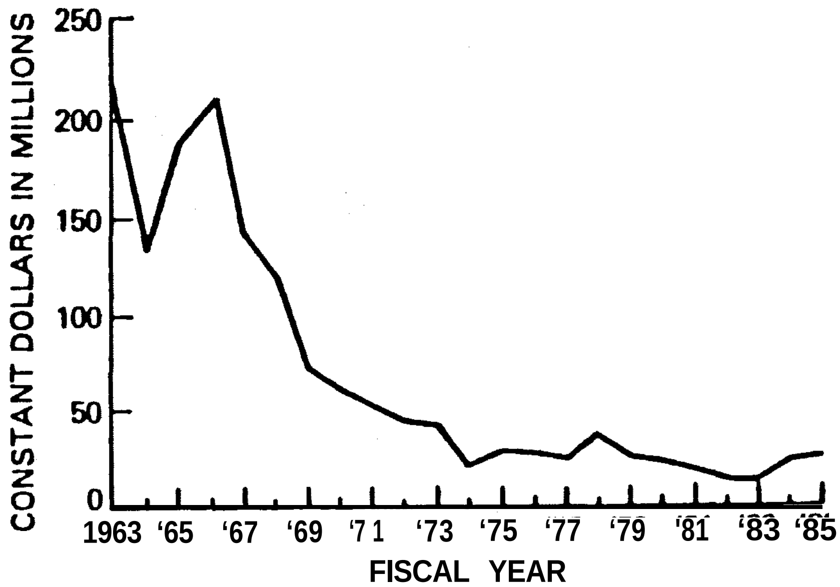


SOURCE: NATIONAL SCIENCE FOUNDATION, OCTOBER, 1985.

- Federal support for academic R&D equipment and facilities dropped sharply in 1967 to almost nothing-and has stayed at that level ever since.

Figure 5

FEDERAL OBLIGATIONS FOR R&D PLANT TO UNIVERSITIES AND COLLEGES



SOURCE: NATIONAL SCIENCE FOUNDATION, OCTOBER, 19.35.

One approach has been to initiate "matching fund" programs designed to get more resources into university research programs. They are:

- lndustry-university cooperative research centers
- Cooperative, integrated program in materials research
  - Industry/university research projects
  - Industry use of government facilities
  - Block grants to 14 universities for materials research laboratories
- Engineering research centers
- Supercomputer centers
- Presidential Young Investigator awards

The NSF initiated industry-university cooperative research centers in the 1970's. Twenty centers with research programs in such areas of mutual interest as polymers, robotics and biotechnology are now in operation with about 10 more in the planning stage. The centers increase their industrial funding as NSF seed money is phased out over a 5-year period. The centers give industry access to a pool of trained future recruits and faculty consultants, plus immediate access to research results which may take two years to appear in the open literature. The universities get student and faculty exposure to the practical, state-of-the-art problems industry faces, equipment donations, and increased income by matching funds from industry.

The NSF offers industry cooperative, integrated programs in materials research. To foster interdisciplinary work in this area, the NSF funds industry-university research projects, encourages industrial researchers to use government facilities, and provides block grants to 14 universities for Materials Research Laboratories. Many industrial scientists participate in the laboratory program.

The NSF has also begun several new programs: the Engineering Research Centers, the Supercomputer Centers, and the Presidential Young Investigator (PYI) awards. All of these require and/or encourage matching contributions from industry. The Engineering Research Centers, begun in 1985, are university-based interdisciplinary programs designed to enhance engineering education and research in the newer technologies. There is strong university-industry and inter-university participation. In 1985, the NSF provided $94.5M to 8 universities for 6 centers.

Four Advanced Scientific Computing Centers have recently been set up by NSF with $40M in funding at several universities. The centers are designed to provide access to supercomputers by academic scientists and engineers. The effort is co-sponsored by supercomputer vendors, the universities, and state and local governments.

The Presidential Young Investigator (PYI) program is unique in that it is designed to couple industrial research directly to young faculty through shared NSF-industry funding. The first 200 PM's were chosen in 1984 followed by a second 200 in 1985. One hundred more were to have been chosen in 1986. The NSF provides a grant of $25,000 to each PYI with another $37,500 available to be matched dollar for dollar by other funds, primarily from industry. Thus, a PYI can establish a research program at the $100,000 per year level if he or she can attract $37,500 in industrial support. The PYI program was created as a vehicle for attracting young scientists to remain in the universities to teach and train students as an alternative to accepting an industrial R&D

position. Industry response has been excellent with 70% of the total industrial match for 1984 pledged by over 100 corporations. The future of all of these matching fund programs remains to be seen, however, as the numbers and variety proliferate at the same time that, in-house industrial R&D programs are squeezed by near-term commercial demands and the need to control R&D expenditures.

The overall impact of these programs has been great, but significant facilities and equipment problems remain. It is estimated that the equipment shortfall is $2B and the need for new facilities is on the order of $l0B. Some universities are turning to our competitors for help.

We can see from Table 3 that this help is in the millions of dollars and is sought by a cross-section of our finest universities from some of the largest Japanese companies. In fact, Hitachi has just announced that it will spend $20 million for the Hitachi Foundation to provide scientific and educational support for U.S. research facilities and academia.

Table 3

JAPANESE FUNDING OF U.S. UNIVERSITY RESEARCH

INSTITUTION	COMPANY	FUNDS (S)	USE
MIT	45,INCL CANON MITSUI HITACHI NEC	30,000/yr EACH	Various
	TOSHIBA SANYO NEC OTHERS	500,000/yr	MEDIA LAB
STANFORD	11 COMPANIES		ADVANCED COMPUTERS
U. OF ARIZONA	. TOSHIBA	5 MILLION	DIGITAL RADIOGRAPHY
TULANE	KAWASAKI STEEL SUZUKI MOTOR MITSUBISHI HITACHI OTHERS	1.5 MILLION	BIOMEDICAL RESEARCH CENTER
U OF CALIFORNIA (IRVINE)	HITACHI CHEMICAL	600,000	BIOCHEMISTRY

SOURCE: CONGRESSIONAL RECORD, OCTOBER 5, 1984.

Immigration policy is another area of change and possible impact on industrial research. In the period 1960-1984, according to NSF, 289,327 doctorates in science and engineering were awarded to U.S. citizens. Of the 74,476 foreigners receiving Ph.D.s, only 21,320 held permanent visas. Recent immigration practices make it difficult to hire foreign nationals without visa status. Restrictions by DOD may make it impossible to employ them in certain government funded programs. The effects will be particularly significant in some of the emerging technology areas where foreign nationals make up a large percentage of the graduates.

The statistics in Table 4 indicate clearly the problem associated with the availability of U.S. citizens in the very active field of Materials Science.

Table 4

Nationality of Ph.D. Graduates

Discipline	Total 1984 Graduates	U.S. Citizens	Foreign Permanent Residents	Foreign Visa Status
Chemistry	1182	983	-	-
Polymer Science	63	37	11	15
Chemical Engineering	345	167	32	146
Ceramics Engineering	25	15	2	8
Metallurgy	76	31	9	36
Materials Science	167	76	17	74
Life Science	3753	3289	-	-

Source: NSF Special Report 1980-84.

Let's look at innovation. What are we doing to promote innovation and what are some of the disincentives? Many issues exist in the private sector which impact innovation. The cultures of many of our businesses are not oriented toward long-term technology development. They are not committed to innovative manufacturing or a relationship with their employees that fosters product and process innovation as a way of life. However, much of the corporate culture is driven by government policies which impact directly on their activities.

Some of the impact areas of government policy on industrial R&D are:

- Direct government support of industrial R&D
- Science and engineering education
- Federal support of university research

- Management of industry-university collaborative research through "industry matching programs"
- Federal tax policy
- Anti-trust regulations
- Patent and trade secret policies
- Immigration policy

Since I have already touched on education and immigration policy, I will discuss some of the other factors.

The most obvious federal policy impact on industrial research is direct funding of industrial organizations by the federal mission agencies. Total R&D spending in the U.S. topped $100 billion for the first time in 1985, and is expected to reach $118.6 billion in fiscal 1986, according to NSF estimates. This 9% increase over 1985 is largely due to the major increase (23%) in Department of Defense R&D support. These R&D funds will be distributed among basic research, (12%); applied research, (21%); and development, (66%). Industry funds approximately 50% and performs about 75% of total U.S. R&D. About 25% of industrial R&D funds comes directly from DOD. This direct federal funding has a great impact on many industrial R&D programs. The government policies which dictate its objectives are the determinants of what R&D will be done and what people and facilities resources the industry will need. These effects, particularly where driven by priority funding from one agency, will be felt for many years in our competitive position since the government-developed technology will be a dominant force in leading-edge commercial products, processes and services.

Research and development funded by DOD and AEC after World War II served the private sector well and the United States became the world's industrial leader. It is not at all clear, however, whether current DOD spending is in areas where commercial spin-offs will be so easy. Also, the current procurement process can hinder the development of subsequent competitive commercial products.

Let's next look at tax policy and anti-trust regulations. Federal tax policy has long had an indirect but significant effect on the base of research training by encouraging private and corporate donations to academic research. Recent administrations have made further changes in tax and patent policies, providing more incentive for industry investment in research. The Patent Policy Act of 1980 permitted non-profit institutions and small businesses to elect to take title to inventions arising from Federally-funded R&D activities. In addition, the rules applying to cooperative research between corporations were clarified when the Department of Justice published the *Anti-trust Guide Concerning Research-Joint Ventures* in 1980.

The Reagan Administration's new vision of the government-industry relationship led to a variety of initiatives designed to stimulate R&D activity. The Economic Recovery Tax Act of 1981 provided for:

- a 25% per year tax credit for increases in industry R&D expenditures (applied to in-house R&D expenses, contributions to a qualified fund, and research contracted out)
- a tax break for new scientific equipment donated by the manufacturer to colleges and universities
- a 2-year suspension of tax regulations which require firms to allocate research expenses between U.S. and foreign source income
- a change allowing taxpayers to depreciate research equipment over 3 years rather than 5.

The Administration has advocated further loosening the anti-trust regulations as they apply to cooperative corporate research and it would like to extend coverage of the 1980 Patent Policy Act to profit-making corporations. The overall effect of these incentives on industrial R&D spending has been somewhat controversial. Many of the incentives are jeopardized by the tax reforms currently being implemented by the Administration and the Congress. For example, the R&D tax credit, which was allowed to expire at the end of 1985, was eventually reinstated for another three years, but at a lower rate—20% rather than 25%. I personally feel that this particular credit is important both in that it has stimulated expanded R&D budgets and, perhaps more important, it has been a symbol that our government understands the role of R&D in our struggle to gain a superior position in the development of technology for balance of trade reductions and the maintenance of an employment base in the United States.

Let me touch now very briefly on the other issues 1 raised at the beginning of my talk. Patent policy has had great impact on this country's technological development. Between the Civil War and WW I, the U.S. became the world's industrial leader and unprecedented numbers of American patents were awarded to independent inventors. These inventors tended to work alone, and could choose the problems they would address. One way they made such choices was by following the patent literature to see what other professionals were working on and what problems might be solved by invention. The Patent Office thus provided information and a spur to competition as well as protection for the inventors. A quote from Scientific American in 1896 captures the contemporary spirit:

> ". . . [this is an] epoch of invention and progress unique in the history of the world. . . It has been a gigantic tidal wave of human ingenuity and resource, so stupendous in its magnitude, so complex in its diversity, so profound in its thought, so fruitful in its wealth, so beneficial in its results, that the mind is strained and embarrassed in its efforts to expand to a full appreciation of it."

Although there are still independent inventors around, they are generally not at the cutting edge of technology. Since WW II, corporations with many inventorscientists and money for development and marketing have become the vehicle for technological change. Only recently has U.S. patent policy, historically designed to favor the lone inventor, begun to recognize this. The penalty for corporate inventors was only removed in 1984. The productivity of scientists working in research groups was hurt by patent law requirements discouraging communication among group members. Such communications were termed "prior art" and resulting work was not patentable.

We should note that U.S. patent activity has also changed. Recent concerns about lethargy in industrial R&D are not soothed by figures showing that 2 of the top 5 corporations receiving U.S. patents in 1984 are Japanese.

Table 5

Top Corporations Receiving U.S. Patents in 1984

Rank	Company	No. Patents
1	General Electric Company	785
2	IBM Corporation	608
3	Hitachi, Ltd.	596
4	Toshiba Co., Ltd.	539
5	U.S. Phillips Corporation	438
6	Canon K. K.	430
7	RCA Corporation	430
8	Siemens A.G.	404
9	Mobil Oil Corporation	373
10	Nissan Motor Company, Ltd.	372

SOURCE: IP0 NEWS, SEPTEMBER 1985.

The current patent system has other problems. It does not protect new technologies and its operating structure is obsolete. Some facts:

- Time required to obtain a patent-more than 2 years
- 1983 backlog—263,000 applications

- Missing at any given time-S% of the 14 million patents
- The International Trade Commission estimated that in 1982, patent and copyright infringement cost the U.S. 131,000 jobs and $5.5 billion in lost sales
- Some countries have little or no patent protection
- Patent examiners educated in new specialized technologies are rare

There is some movement to change. Currently, tougher legislation in the form of the 1985 Intellectual Property Rights Amendments to the Tariff Act of 1930 aims to strengthen inventors' rights. Dozens of bills now await congressional action. Work has begun on automating the patent office. Automation is expected to speed the patent process, reduce theft and increase public access to the patent literature. In addition, our Patent Office will be able to exchange information with computerized foreign patent offices. Perhaps more significant has been the creation in 1982 of the Court of Appeals for the Federal Circuit which is challenged to interpret the body of patent law to protect inventors.

To sum up, we have a substantial investment in personnel development and a large commitment to R&D in this country, both federally and privately funded. It is significant that the recession in the early '80's did not see a downturn in industrial R&D spending-indeed, it continued to climb. The test will be to see if the country has the patience and courage to continue to build its R&D infrastructure and to reward innovation in a time of tight federal budgets, pressing international problems, and uncertainty in the private sector about the near-term economic outlook. There are some good signs: our science leadership is unchallenged (especially when we compare Nobel prizes and other recognition for basic research); the establishment of new, technology-based, entrepreneurial companies is at an all-time high; industrial R&D spending continues to rise; and there is an awareness by the government and the public that science and technology are crucial to our long-term economic health. To win, we must continue to fund these activities even while we make significant reductions in the deficit. We also must remove trade barriers that hinder our ability to sell the fruits of our innovation worldwide. I believe American business is up to the task, but it will need the understanding and support of the American people. People like yourselves can do a great deal to help with this process.

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The Creative Intellect and Competitive Realities

Roland W. Schmitt

(Editor's note: This paper was presented as the Keynote Address at a Plenary Session of the 28th Annual NCURA Meeting, Washington, D.C., November 4, 1986).

This particular day-an election day, one week after the World Series, and half way to the Super Bowl-is a good time to discuss the issue of competitiveness.

When it comes to being the winner in the world economy, will our nation turn out to be the Mets-or the Red Sox? For some time now, I have joined a number of other people making the case in this town that in the economic "world series" the United States possesses a tremendous competitive advantage over our international rivals-our great universities. Today, just when the strengths of those universities are most needed they are most threatened. We have recited a litany of problems-as research administrators, you're fully familiar with them. We've talked about the lack of adequate equipment, and about the National Science Foundation surveys showing that one quarter of academic research equipment is obsolete, one third is more than ten years old, while less than one sixth can be called state-of-the-art. We've pointed out the sad state of university buildings and fixed equipment, and estimates suggesting that some $5 to $20 billion will be needed just to meet the facilities need. We've spoken of alarming faculty shortages in science and engineering, and how this challenge will become extraordinarily crucial in the 1990s when the generation trained in the postwar "golden age" of U.S. science and engineering reaches retirement age. We've pointed out the incredible fact that Japan, a nation

Roland W. Schmitt, Ph.D. is Senior Vice President-Chief Scientist of the General Electric Company, Schenectady, NY 12361.

with only half our population, now graduates more engineers each year than we do-and we've presented the demographic charts indicating that the problem will get worse, not better.

As the bottom line, I recently joined several others in pressing on the present Administration the importance of our universities to competitiveness, and the need to take steps to preserve their strength.

In making that case, we were not activated by philanthropic or cultural motives. We argued that this is one of the best investments our nation can make in improving its competitiveness in the world economy. But even as we made that assertion, we were fully aware that money alone is only a necessary, not a sufficient condition. Increased financial support must be accompanied by changes in the way universities conduct research and educate students. Unless those changes occur, our claim that universities are a great competitive asset will be hard to sustain.

So that's the challenge I put before you today-a challenge to make better use of the creative intellects in U.S. universities in enhancing the competitiveness of the United States in the world economy.

But what do those words mean? What can the universities do about the competitiveness problem? To answer that, we first have to understand what the problem is. And that can best be understood by comparing the United States with its most successful international rival, Japan.

In large part, that comparison is a modern version of Aesop's fable of the race between the tortoise and the hare. The United States is the hare, Japan is the tortoise, and the race is one of creating new technology and putting it to work in commercially successful products. In this race, the American hare usually gets off to a leaping start-for example, inventing the transistor, integrated circuit, and the videotape recorder. But then it snoozes or stumbles while the Japanese tortoise makes its way to the finish line. The Japanese have succeeded by a strategy that combines incremental technology steps with superb efforts at design, manufacturing, and quality control. And they have been preeminently successful in linking their research to markets and in gaining competitive advantages in industry after industry. That contrasts strongly with the American strategy of combining technology leaps with stumbling efforts to translate that technology into commercial success.

What can be done about this difference in approach? One temptation is simply to imitate Japan. But you don't turn the hare into a winner by strapping a shell on his back and telling him to walk instead of hop. Instead, you keep him awake and leaping all the way from start to finish. A tortoise will never beat a wide awake hare that leaps as strongly over the whole course as he does in getting out of the starting gate.

The Japanese have recognized this and are seeking to become better at revolutionary innovation, So our strategies are converging. I believe that this convergence can become our advantage-that it will be easier for the hare to learn endurance than for the tortoise to learn to leap.

I say this because of that U.S. advantage you people represent-the world's best university system. Competitiveness has two parts. First, get the hare to leap even further than he already does, so that even if the tortoise takes jumping lessons you'll still beat him. And second, teach the hare stamina-get him to leap as well in every part of the race as he does at the start.

So for our nation's universities, the challenge of competitiveness also has two parts-strengthening our ability to make great leaps of creativity, in which we continue to lead the world. . . and restoring and strengthening our ability to turn creative ideas into winning products, where we have slipped. Let's look at these two parts separately-starting with the leaps.

The traditional academic environment for exploring the frontiers of knowledge has concentrated on that leaping role. Our universities have traditionally been the source of great leaps of discovery and knowledge. The university researcher or teacher has not only been left free to pick his problems-but he has also largely been kept free of information about messy real world industrial issues in the outside world. We believe that this kind of freedom is necessary for true creativity. Based on that traditional environment, the US. academic research system has been highly productive and has been a major asset in U.S. competitiveness.

That system was ideally suited for a time when the United States dominated the world economy through its superiority across the board-in technology, skilled workers, raw materials, and capital formation. In those days, the primary role of science and technology in the United States was generating knowledge, and supporting national missions in such areas as defense, health and space.

Today, the economic context for research is totally different. The problems of competitiveness are putting new demands on education and research. The universities are caught in the squeeze I spoke of earlier, between increasing demands, and tightening budgets.

In part, research administrators may be able to shield the creative intellect from these changes. But this can only go so far. For one thing, you may not succeed. But, more important, it may not be what you should be attempting.

I encourage you instead to face the reality of the new world-one in which competitiveness has a priority right alongside the older missions. I encourage you to ask the question-can academic teaching and research thrive and be as productive in this new world as it has been in the past?

My answer here is yes-if we do the job right. The environment of the researcher can be enriched if these challenges are regarded as just that-challenges, not threats. And the research administrator, in his or her role, must not be a shield between the researcher and reality, but instead a conduit to bring new realities to the researcher.

Researchers are harder-shelled creatures than many of us realize. They thrive on putting together diverse information in creative ways. Some of the greatest research discoveries result when a creative mind uses the findings of one field to enrich the methods and concepts of another. Consider the way Carnot brought the steam engine into physics, or the use Darwin made of ideas from economics, for example. The realities of today's competitive world can become part of this rich stew of raw material for this creative process. Competitive challenges can pose new kinds of questions for the researcher, can trigger new kinds of approaches. They can lead to discoveries, ideas and new knowledge every bit as creative as in the past, yet more responsive to the new imperatives.

Both industry and university leaders have responsibilities for broadening the flow of challenging problems and innovative ideas moving between the universities and industry from today's trickle to a much more substantial flow. The Nobel Laureate and president of the Royal Society, Sir George Porter, summed this up very well recently when he said "the link up between basic research in the universities and industrial needs must be initiated to a greater extent by those in industry. They may expect the full cooperation of the university research worker-the days of ivory-tower snobbishness about pure research are long since past."

Let me be a little more specific about this link up by looking in some detail at one area where it is especially crucial-the area of engineering research. It generates much of the knowledge underlying the practice of engineering, and it provides a crucial bridge between the leap-ahead ideas in which this nation excels, and the ability to use those ideas. A few years ago, many of us became concerned that the nation was falling down in engineering research. The Committee of Science and Public Policy of the National Research Council, for example, found universities reluctant to grapple with the research issues underlying advanced automation, in such fields as human computer interfaces, expert systems, and geometric modeling. It found universities weak in crucial fields of materials engineering, such as advanced polymers, composites and ceramics. And in biotechnology it found that we are not developing "a knowledge base in process engineering that combines the skills of the biologist and the chemical engineer."

Once the needs were identified, an initiative was launched to meet it. The National Science Foundation created a program of Engineering Research Centers located at universities and aimed at enriching engineering research. The centers were explicitly designed to link industry and universities-creating bridges that would carry not merely money, but, much more importantly, the challenging problems and stimulating people who can enrich work at both ends of the bridge. They were designed to be truly interdisciplinary. And they were designed to take a broad view and embed engineering research in the total process of innovation needed to make our nation more competitive.

As many of you know, the response to the program has been overwhelmingly positive. The initial offering was only $10 million for the establishment of three to six centers. That drew some 140 proposals, requesting a total of more than $2 billion. That strong response helped confirm the need for the program, and it is now launched and growing in a second round, with a total of eleven centers established so far. Industry is now providing about half the support for them.

Those Centers are just one example of enriching the environment of researchers by immersing them in the competitive challenges created by the new world economy. We need similar initiatives across the board, in science as well as engineering. They will not direct science away from excellence, but will increase the opportunities for research excellence.

My confidence that such initiatives will enrich research itself is heightened by the track record of the past. Time and again, such challenges have produced not only practical answers, but also better research. Consider, for example, the chemistry of Lavoisier that was enriched by his projects in the field of agriculture. . . the bacteriology of Pasteur, inspired in part by consulting work for the wine and beer industries. . . the discoveries in physical chemistry of Haber and Nernst, stimulated by the need for nitrogen fertilizers. . . the surface chemistry discoveries of Langmuir that began with studies of the blackening of light bulbs. . . Jannsky's pioneering work in radio astronomy, stimulated by his radio work. . . the discoveries in such areas of physics as elementary particles, and nuclear magnetic resonance that grew directly out of radar work during World War II. . .or the more recent work carried out both in industry and academia in such forefront fields as artificial intelligence and new computer architectures. . . and right up to this year's Nobel Prize winning work, done in an industrial laboratory, on scanning tunneling microscopy, an exciting new way to see atomic lattices on surfaces.

That long track record gives me confidence in that positive answer to the first of my two questions. Academic teaching and research can thrive in the new world economy. The environment of the researcher can be enriched by these new challenges.

But that is only half the problem-and probably the easier half. We are still faced with the issue of increasing the hare's staying power, getting him to leap strongly all the way to the finish line. Here research is probably not the answer. We need more engineering researchers as we just suggested. But the rest of our engineers-the vast majority-need to be trained less like researchers than they are today-and motivated more like old-fashioned, practicing, dirt-under-the-fingernails engineers.

Just like the rabbit in the fable, Americans tend to be bored by that prospect-the prospect of concentrating on the many steps between the impressive opening leap and the finish line of commercial success. We simply do not follow through on the engineering details as rapidly or effectively as we should.

Instead, we often treat them as a research problem-a problem of creating the optimum solution, independent of such considerations as cost and manufacturability. We tend to exercise our ingenuity at building new features into products, while the Japanese exercise their skill at including only those features that are really needed, and keeping strictly to stringent targets for cost and quality and manufacturability.

There are at least two possible reasons for this. Perhaps the engineers are being mismanaged. That is certainly part of the truth, and a part which I have addressed before industrial audiences-the ones who need to hear that part of the story. But today I'll concentrate on the other part of the answer-the possibility that engineers are not being educated to meet the competitive challenge.

This is a cultural problem. Throughout this century, we have seen a growing emphasis on fundamentals and theory, at the expense of hands-on experience. The objectives of this change were laudable-to give the engineering graduate a command of the fundamentals, rather than a mere exposure to obsolete machines and superficial shop techniques. But one must ask whether the process was carried too far-whether the rise of theory-based engineering education did not completely separate the student from the real-world. Students who will work in a competitive culture are being trained in a culture of research and analysis-the culture of their professors. The values imparted by our education system are research and academic values, emphasizing the optimum solution, and putting little emphasis on such problems as speed, cost, and customer satisfaction-the values of the marketplace.

Those academic values are not so much a problem in the portion of U.S. industry dedicated to aerospace work, where performance and features are the key. But they can be disastrous in commercial work. They have crept into U.S. industry in a way that does not happen in Japan. Consider for example, the area of automation, where the Japanese company Fanuc has made an incredible rise to world leadership in recent years. One of my General Electric colleagues recently discussed this issue of engineering execution with some of his counterparts at Fanuc and got an interesting perspective. The difference between U.S. and Japanese approaches, he was told, is the difference between a snake and a wall. Both U.S. and Japanese companies start a project aiming at roughly the same cost and performance targets. But the U.S. engineers, in their obsession with performance, allow the characteristics of the product to snake upward in both performance and cost, until they have purchased performance improvements at a cost the customer may be unwilling to pay.

The Japanese company, by contrast, begins the project by erecting a wall. It might be a cost wall, as it typically is with Fanuc's automation products. It might be a size wall, like the one established by the manager at Sony who brought a wooden block in to his engineers and told them-you must design our compact disk player to stay within the size of this block. The wall is rigidly enforced, and the engineer is challenged to build the best product he can without crossing the wall. The result often cannot match the peak performance of the American rival. But usually it surpasses the American product in the total package of performance, quality, and cost.

That snake-versus-wall comparison is not the whole story. There are also issues in the speed of innovation, the size of the innovation steps one tries to implement all at once, the need for patience and persistence, and many more. All these points do not add up to some inscrutable oriental cultural advantage. They are just good old fashioned engineering. They are best expressed not in sayings of Japanese sages, but rather by that anonymous Western engineer who, many years ago, defined engineerings as "the ability to do for one dollar what any damn fool can do for two.,'

Our nation has departed from the course this maxim marks out. What can we do about it? We can bring technology in to at least partly solve the problem. Computer aided engineering can help speed up the execution of engineering projects. Eliminating paper from the manufacturing process, and enabling the engineer to test ideas quickly and inexpensively on computer simulations can drastically cut down the length and cost of the design cycle, and lead to better quality products in the bargain.

Another technology, artificial intelligence, might help with the cultural problem. If old-fashioned engineers are really an endangered species, perhaps the answer is to clone them. Not biologically-genetic engineering isn't up to that yet-but electronically. Using a software package called an expert system, it's becoming possible to capture the knowledge and skills of an expert designer, repair person, or manufacturing engineer in a computer program. That can be a tremendous tool to assist or educate the young engineer.

But we shouldn't look to technology for the whole answer. I believe a redesign of engineering education is in order. Note, however, that I said a redesign, not a re-invention. We need an experimental, incremental process that keeps the best of the old while it reshapes the system to fit a new world. In the new system, some old pieces might prove more relevant than ever. For example, co-op programs can give students some first-hand experience with industrial values. And entry level courses within industry can ease the culture shock between the university and the factory.

As we carry out evolutionary, incremental reform, let's keep some basic principles in mind. First, in keeping with an old maxim of medicine, let's remember to, first, do not harm. Reforms should not interfere with the teaching of fundamentals. An engineer needs an understanding of basic science and mathematics. The only place he is ever likely to get it is at the university. Let's not permit educational reform to threaten the fundamentals. Discipline-oriented research and education is the backbone of our nation's technology. It needs to be strengthened, not weakened.

The place to prune is in the more specialized undergraduate courses that are intended to build on those fundamentals-but in fact often provide only a superficial survey of advanced terrain. Along this line, it's been suggested that engineers be trained like doctors and lawyers, and not enter into specialized study until their postgraduate courses. Only then will they have the capability and the incentive to really apply themselves to specialization. This proposal deserves a close look, and, perhaps, an experimental trial.

A second suggestion has been put forward by Nam Suh of the NSF He points out that teaching the fundamentals is not sufficient-you also have to choose the *right* fundamentals. In engineering, the choice of fundamentals has been one sided. The emphasis has been on analysis-taking things apart-rather than synthesis-putting things together. Engineering has been taught as though it was merely applied science aimed at analyzing a man-made universe.

But there are also fundamentals unique to engineering synthesis-fundamentals underlying the processes of design and manufacturing. Part of the reason they are not taught is that they are not understood-either in academia or in industry.

Educators should seek to develop these principles. This is very much an experiment. It may turn out that the only way to become a good engineering designer is by experience-that is, by creating a lot of bad designs, and learning something from each one! But let's not assume that in advance. Instead, let's support experiments aimed at developing a set of principles underlying engineering synthesis.

As a final guideline, we need a new approach to industry-university interaction. This was expressed very well by the president of one well known university. Losing patience with the clamoring for increased industry financial support of universities, he remarked, "don't just send money. . . send the best people who have thought deeply about the process. . . and not just for a day or a week, but full time for months." Right now people on both sides of the fence give lip service to industry university interaction. We can point to a substantial number of industry people who move on to teaching careers. But a closer look shows that the industrial people who go to academia are usually the ones already most like professors in their outlook and activities. The masters of engineering execution in industry rarely have the time and inclination to spend much time on campus. But we should find ways to make it worth their while, and worth the while of the company that pays their salary. And, in the same way, I have considerable sympathy with the proposal that a few years working on factory floor manufacturing and design problems in industry ought to count at least as favorably at an assistant professor of engineering's tenure hearing as theoretical or analytical papers in a professional journal.

Well, I've outlined a few principles that should underlie the coming period of experimentation and evolution in engineering education. I leave you on this issue not with an answer but a challenge. It is a challenge that cannot be ignored. The new world economy, based on knowledge, training, and skill, is here. The implications of international competition will permeate all of U.S. science and technology. The time has come for a new social compact among universities, industry and government.

In the previous such compact, reached after World War II, the watchword was research. That compact consisted of general acceptance of the major Federal role as a funder of university research and education. In response, the universities increasingly targeted national missions, such as the growth of knowledge, defense, health, space, and energy.

The new social compact adds a new mission-international competitiveness. The Federal government must again provide most of the money. But this must not be a unilateral commitment. The universities must respond by performing research that is both excellent and relevant. . .and by educating engineers who can carry out innovation rapidly, inexpensively, and right.

Fortunately, these demanding goals do not require a sacrifice of research quality. Just the opposite. The rabbit that can leap more strongly all the way through the race will also be able to leap more widely into wholly new fields. Once again, as so often in the past, I am confident that responsive science and technology will be creative science and technology. Presenting new challenges to researchers and educators will not weigh them down. It will spur them on to new achievements in both broadening knowledge and serving society.

Initiating and Managing University-Based International Research and Development Activities

Marla P. Peterson

International R&D within the Campus Context

International Competence: A National Priority

On September 24, 1985, The University of Tennessee, Knoxville, hosted the President of the United States for a briefing on corporate, university, and government partnerships which have resulted in moving basic research from the university research laboratory to the commercialization stage. There were five speakers on the stage: a scientist, an engineer, and the Dean of the College of Business Administration from The University of Tennessee; the director of Oak Ridge National Laboratory and the manager of a local plant that is a major component of a prominent American corporation.

Among other things, this is what the President heard. A Cuban-born University of Tennessee engineer who is also the president of a machine intelligence company told the President about computer vision products that can read car license plates on automobiles traveling at speeds up ' to seventy miles per hour. These products are under consideration for installation at all United States border crossing points. A University of Tennessee botanist showed the President plants that had been genetically engineered for certain drought- and disease-resistant characteristics. He further elaborated on what this technology might mean for plants grown in developing countries. The Dean of the College of Business Administration discussed The University of Tennessee statistical quality control management development program which has trained hundreds of corporate personnel to employ techniques to

Marla P. Peterson, Ph.D. is in the College of Education at The University of Tennessee, Knoxville, TX 37996-3400.

improve the quality of products. References to Japanese quality control were interspersed throughout his speech.

Finally, the plant manager pointed proudly to the physical model of a major remodeling and retooling project that will modernize his facility. However, he startled the audience when he said, "Mr. President, the good news is that our corporation, as a smokestack industry, did not give up the ship and pull out of Tennessee. We decided to invest $250,000,000 in this plant. The bad news, Mr. President, is that we had to spend $150,000,000 outside the United States-in Germany and Japan, to be specific-in order to buy the quality of new rolling mill that we needed."

There were one-hundred and twenty prominent Tennesseans in the room. Although constrained by the formality of the occasion, gasps could be heard when the plant manager finished his statement. Those in attendance did not have to be further convinced that The University of Tennessee should do everything possible to increase the international competence of its graduates.

The current balance of payments problems are helping generate support for universities to internationalize the curriculum and engage in international R&D. On campuses, committees are studying how to integrate international components into many curricular offerings, foreign language requirements are reemerging, additional courses with an international focus are being added to the curriculum, student and faculty international exchange programs are being encouraged, and some university research administrators are wondering how they can increase their expertise in managing international research and development activities.

Research Administration Skills and International Development Activities

International contract and grant efforts include a broad spectrum of possible activities. Some of these are related to programs like the International Cooperative Scientific Activities of the National Science Foundation with its emphasis on bi-national scientific cooperation; the various programs of the International Education Office in the Department of Education which focus on area studies, foreign language training, etc. It is not these types of programs that are the subject of this article. Rather, considerations in managing international development projects will be addressed. For the purpose of this article the term, "international development activities," will be limited to those efforts funded by the United States Agency for International Development (USAID) and efforts resulting from loans made by the various development banks for operation of both in-country ‘(technical assistance” and on-campus “participant training” activities.

As with any field, there is a language which must be understood. A good international development vocabulary will include effective use of the terms “technical assistance” and “participant training!’ Generally, when international development personnel refer to technical assistance they mean some type of activity which usually takes place in the country where assistance is being provided. Participant training refers to the training of foreign nationals and usually takes place in the United States. However, there may be occasions when a university will be asked to conduct some participant training in the host country, some in the United States, and some in a third country. The university that has the ability to work with British, French, Swedish, German, Brazilian and Canadian universities or education groups-to name a few-may have some advantages in a competitive bid situation. However, this is a sophisticated approach that will probably not be used if a university is dealing with the international development realm for the first time.

Entering the international development contracting arena is a decision that should not be taken lightly. Among the mistakes that have been made by universities are:

1. Underestimating the costs and activities needed to acquire an international contract;
2. Failing to provide proper back-stopping activities on the campus;
3. Failing to have policies in place relative to staff benefits and faculty reward systems;
4. Failing to require appropriate advance payments when contract is directly with a foreign government;
5. Moving too rapidly to a contract with a foreign government before gaining experience with U.S. government contracts;
6. Staffing projects with inappropriate personnel;
7. Ignoring the importance of pre-departure orientation and cross-cultural training;
8. Underestimating staffing requirements for participant training projects; and
9. Sending inexperienced negotiators to negotiate host country contracts.

Obviously, not all of the above topics can be addressed in this paper. In attempting to delimit the broad topic of initiating and managing international research and development it is appropriate to select those items which most directly affect the work of the research administrator:

1. Basic principles for participation in international development activities;
2. USAID and World Development Bank project cycles;
3. USAID and World Bank contracting modes and instruments;
4. International contract negotiations; and
5. A basic set of reference tools

Basic Principles for Participation in International Development Activities

In 1979 the National Association of State Universities and Land Grant Colleges adopted a "Statement of Principles for Effective Participation in International Development Activities!' It is appropriate to review these principles:

PRINCIPLE 1: Effective participation in international development activities requires a commitment by both administration and faculty;

PRINCIPLE 2: Effective involvement in international development activities should be consistent with the institution's mission, commitment, and competencies;

PRINCIPLE 3: Requisite key and supporting personnel resources must be available to assure effective, responsible and continuous involvement in each project undertaken;

PRINCIPLE 4: Adequate incentives should exist to assure that high quality, professionally active faculty members become involved in development activities;

PRINCIPLE 5: Adequate and timely logistical support of and professional service to a faculty member or a team abroad requires special administrative policies;

PRINCIPLE 6: Provision of adequate orientation and specialized training of project personnel is necessary, especially before departure for international assignments;

PRINCIPLE 7: Teaching, research and public service activities of the university are enhanced by properly selected and executed international development activities, followed by appropriate integration efforts;

PRINCIPLE 8: Adequate and appropriate training for international students, particularly through contract training programs, depends on specially focused university policies and practices to deal with the students' unique needs and background, and the highly specialized requirements of the training program;

PRINCIPLE 9: Internal evaluation procedures are necessary to provide for continuous monitoring of activities, including international, and prompt adjustments when needed for international development activities.

USAID and World Bank Project Cycles

Research administrators need to understand some of the similarities and differences in the project cycles of the United States Agency for International Development and the World Bank. At the outset it should be understood that universities generally do not contract directly with the World or other development banks whereas it is quite common to contract directly with AID.

The World Bank is like any other bank: it lends money. Specifically, the World Bank lends money for development projects. Universities interested in conducting work in countries that are the recipients of the loans will find themselves competing with other universities and contractors from throughout the world and will generally contract directly with the various entities that receive and administer the loans. Herein lie several precautions when contracting with loan recipients: (1) In-country contacts are a must and may involve considerable investment and (2) Partial and, in some cases, full advance payment should be part of the contract negotiations.

There are, of course, ways to minimize up-front costs associated with making appropriate visits to countries where potential contracting opportunities exist. One way is to serve as a subcontractor to a corporate contractor with subcontracting staff making appropriate in-country contacts related to efforts for which a university contractor may be sought. The author has been part of an effort where such corporate and university collaboration benefitted both parties. Another approach is to ask university staff who are already in a country for faculty development activities to act as the university representative with personnel who will implement projects as a result of receiving a loan. This requires university coordination and communication of travel schedule information so that research administrators can be aware of travel plans.

No university likes to be in the position of delivering services and then finding itself unable to collect monies for these services. The best admonition is to require advance payment. University research administrators need to be aware that there are three ways in which World Bank contractors, suppliers, and consultants can be paid:

1. The borrower can pay the university directly and be reimbursed by The World Bank;
2. The World Bank can make payments to the university on behalf of the borrower; and
3. The borrower may arrange a letter of credit with a commerical bank in the United States.

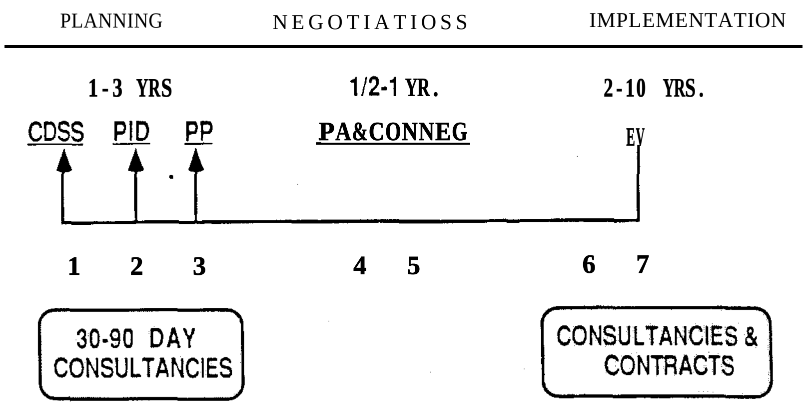
As with any bank loan, The World Bank tries to assure that funds are invested in sound, productive projects that contribute to the development of the borrowing country's economy as well as to its capacity to repay the loan. In many cases AID monies are given with no expectation for repayment. However, in some cases development assistance given by AID is matched with monies provided by the recipient country. The financial risk with AID-financed efforts is less than with efforts financed by the various development banks-particularly if the borrower is paying the contractor directly.

The World Bank finances projects in most major fields-agriculture and rural development, education, energy (electric power, oil, gas, and coal), health services, industry, mining, population planning, technical assistance, transportation, telecommunications, urban development, and water supply. USAID projects are intimately tied to general foreign relations policies, including security interests, of the United States. At present aid is given to approximately 70 countries for projects related to areas such as agriculture; rural development and nutrition; population planning; health; education; energy, research, and reconstruction; science and technology.

World Bank projects progress through six stages. The first four take place before the Bank formally approves a project: the identification, preparation, appraisal, and negotiation stages, when the legal conditions of the loan are determined. The implementation and supervision stage occurs after loans are approved and while the project is under way. The evaluation stage takes place after the project is completed and funds are disbursed.

Just as The World Bank spends one-two years of preparatory work before a project is brought to the Bank's Executive Directors for loan approval, similarly the AID project cycle includes one-three years of planning time when the Country Development Strategy Statement (CDSS), the Project Identification Document (PID), and the Project Paper (PI') are prepared and approved. Following the planning stage, a contractor can expect one-half to one year of negotiations before implementation.

USAID Project Cycle



STEPS

1. Country Development Strategy Statement prep & approval
2. Project Identification Document prep & approval
3. Project Paper prep & approval
4. Project agreement negotiation and signing
5. Contract negotiation and signing
6. Implementation
7. Evaluation

'ADAPTED FROM DESIGNING ORIENTATION AND PROJECT SUPPORT PROGRAMS FOR OVERSEAS TECHNICAL ASSISTANCE PERSONNEL: A HANDBOOK FOR UNIVERSITY ADMINISTRATORS AND PROJECT MANAGERS. UNIVERSITY OF HAWAII, MANOA: COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES, P. 13, 1984.

AID and World Bank Contracting Modes and Instruments

In addition to standard contracts, there are opportunities for consultants at various steps of The World Bank project cycle. However, a general condition that prevails at the Bank is: "Do not contact us, consultants. We will contact you. We want only the best experts we can find."

AID uses a variety of contracting modes. Some of the modes are included on the next page and have been abstracted from pp. 49-52 of a very useful document, *Guidelines for Universities in Negotiating*

Used latest USAID per diem rates? (Subscribe to monthly update)

Exempted field staff from host country taxes?

Assured that personal effects, including vehicles, are duty free?

Budgeted enough for air freight, shipping (do not forget the unexpected requests for shipments of printed materials from the home campus), storage, trips for back stopping personnel to host country and trips for team leader to visit home campus?

Included a clause in the contract that International Chamber of Commerce arbitration rules will be followed in the case of a contract dispute and that cases will be heard in a neutral court not located in the host country?

Provided for a termination clause if non-payment occurs?

Experienced international contracts negotiators can surely add more items to the above list. The printed contract must be examined so that the interests of the university are protected. Once that is completed, however, the art and skill of negotiating come into play. Negotiators must understand the cultural context in which the negotiations will take place. Learn as much as possible about the host country and its customs. In some countries to consult with others during negotiations will undermine your credibility; in others, consulting with others is expected and officials may be insulted if such “care” is not taken.

Americans often appear rushed. Allow plenty of time to conduct the negotiations-particularly when the negotiations are in the host country.

Arrogance and rigidity must be avoided. An experienced contract negotiator with fluency in the language of the host country and who is sensitive to the cultural context is ideal. Choose your negotiators with care. Their work creates initial impressions with both AID and host country personnel that may well set the tone for and influence the success of the project.

Through the years the author has discovered materials that are extremely useful when initiating and managing international R&D efforts. The documents cited in the bibliography and the list of basic desk references will be helpful to research administrators who are interested in helping their campus increase its international competency.

Summary

1. Be conversant with the project and proposal; anticipate modifications requested by AID;
2. Request critiques of your proposal prepared by proposal review team;
3. Have someone present who can talk about substance and technical content of proposal;
4. University research administrator/contracts officer must be present;
5. Be conversant with AID regulations and know which ones are required and which ones are suggested;
6. Secure expert advice if you have never conducted an international contract negotiation; and
7. Contract amendments and revisions usually are needed after the contract is signed.

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College of Tropical Agriculture and Human Resources, University of Hawaii. Designing Orientation *and* Project Support Programs for Overseas *Technical Assistance Personnel: A Handbook for University Administrators and* Project Managers. Prepared for the Board for International Food and Agricultural Development, United States Agency for International Development, 1984.

World Bunk Project Cycle. No author cited. Undated information flyer.

Appendix

To
Initiating and Managing University-Based International Research and Development Activities

World Bank

There are three steps that should be taken if you wish to acquire contracts as the result of World Bank loans:

1. Attend **one** of The World Bank monthly briefing sessions;
2. Subscribe to the *Development Forum;* the *World Bunk Telephone Directory,* and
3. Register your university with the bank.

The World Bank holds regular monthly briefing sessions for the business and financial community. At these sessions Bank officials cover:

General information on the Bank
Project work
Financing
Procurement Policies

Participants are accepted on a first-come, first-served basis. Sessions begin at 9:15 a.m. and conclude at 1:00 p.m. Reservations should be made by contacting

Mrs. Candace Brice
2021477-5322

Subscribing to the *Development Forum* is a must. Monthly operational summaries for The World Bank, Inter-American, and Asian Development Banks are included. These summaries announce loans that are under consideration as well as those that have been approved for various projects. Subscriptions should be sent to:

Development Business
United Nations
P.O. Box 5850
Grand Central Station
New York, NY 10163-5850
Subscription: $250 per year

The World **Bunk Telephone** Directory is an extremely valuable tool which is issued quarterly on a subscription basis for $20 per year. Order yearly subscriptions or obtain single issues at:

World Bank Bookstore
600 19th Street, N.W.
Washington, D.C. 20433
2021473-2941

Take time to browse in the bookstore. You will find valuable country reports and important procurement documents such as:

Guidelines for Procurement under World Bunk Loans and IDA Credits

Guidelines for the Use of **Consultants by World Bank Borrowers and by The World Bunk** as Executing **Agency**

Registration with The World Banks's computer-based system, DACON, is not absolutely necessary for securing a contract on a World Bank-financed project. However, since the Bank must be satisfied as to the capability of a contractor proposed by a borrower, it is naturally more convenient for all parties if up-to-date information is readily available. To obtain the necessary registration forms, write:

The DACON Information Center
World Bank
Washington, D.C. 20433

United States Agency for International Development

As with The World Bank, there **are** some reference tools and steps which will assist in understanding the organizational structure and policies of USAID. Those include but are not limited to:

1. Acquiring the multi-volume AID annual **Congressional** Presentation;
2. Acquiring AID handbooks;
3. Subscribing to monthly "Maximum Travel Per Diem Allowances for Foreign Areas" and "U.S. Department of State Standardized Regulations (Government Civilians, Foreign Areas)," and
4. Acquiring *AID Telephone Directory*.

Nine volumes were included in the FY 1986 AID Congressional presentation. The number of volumes and the price varies from year to year. The complete set can usually be obtained after March 1 of each year from:

NATIONAL TECHNICAL INFORMATION SERVICES
5285 Port Royal Rd.
Springfield, VA 22161

The AID handbooks are numerous and varied. The following are particularly useful:

Handbook 10 (Participant Trainees)
Handbook 13 (Grants)
Handbook 72 (Travel)

The AID handbook can be ordered from:

Agency for International Development
Distribution Center B 927 NS
320 21st Street, N.W.
Washington, D.C. 20523
202/632-8410

Telephone books are available from the Distribution Center.

Subscriptions to monthly issues of "Maximum Travel Per Diem Allowances for Foreign Areas" at $18 per year and "U.S. Department of State Standardized Regulations (Government Civilians, Foreign Areas)" at $30 per year can be obtained from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Corporate Proprietary Data
vs
Thesis Publication,
an Exercise in Diplomacy

Alan Stein

I. Perspective

In fiscal year 1980, Colorado School of Mines' distribution of research dollars was 85% public vs 15% private funding. In fiscal year 1985, it was 70% federal and state to 30% private. Considering that the research award volume advanced in the same period from $5 million to $7.5 million, this tripling of corporate money had a considerable impact on the number of privately funded projects, and the unique contractual considerations that went along with them. Because of this, we were quickly faced with a reversal of attitude; governmental agencies normally encourage publication, private corporations frequently discourage same. The basic reason, of course, being that a private corporation usually doesn't want competitors to have access to their data, and at times doesn't even want a competitor to know what avenue of research is being pursued.

Over the past five years we have observed that the same corporation that didn't even think about confidentiality statements in 1981 or 1982 are now demanding them as a matter of routine. The corporate community seems to be much more security conscious than they were, even a few years ago. One could speculate on the reasons for this, which is rather beside the point in this presentation; suffice to say that corporate security considerations are on the increase, and we may as well learn to live with them.

At this point it is appropriate to remind ourselves of our priorities as universities. The first priority is, and must remain, the educational and professional welfare of our students. Even the stature of our finest professors is supportive of that primary objective. Our second obligation

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Ah A. *Stein is Contracts* & *Grants Administrator at* The Colorado School of Mines, Golden, CO 80401.

is to the general public, in the dissemination of useful knowledge to the community at large. State supported institutions see this relationship directly, but even the private universities have tax advantages, which in effect are subsidies. Our third obligation is to the sponsor who buys a product (the research result) from us. The obligation to that sponsor is very genuine and real, but it must be balanced against the two primary obligations. If we forget or confuse this basic sequence of priorities, we are indeed in trouble.

11. Problem

To the graduate student, the need to publish his or her thesis is paramount. The student has quite enough obstacles in order to satisfy his / her committee; he / she should not have to sweat out the possibility of suppression at the last moment, because of restricted, "proprietary" data. Although not as critical as the thesis, this applies to publications in scientific journals as well.

I will define Proprietary data in the phrase that I've seen most frequently in contract documents, " . .data, either provided by the company, or generated in the course of the research, which in the hands of a competitor would be harmful to the best interests of the corporation!' This rather subjective definition can cover a multitude of sins, so to speak-interpretations will differ, of which more later.

How does a university address this problem, this seemingly direct conflict of purposes? We want to do well by our students, we want to perform the research, we want the dollars that the research will bring in-again in the specific order of priorities.

At the outset, let us dismiss one solution that I understand has been used in some cases, namely the acceptance of a thesis, and then putting it under lock and key. First, it makes a farce out of the public defense requirement for acceptance of a thesis, not to mention the requirement that a thesis be a contribution to the knowledge in the academic field. Thus, not only is it a matter of questionable ethics, it is an invitation to further problems at a later date. If some of the information in the thesis becomes available through other channels, both the university and the student are vulnerable, at the worst, to a law suit. At the very least, the integrity of both the university and the student are compromised in the very working environment in which they operate. For these reasons, "classification" of a thesis must be considered self defeating, and put into its proper place as a dishonest non-option.

The first elementary step is for the university to decide who will be the focal point for any negotiations in this area. Since a multitude of professors dealing with different companies would produce a different set of agreements at every turn, that clearly is not a viable choice in that the mosaic of differing agreements would be hopelessly chaotic with no common policy. The business or legal staff is usually too far removed from working research considerations to be much more than a coordinating party.

This leaves research administration as the logical place within the university structure for the conduct of any negotiations in this area. In addition, in most cases research administration is the best equipped of any office within the university to discharge this obligation. Sponsored research support deals, on an ongoing basis, with the business offices of the various sponsors. The research administrator also has at least a working knowledge of contract law.

III. Solutions

How are such negotiations approached? First, the problem must be defined and localized in the eyes of the sponsor. The important first step is to divorce this issue from the patent and copyright considerations. Surprisingly, many sponsors think of this as one aspect or facet of the patent and/or copyright provisions of the contract. Usually a few moments of conversation with the corporate contracting officer will establish the separation. Once the separation is accomplished, it becomes necessary to define the sponsor's legitimate needs, and to see where there may be a conflict. On points where there is not conflict, we have found it expedient to concede those points at the outset of any negotiations.

From here on though, the diplomacy becomes considerably more subtle. One cannot overemphasize the need for an agreement early in the contractual period, when there is not paper or thesis as the core of dispute. It is vital to take the initiative, both for the safety of the student as well as to give the sponsor something that he can live with. All negotiation must be in close coordination with the principal investigator. The basic direction and goal is to provide for keeping the sponsor apprised of work in progress, and to leave the sponsor with the burden of defining specifics that he considers sensitive.

Two general approaches present themselves at this early stage of negotiation. The first is a matter of increased frequency of reporting technical progress, which normally will require greater detail as well. The second is to allow the sponsor to have advance access to the thesis, as well as any other publication contemplated from the work. The choice will depend on the desires of both the principal investigator and the sponsor. Some professors consider additional reporting to be a nuisance that they can't live with, while others regard advance thesis distribution as a non-acceptable invasion of their position as advisor and / or principal investigator. Here it is an absolute necessity to know what your investigator can and will deliver-a commitment made and broken can be very harmful indeed.

The end result of this negotiation should be a written agreement, either as a contract clause, or as a letter appendage to the contract which will establish the mechanisms for the resolution of case conflicts that might arise. During such negotiations, the following suggestions are useful: (1) maintain the initative; (2) keep the discussion as abstract as possible, using cases only as illustration; and (3) be ready with alternate proposals to the sponsor. I have known these negotiations to be as brief as one phone call, followed up in writing, or as long as three or four months, with correspondence and review by legal staffs and all of the attendant complications.

Any good agreement of this sort must provide for (1) timely notification by the university to the sponsor of data, findings, and the like; (2) require the sponsor to identify proprietary data at the earliest time; and (3) fix responsibility for the determination of sensitive data. As mentioned in Section II, different people will have different opinions as to what is sensitive. If at all possible, try to have the corporate scientists make that determination; it will generally be much more realistic than, say, the legal staff. In reality, a desirable agreement compartmentalizes the problem, both as to time and personnel involved.

At this time, it is well to have a draft clause ready to present to the sponsor. With various and sundry minor variations, we have used one of the two following clauses to good effect:

(A) "CSM will render monthly technical progress reports. It is the obligation of XYZ company's technical monitor to screen these reports for proprietary data and to inform CSM no later than 30 days of receipt of the report of any data sensitive to XYZ corporation with reference to publication either in thesis or scientific journals."

or

(B) "Any MS or Ph.D. thesis generated under this contract will be submitted in draft form to the XYZ corporation technical monitor at the same time it is submitted to the student's committee. The XYZ corporation will have 60 days to indicate objection to thesis publication of any data contained in said document. If no objection is raised within the 60 day period, it is assumed that the XYZ corporation has no objection to the publication. In the event of an objection, negotiation between the Principal Investigator and the XYZ technical monitor will determine what information can be published in the thesis."

IV. Summary

While there are no routine formulae which can be applied, there is considerable scope for the research administrator to act constructively to the benefit of all concerned. The administrator must (1) clearly define the valid needs of the various parties; (2) isolate the issue from other issues such as patents and copyrights; and (3) compartmentalize the problem early so that while legal staffs can be useful in establishing basic terms, they are out of the picture when a case is on the table.

The negotiation process can be very intricate and time consuming in some cases, but also very rewarding. As to results, to date CSM has had no case problem that has gone beyond the verbal discussion stage. We have had two cases in the past three years where the principal investigator and the corporate technical monitor have had long conversations on the phone regarding inclusion of data. Both were resolved in that manner, with no written correspondence, let alone formal protest.

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Research Subcontracting: Taking The Worry Out of Being Close

Stephen Erickson

Introduction

Writing and administering proper subcontracts are essential components of effective grant and contract management. Frequently, prime grantees and contractors (PGCs) issue letters, simple purchase orders, or other similarly brief documents in order to establish subcontracting relationships. This paper attempts to explain why, although such documents are legally "subcontracts", they are not enough to do the job. l

When awarded a grant or contract, the PGC performs the same essential functions as the sponsor's Contracting Officer and the Contracting Officer's Technical Representative in writing and administering its subcontracts. The rules and regulations referred to in this paper are largely those pertaining to federal grants and contracts. Each non-federal sponsor will have its own particular requirements; however, the points covered serve as a guide for virtually all subcontracting situations. As a general caution, the subcontract writer must check the prime grant or contract for any special subcontracting provisions. The prime grantee or contractor is accountable to the sponsor for its actions.

The PGC is required to provide oversight for subcontracted work. This does not mean that one must intrude upon the prerogatives of a subcontracting institution to manage the subcontracted work. Rather, "oversight" simply means that, at the beginning of the project, the rights and responsibilities of both parties are set out, and that the subcontract is administered within the limits of those rights and responsibilities.

Stephen *Erickson,* Ph.D. is *Senior* Assistant Director, *Office* for Sponsored Research at Harvard University, Cambridge, MA 02 138.

Inadequate subcontracting can result in the following problems. First, not following the requirements of the prime award can lead to the disallowance of all subcontracted costs under the prime award. Second, the PGC will be unable to fulfill its responsibilities to its sponsor if it has not properly managed the entire grant or contract. Third, a subcontractor may not realize what is expected of it during the course of the agreement. This will lead almost inevitably to unnecessary disputes and misunderstandings over a number of issues including ownership of equipment, delivery of reports, and payments. Fourth, an inadequately prepared subcontract offers little or no protection when dealing with those organizations that find it profitable to take advantage of ambiguous situations.

I. Some Basic Considerations

The Federal Acquisition Regulations (FAR) state that a subcontract is " . . any contract. . .entered into. . . to furnish supplies or services for performance of a prime contract or a subcontract. It includes but is not limited to purchase orders, and changes and modifications to purchase orders (FAR Part 44.101). The scope of that definition is important to remember when developing subcontracting plans or reports under large prime contracts. However, it is not terribly useful for our discussion.

We need a more pertinent definition. For the purposes of this paper, I define a subcontract as follows: *An* agreement written under *the authority* of, and consistent with the *terms* and conditions of, a prime *award* that transfers a portion of the research or substantive effort to *another organization.* While not excluding the use of purchase orders or letter agreements when permitted, the phrase "and consistent with the terms and conditions of a prime award" in most cases denotes something different. It means that the PGC must be cognizant of its rights and responsibilities under the prime award as well as those held by the subcontractor. By implication, it also means that both the PGC and the subcontractor must be aware of the contractual terms of reference. There is no better way of assuring that than by writing a proper subcontract.

A subcontract should be written any time *a* portion of the work is to be done by another organization.[2] It also does not matter if the period of performance is one month or two years. It also does not matter if the cost of the work is a thousand dollars or a million dollars. Although the FAR requires subcontract approval only under certain conditions, that does not mean that a subcontract should be written only in those circumstances.[3] Furthermore, the FAR pertains to prime contracts, not grants. Each granting sponsor has its own approval requirements. In most cases, approval is required for all subcontracts under grants regardless of dollar value or period of performance. Such approval is often considered to have been given if the subcontract is included in the approved grant budget. However, in certain circumstances, the sponsor's Grant Officer may want either to approve the subcontract document itself or be provided with a copy of the executed document. One should also review Attachment 0 of OMB Circular A-110 for procurement standards affecting both pre- and post-award administration of subcontracts. The FAR and the various grant regulations were written to protect the government. An important, if not the primary, purpose of a subcontract is to protect the PGC. Therefore, and to reiterate, one should write a subcontract whenever a portion of the work is to be performed by another organization.

A subcontract has other important purposes. It provides evidence of PGC accountability to the sponsor. It clarifies the PGC's expectations of the subcontractor's effort. A subcontract provides a mechanism for preventing and, if necessary, resolving disputes by setting out as clearly as possible the terms and conditions by which both the PGC and subcontractor must abide. Finally, it offers a measure of protection for both parties should something unforeseen occur. One should remember that a subcontract, like any contract, represents a meeting of the minds between two parties. It should be equitably written and should fairly represent the interests of both the PGC and the subcontractor.

There are several basic types of subcontracts. A PGC can write a cost reimbursement (with or without fixed fee) subcontract. This type is most often written under cost reimbursement prime contracts. If the PGC is operating under a fixed price contract, it is important that the subcontract be fixed price as well. A fixed price subcontract can also be written under a cost reimbursement contract if circumstances indicate it would be more prudent to do so. If the PGC has a grant, the subcontract, or "subgrant", should be consistent with the terms of the prime award. In effect, that means that the amount of the subcontract represents a cost ceiling since it is unlikely that more money will be forthcoming to offset overruns. Finally, NIH regulations refer to consortium agreements. If the regulations am read carefully, there is little difference between a subcontract and a consortium agreement. Some see the latter as representing a more collaborative relationship in the conduct of the scientific effort. However, the administrative responsibilities of the parties are identical.

There is nothing inherent in any type of subcontract that prevents the scientific efforts from being collaborative. It is important to remember that a subcontract should always serve to facilitate the funded project within (1) the legal and regulatory limitations imposed on the organizations and (2) the bounds of prudent management. In other words, to the greatest extent possible, the subcontract should help, not hinder, the work to be performed while protecting the organizations that are parties to it.

11. Writing A Subcontract

Many, if not most, people have trouble when sitting down to write a subcontract. It is often difficult to decide what to include in the document and what to leave out. A number of institutions have created standard forms because they write many subcontracts under a given sponsor's awards. Such forms are valuable, time saving instruments. In many cases, however, the standard forms are useful solely as format guidelines. Each subcontract needs to be tailored to meet the needs of the particular situation. The subcontract sections must be appropriate to the circumstance and must act as integrated parts of the whole subcontract. [4] In the discussion that follows 1 will describe the purpose of each section and briefly indicate how it fits with the rest of the subcontract.

I. The Preamble. This section is usually one or two sentences long. It identifies the parties to the subcontract and the prime award. As noted below, it can be expanded to include what might otherwise be placed in the Recitals.

2. The Recitals. The Recitals are optional to many PGCs. Sometimes, this section is referred to as "the whereases" since, as might have been guessed, each paragraph usually begins with the word "whereas'! The Recitals set the tone of the subcontract and are used to state the reasons for entering into the agreement. Examples of Recitals are: "Whereas the PGC and the Subcontractor intend to collaborate on the study of synthetic skin development" and "Whereas the Subcontractor has created a method of synthetic skin grafting". Again, this section is optional. Sometimes, the purposes of the subcontract are written into the preamble (most often without the "whereas").

3. The Schedule. This section is comprised of articles that give important information pertaining to the particular project. Among the articles in the Schedule are the period of performance, the estimated cost or fixed price, and the identification of the administrative and technical representatives for both the PGC and the subcontractor. It is useful to include within the articles other brief statements that set forth particular aspects of the subcontract. For instance, in the estimated cost article, the PGC should state whether the subcontract is to be incrementally funded or that all funds have been obligated. Finally,

the Schedule takes precedence over all other sections of the subcontract. There may be references in the various sections of the subcontract pertaining to the same subject. It is beneficial, for the sake of clarity, to include an "order of precedence" clause in the contract in order to prevent disputes over which provision applies to a given circumstance. The typical order of precedence is: (1) the Schedule, (2) the Special Provisions, (3) the General Provisions, and (4) the Statement of Work and the Budget.

4. The Special *Provisions.* This section may not be necessary when subcontracting under many federal grants (e.g. NIH and NSF). On the other hand, it has been valuable when dealing with prime grant provisions that read virtually the same as contracts (e.g. HUD and DOE). As a general rule, Special Provisions are most always necessary when subcontracting under a prime contract.

The Special Provisions enable the PGC to incorporate items negotiated with the subcontractor that are not covered in the prime agreement. In addition, this section can be used by the parties to incorporate items that supersede parts of the General Provisions and are necessary to enhance the administration of the subcontract. For example, one might use a Payment article that supersedes the invoicing section of the "Allowable Cost and Payment" clause in the General Provisions': The "Payments" article may state to whom invoices are to be sent, how frequently, and in what form. It would also leave intact the allowable cost sections of the General Provision clause.

5. The General Provisions. It is often assumed that all the PGC needs to do with the General Provisions is simply attach them verbatim to the subcontract or incorporate them as a unit in a simple, single reference.[5] Neither method is sufficient. The General Provisions must be addressed as carefully as any other part of the subcontract. It is inappropriate to pass on provisions that do not apply either to the type of subcontract issued or to the subcontractor as an organization. For instance, one should not include General Provisions from a cost reimbursement prime contract in a fixed price subcontract. Similarly, a nonprofit PGC should not pass on its prime award General Provisions to a profit-making concern.

Admittedly, it is a problem deciding which provisions to pass on and which to exclude. A relatively simple approach to the problem is to separate the General Provisions into three types. First, there are those that are passed on without change to the subcontractor. An example is the "Officials Not To Benefit" clause found in contracts. Second, the PGC may want to exercise rights concurrent with the sponsor under certain clauses. An "Inspection" clause that gives the sponsor the right to visit and review work in progress is pertinent here. Third, there are clauses that are necessary to pass through to the subcontractor for which the PGC effectively supplants the sponsor in seeing that the requirements of the clauses are carried out. This is true in the "Limitation of Cost" clause. Each type should be separately identified and listed under its own heading within the rubric of the General Provisions.

The General Provisions may be presented either by simply listing them by clause title and FAR or agency acquisition regulation citation or by providing the complete text of each clause. It must be remembered, however, if the texts of the clauses are not included in the subcontract, the PGC must be prepared to deliver them immediately upon request.

6. The Statement of Work. How often have we all seen, in fact have we all written, statements of work that say something like "the subcontractor will cooperate with the PGC in completing the work under the prime grant contract?" Such a statement really tells the subcontractor nothing of substance and can lead to disagreements during the course of the work. One should ask the prime award's Principal Investigator to write the Statement of Work for the subcontract if the information cannot easily be culled from the prime award proposal. The Principal Investigator knows better than anyone what he expects from the subcontractor. The Statement of Work does not have to be terribly long and detailed. It should, however, be a concise narrative abstract of the work to be undertaken by the subcontractor. In fixed price subcontracts, the Statement of Work should also contain performance standards and deliverable schedules.

7. The *Budget.* Every cost reimbursement subcontract and each subcontract under a grant should have a budget attached. It is not required for fixed price subcontracts; however, there should be sufficient cost data provided by the subcontractor to permit the PGC to perform a pre-award cost analysis. This is important because the PGC is not permitted to perform post-award audits on fixed price subcontracts.

The budget should be as detailed as necessary to indicate cost item accountability and should be in the same form as, if not more detailed than, the invoices and financial reports required under the subcontract. If possible, percentages of effort or labor hours for personnel, fringe benefit rates, general and administrative rates, and indirect cost rates should be clearly established. If cost sharing is required, the percentage and the amount should be included on the budget page.

III. Subcontract Administration

The points raised in this section are applicable to subcontract administration in general. I am not proposing preferred institutional structures as that is well beyond the scope of this paper.

The Research Administration *Office*

The Research Administration Office (RAO) should have the institutional authority to administer subcontracts. As discussed above, the RAO and its authorized signatory perform the same functions as the sponsor's grants and contracts office and the grants or contracting officer respectively in the writing, negotiation, and execution of subcontracts. Here, we add the administrative aspects. These functions should be clearly understood by all concerned both at the PGC and the subcontractor in order to avoid problems emanating from an unauthorized person approving subcontracts or changes to them.

It is essential, to begin with, that the RAO maintain the responsibility of signing subcontracts and any modifications to them. If this is not done, the PGC becomes liable for the actions of its employees who may be writing their own version of subcontracts with little or no knowledge of the sponsor's requirements. Should a problem or dispute arise, the subcontracting institution will, naturally, hold the PGC responsible for taking corrective measures. It does little good to argue that the subcontract is invalid because it was not signed in accordance with the PGC's policies. Furthermore, the sponsor will not come to the PGC's rescue in this situation, but rather will insist that the PGC solve its own problems. Finally, since the unauthorized person writing a subcontract likely will not have obtained the sponsor's approval for the subcontract, the costs incurred by the subcontractor will probably be found to be unallowable.

Similarly, it is important to insure that the RAO hold the approval rights necessary to the proper administration of the subcontract. These would include requests for approval of rebudgeting, foreign travel, the purchase of equipment, the hiring of consultants, and sometimes the transfer of funds from the indirect cost category to pay for direct costs. While the RAO should consult with the Principal Investigator before approving or rejecting such requests, it is important that the final right of approval be held by the RAO. The sponsor's approval may be necessary for certain changes. The best way to make sure that it has been obtained is to have all subcontractor requests for approval come through the RAO.

The RAO is also responsible for assuring subcontractor compliance with the terms of the subcontract. For instance, three administrative reports are usually necessary under the terms of a subcontract: a report of inventions, a final invoice or financial report, and a report of equipment purchased by the subcontractor. It is advisable to develop a procedure to monitor subcontractor compliance with these reporting requirements. The follow-up system should be made as simple as possible while generating proper oversight.

The PGC must also be sure it has complied with the sponsor's requirements in selecting the subcontractor, particularly in light of recent efforts to enhance competition in contracting. OMB Circular A-110 requires the PGC to conduct its subcontracting in such a way so as to promote open competition. (OMB Circular A-110, Attachment 0, Paragraph [3] [B]). Certainly, most subcontracting, as I have defined it in this paper, is the result of the Principal Investigator having previously developed relationships with investigators at other institutions and involves little formal solicitation. Nevertheless, the RAO should advise the Principal Investigator to be aware of the competition requirements in the prime award. It is also a good idea to document the file with a simple competition statement. I use a short questionnaire containing three questions. The questions are: "(1) Why was the subcontractor selected to perform the work?; (2) Were competitive bids sought? If so, please attach documentation to the completed questionnaire. If not, please provide sole source justification; (3) What was the basis for the subcontract cost or price (e.g., prevailing wage rates, federal negotiated indirect cost rate, etc.)."

Finally, the RAO has a responsibility to coordinate its administrative activities with other offices and individuals at the institution. The sponsor's policies, procedures and requirements must be made clear to all concerned. The. RAO should consult with the Principal Investigator and academic department when a subcontractor requests approvals or other necessary changes in the subcontract. It may also be necessary to coordinate one's efforts with the institution's purchasing, legal, and insurance offices on a variety of matters.

The Principal Investigator and Academic Department

The most vital function performed by the Principal Investigator is to monitor the work in progress. Doing so will enable the Principal Investigator to quickly remedy unforeseen problems or to prevent difficulties from occurring by taking preventative measures. Monitoring usually occurs by informal contacts between investigators. In certain situations, however, it may be desirable to require monthly or quarterly technical reports if the Principal Investigator agrees that they are necessary.

At some institutions, the Principal Investigator and his department also provide initial approval of the subcontractor's invoices. This is done to determine if the costs are reasonable and comply with the negotiated budget. Payment approval by the Principal Investigator will help him monitor the rate of expenditure in order that he might determine if the work is progressing as planned and if there will be sufficient funds available to complete the agreed upon statement of work.

The Principal Investigator is responsible for monitoring the subcontractor's compliance with rebudgeting requirements and the delivery of technical reports. If there are problems in this area, the Principal Investigator should be encouraged to request the RAO's assistance. This should be done as a part of the overall coordination effort that occurs during the administration of subcontracts. Just as the RAO should consult with the Principal Investigator and all other institutional offices concerned with subcontract administration, so too should the Principal Investigator and the academic department be urged to coordinate their activities with everyone in the subcontract loop.

In this paper, I have discussed basic, general concerns affecting the writing and administration of subcontracts by educational and other nonprofit institutions. I believe that if the guidelines I have presented are followed, PGCs will find subcontracting easier. More importantly, the PGC will find itself in compliance with its sponsors' requirements and will be fully protected in the event of difficulties arising with subcontractors. In short, by developing a proper subcontracting relationship with another organization, the PGC will "take the worry out of being close'!

References

[1] In fact, Office of Management and Budget (OMB) Circular A-110, Attachment O, paragraph 4 requires grantees to include in subcontracts "provisions to define a sound and complete agreement. . ."

[2] Specialized subcontracts can also be written for consulting work and equipment fabrication. The PGC's purchasing department should be consulted when the latter is to be undertaken.

[3] FAR Parts and 44.201-2 set forth the consent criteria. It should *not* be assumed that the presence of a subcontract line item in an approved budget constitutes sufficient approval under prime contracts.

[4] The basic format for the subcontract sections is as follows:

I. Preamble

II. Recitals (optional)

III. Schedule

IV. Special Provisions (necessary under prime contracts, optional under prime grants)

V. General Provisions

VI. Statement of Work

VII. Budget

Depending on their complexity, under non-federal prime awards, it is often better to include a Special Provisions section.

[5] Paragraph 5 of the text is directed toward writing General Provisions under prime contracts as well as prime grants that have provisions similar to those found in contracts. Subcontracts written under NIH and NSF grants many times implement the prime agency's provisions in a set of standard General Provisions.

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