1987

TECHNOLOGY TRANSFER FROM FEDERAL LABORATORIES TO THE PRIVATE SECTOR

INSTRUCTIONAL MATERIALS FOR TECHNOLOGY MANAGERS

Volume 2 of 2

Prepared for

U.S. Department of Commerce
Office of Federal Technology Management
Washington, D.C.

GULF SOUTH RESEARCH INSTITUTE
Baton Rouge, LA • New Orleans, LA • Washington, D.C.

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ORGANIZATION OF

INSTRUCTIONAL MATERIALS FOR TECHNOLOGY MANAGERS

This manual contains the following units, published in two volumes:

Volume 1

Introduction

Unit 1: National Policy for Technology Transfer

Unit 2: Technology Transfer Legislation

Unit 3: Technology

Unit 4: Technology Transfer

Unit 5: Key Implementation Concepts

Unit 6: Technology Transfer Mechanisms

Unit 7: The Technological Innovation Process

Unit 8: The Innovation Process in the Company

Unit 9: Technology Transfer and the Private Sector

Unit 10: Management of Technology Transfer

Unit 11: Actors in the Transfer Process

Volume 2

Unit 12: Cooperative Research

Unit 13: Intellectual Property: Patents and Licenses

Unit 14: Conflict Issues

Unit 15: Classifying, Evaluating, and Managing Technologies for Transfer

Unit 16: The Technology Portfolio Concept

Unit 17: Marketing Technology

Unit 18: Introduction to Technology Value and Pricing Issues

Unit 19: Technology Transfer Incentives

Unit 20: Commercialization Strategy Workshop

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Unit 12

TITLE: COOPERATIVE RESEARCH

PURPOSE: This unit provides a discussion of the functions cooperative research serves, the types of cooperative arrangements, and the motives for establishing cooperative research ventures, stressing the private sector perspective.

OBJECTIVES: Upon completion of this unit, participants will:

- Have an understanding of the significance of cooperative research as a mechanism for enhancing transfer
- Have reviewed the potential benefits of cooperative research for the private sector, universities, and Federal laboratories
- Have considered the motives for research organizations (particularly the private sector) in developing cooperative arrangements
- Understand the role of cooperative R&D in contributing to a firm's product concepts and R&D activities
- Have been introduced to the factors encouraging cooperative research among competing firms
- Have become acquainted with examples of industry structure and technology characteristics that are conducive to cooperative arrangements.

MATERIALS:

Transparency 12-1:	Cooperative Research
Transparency 12-2:	Cooperative Research Promotes Transfer By. . .
Transparency 12-3:	Types of Cooperative R&D
Transparency 12-4:	Overview
Transparency 12-5:	Potential Benefits
Transparency 12-6:	Motivations for Cooperative Research
Transparency 12-7:	Private Sector Labs: Product Concepts and R&D Activities
Transparency 12-8:	Duration Between Conception and Commercial Introduction for Selected Innovations

Transparency 12-9: Examples of Imitation by Industry Rivals: Major Inventions

Transparency 12-10: University and Science-Oriented Public Lab Research Activities

Transparency 12-11: Public Labs: Product Concepts and R&D Activities

Transparency 12-12: Common Problems

Transparency 12-13: High-Technology Base

Transparency 12-14: High-Wide Technology Base

Transparency 12-15: Scale

Transparency 12-16: Risk

Transparency 12-17: Form of Cooperation

Transparency 12-18: Industry Structure

Transparency 12-19: Technology Characteristics

Transparency 12-20: Examples

Transparency 12-21: How to Make It Happen. . .

REQUIRED READING:

1. Issue Paper IV--Cooperative Research and the Private Sector

2. Rowland W. Schmitt, "Technology Transfer--Lessons from Industry," pages 33-54 in Argonne National Laboratory Technology Transfer Center, Industry, Innovation, and Technology Transfer: Lectures Delivered at the Director's Special Colloquium, undated.

OPTIONAL READING:

1. E. J. Soderstrom et al., Enhancing Technology Transfer Through Laboratory/Industry Cooperative Research and Development, Oak Ridge National Laboratory, March 1985 (NTIS Order No. DE85013521; ORNL-6107).

2. W. G. Simeral, "The Evolution of Research and Development Policy in a Corporation: A Case Study," Chapter 9 in Thomas W. Langfitt, ed., Partners in the Research Enterprise, University of Pennsylvania Press, 1983.

SUPPLEMENTAL READING:

1. Research Agreement, University of Massachusetts Polymer Research Center

2. Research Agreement, North Carolina State University

3. Research Agreement, Washington University and Sungene Technologies Corporation

4. Research Agreement, Massachusetts General Hospital

NOTES TO INSTRUCTOR:

1. This unit presents the private sector motivations for participation and offers comparisons with universities and Federal laboratories. It is very important in structuring cooperative agreements that the objectives of all the parties are met. Awareness of the firms' motivations and the circumstances that most favor cooperative research should enable Federal laboratories to attract industrial sponsors and to structure agreements that satisfy mutual objectives.

2. The required reading by Schmitt (senior vice president for corporate R&D at GE) gives an excellent private sector perspective on what the Federal labs should do, placing a heavy emphasis on cooperative research.

3. The optional reading by Soderstrom et al. provides a perspective on cooperative research from practitioners in Federal laboratory technology transfer. The optional reading by Simeral describes how Du Pont utilized technical knowledge acquired through cooperative research arrangements with two universities.

4. Supplemental materials are copies of actual agreements, guidelines, and other materials that have been used by universities. These materials provide models and examples to assist Federal laboratory personnel in the practical aspects of structuring cooperative research ventures.

ESTIMATED TIME:

30 minutes for presentation
50 minutes with discussion

Unit 12

COOPERATIVE RESEARCH

INTRODUCTION

Transparency 12-1: Cooperative Research

NOTE: PRESENT PURPOSE AND OBJECTIVES OF THIS UNIT.

Cooperative research and licensing are the new mechanisms legislation has made available to Federal laboratories to enhance transfer activities. Cooperative research is the primary mechanism for transferring knowhow, as part of a patented or unpatented technology.

Through many years of attempting to transfer technology from public institutions to private firms, practitioners have learned that in most cases technology cannot be simply "handed off" from one organization to another. This also parallels the experience within industrial firms that maintain R&D departments. A great deal of cooperation is needed between the R&D group (whether it is a part of or external to the firm) and the firm's production and marketing groups.

COOPERATIVE RESEARCH AND TRANSFER

Transparency 12-2: Cooperative Research Promotes Transfer by. . .

There are three reasons why cooperative research is emerging as an increasingly significant transfer mechanism. Early involvement and cooperation with a firm provides market focus to the research project. The degree of focus is determined by the type of agreement.

Secondly, industry's early involvement facilitates the design process by taking into account performance criteria and manufacturing systems. Attention to these factors can reduce costly redesign efforts, and quality affects whether a technology is transferable.

Finally, cooperative research is the primary method for transferring the knowhow that is always inherent in technology. Knowhow transfer is of critical importance with respect to patented or

unpatented technology. In the event that patentable technology emerges from a cooperative research arrangement, the licensing potential is greatly increased by the involvement of one or more industrial firms that have committed resources to the research and already understand the technology and its significance to their markets.

In a cooperative research venture, the participants become partners in the innovation process. It is a long-term relationship between the laboratory conducting the research and the firm that will typically complete the development work, produce products that embody the technology, market the products, and continue to make modifications and improvements.

This relationship needs to begin long before there is a technology to transfer through a licensing agreement. In fact, cooperative research at an early stage can lead to successful licenses because the manufacturers and marketers of the final product and the scientists and engineers working on the new technology have brought the project along in concert. Cooperative research combines "technology push" with "market pull."

TYPES OF COOPERATIVE R&D AND EXPECTED OUTCOMES

Cooperative R&D is an effective mechanism at several stages of the innovation process. These can be categorized by the types of cooperative R&D ventures and their expected outcomes.

Transparency 12-3: Types of Cooperative R&D

Cooperative research can be conducted in a consortia, or as an arrangement between a laboratory and a single firm. It can be used as a mechanism to fund basic or applied research at the early stages of technology development or to provide technical assistance as the firm requires problem-solving capabilities.

Consortia

A consortium is a group of firms, usually within the same industry, working together or in cooperation with a university or Federal laboratory. Each of the industrial participants contributes an

annual fee to support the research. The research is typically basic research performed at the forefront of a broad technological area that is important to the industry as a whole.

Long-range research programs are established in selected areas. Products, or even prototypes, are not an expected outcome. If patented technology emerges from the research, nonexclusive licenses are usually granted to all the participating firms. However, in most cases, the individual firms are more interested in maintaining a "window on technology"--that is, following the progress and direction of a particular field of research.

In this type of consortium with universities, firms often are most interested in recruiting promising graduate students with research experience in areas of interest to the firm. Research results are generally published. If there are results that a firm can incorporate in its products or processes, the application work is conducted by in-house R&D personnel.

Single Firm

Another type of cooperative research is an agreement between a laboratory and a single firm. There have been a few widely publicized agreements between major universities and individual firms, primarily in the biotechnology area (e.g., Harvard-Monsanto). The firm contributes significant financial resources to support laboratory research. Basic research is conducted, with the firm typically expecting to fold the results of ongoing laboratory research efforts into its internal R&D program. If patentable technology emerges from the cooperative arrangement, the firm usually expects an exclusive license.

NOTE: THE PROCESS BY WHICH EXTERNAL RESEARCH IS FOLDED INTO THE INTERNAL R&D OF A FIRM IS DESCRIBED IN THE OPTIONAL READING BY SIMERAL.

This type of cooperative R&D arrangement is also appropriate for a firm and a laboratory working jointly on a specific technology with market potential. The work may be basic or applied research conducted

solely in the public laboratory or in parallel with the firm's R&D group.

Development work through prototype stage may also be appropriate. If applied research or development work is being conducted, it is especially important that close contact is maintained between the firm and the laboratory. Researchers will need to be flexible and responsive to the firm's manufacturing and marketing criteria.

Once a technology has been licensed, researchers may still be involved in transferring knowhow. This can be accomplished as part of an ongoing cooperative research agreement or a separate agreement. Since design modifications will be needed once the technology has been transferred, and development work and product improvements will be needed once marketing has begun, the firm may continue the relationship with the originators of the technology. The work may be conducted within the originating laboratory or through personnel exchange.

ARE THE PARTICIPANTS CLEAR ABOUT THE TWO BASIC TYPES OF COOPERATIVE RESEARCH ARRANGEMENTS?

MOTIVES FOR PARTICIPATION

Cooperation between private firms and Federal laboratories can be facilitated if there is an appreciation of the needs and motives of the participants.

Transparency 12-4: Overview

A necessary condition for cooperation among firms and public laboratories is an intersection of research objectives. Much of the work in university-industry cooperative research arrangements has been basic research in an area of interest to the participating industrial firm or firms. That means that an interest in a technological area (or scientific matter) under investigation must relate in a broad sense to the firm's business interests. Additionally, if several firms are involved, the research must be conducted in a cooperative setting conducive to the ultimate goals of each organization.

A private firm would not be interested in getting involved in a cooperative venture if the results would become available to a competitor for product development. A university, on the other hand, would have a conflicting interest. Whatever research results came out of a cooperative program would have to be publishable in some form. Most Federal laboratories would share that same concern, while others (e.g., DOD labs) would be much more used to dealing with secrecy.

In order for there to be cooperation, there will have to be an intersection of interests. Without that intersection, cooperation will not take place.

Research entities also share certain common problems that can be reduced through cooperation, and these common problems contribute to the likelihood of cooperation, but they are not in and of themselves necessary conditions.

Finally, there are certain characteristics of technologies that make them more amenable to cooperation, and we will discuss those as well.

POTENTIAL BENEFITS

Transparency 12-5: Potential Benefits

This transparency is a partial list of the potential benefits of cooperative research. Basically, most benefits can be broken down into two broad categories: the input side and the output side.

On the input side, cooperation leads to increased efficiency measured by a broader scope of research, reduction in duplicative work, less capital invested per result, better use of technical people, and more rapid integration of technologies.

On the output side, the organizational goals might include retaining scientific leadership, retaining technological leadership, increasing profits, or increasing the returns on public R&D investment.

ASK THE PARTICIPANTS IF THEY HAVE ADDITIONS TO THIS LIST OF POTENTIAL BENEFITS OF COOPERATIVE RESEARCH.

RESEARCH OBJECTIVES

Transparency 12-6: Motivations for Cooperative Research

The perceived benefits of cooperative research spring directly from motivations. Research objectives are the key determinants of the willingness of a firm, university lab, or Federal lab to become involved in cooperative research.

Additionally, a firm is especially interested in realizing its objectives more quickly and in undertaking types of research that it cannot afford to do otherwise. These same goals can be shared by Federal labs and universities. Let's look at the private sector first.

Private Sector

To understand why a private firm might become involved in cooperative research, it is necessary to review the research objectives they might establish. Let's look at a single product concept and its specifications.

Transparency 12-7: Private Sector Labs: Product Concepts and R&D Activities

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For each product specification, there are two types of technologies the firm can bring to bear: demonstrated and undemonstrated. The firm seeks to select a mixture of new and old technology that it expects will contribute to future profits. It will perform research on undemonstrated technologies and will find ways to demonstrate them. It will attempt to reduce technical risk. It may buy some research from external sources. It may sell some of the outputs of its research to other people if it can't use the results itself.

With these sorts of objectives, a firm will cooperate with competitors when it can increase its profits either by reducing the cost of the technology mix it has selected, or by improving the mix.

In university-industry cooperative consortia, there has been much more of an educational motive at work. Basic research of interest to

faculty that is also of interest to industry is combined with a strong emphasis on providing students a research experience--often interdisciplinary--that approximates an industrial research environment.

Transparency 12-8: Duration Between Conception and Commercial Introduction for Selected Innovations

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Another motivation for cooperation by a firm is to increase the speed of its products to the marketplace. This transparency lists some twentieth-century innovations and shows the average duration between the year of first conception and the year of introduction in the marketplace. The average is approximately 19 years.

For a firm, increasing or decreasing the time from conception to introduction in the marketplace can often be of vital importance, especially in an industry like semiconductors where product life cycles continue to decrease every year.

NOTE: A PRODUCT'S LIFE CYCLE IS THE PERIOD OF TIME FROM ITS INTRODUCTION IN THE MARKET (INNOVATION) TO THE END OF ITS USEFUL ECONOMIC LIFE. ALL PRODUCTS HAVE A LIFE CYCLE BEGINNING WITH INTRODUCTION AND GROWTH AND MOVING INTO MATURITY AND DECLINE AND FINALLY TO THE END OF THEIR COMMERCIAL USEFULNESS. IN SOME INDUSTRIES WHERE THE TECHNOLOGY IS ADVANCING VERY RAPIDLY, NEW PRODUCTS ARE INTRODUCED AT SUCH A FAST RATE THAT OLDER PRODUCTS HAVE A SHORT LIFE CYCLE BECAUSE OF RAPID OBSOLESCENCE. ASK THE PARTICIPANTS TO THINK OF OTHER INDUSTRIES THAT HAVE EXPERIENCED THIS PATTERN.

Another motivation for cooperation is the so-called appropriability problem. A firm may have difficulty justifying an investment in research when the returns (i.e., the profits) are not significant.

Transparency 12-9: Examples of Imitation by Industry Rivals: Major Inventions

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This chart shows the major innovations in the aeronautics industry since about 1906 and indicates that virtually every one of them was imitated. The innovator was not compensated by the imitator in a single case, and so was unable to fully benefit from its own R&D.

Firms find it very difficult to carry on significant research when the research results are easily appropriated by outsiders. In this case, it sometimes makes sense to cooperate and share the cost of research, because the research results are going to be copied anyway.

Let's summarize briefly the private firm's motives for participating in cooperative research. Firms allocate money to research in order to improve profitability of their product concepts. They will cooperate when they can reduce the cost of the technology mix needed in their products, improve the mix itself, speed the product to market, or reduce the cost of research on appropriable technologies without directly helping their competitors.

NOTE: THE CONCEPT OF APPROPRIABILITY (WITH RESPECT TO RESEARCH INVESTMENT) IS THE ABILITY OF A FIRM TO APPROPRIATE (OR TO FULLY CAPTURE) THE BENEFITS OF ITS R&D INVESTMENT AS MEASURED IN PROFITS GENERATED BY A PARTICULAR TECHNOLOGY (AS EMBODIED IN A PROCESS OR PRODUCT). FOR MORE DETAIL ON THIS CONCEPT, WHICH IS OF GREAT IMPORTANCE IN LEADING FIRMS TO PARTICIPATE IN COOPERATIVE ARRANGEMENTS, SEE ISSUE PAPER IV--COOPERATIVE RESEARCH AND THE PRIVATE SECTOR.

Public Sector

The motivations for universities and science-oriented Federal labs are quite different from those of the private sector.

Transparency 12-10: University and Science-Oriented Public Lab Research Activities

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Here, research activities are based primarily on outstanding scientific questions. The results are intended to contribute to the science literature, not products. Where these questions bear directly on market applications, private funding or cooperation with private research labs may be possible. An example is the recent association of

the semiconductor industry with several universities throughout the United States.

Public funding of university projects may be part of the general support of science by the government, part of the government's targeting of specific industries (e.g., nuclear power or aeronautics), or cooperation between a public institution and a university. In any case, the motivations are driven by scientific questions and not by profit considerations.

Transparency 12-11: Public Labs: Product Concepts and R&D Activities

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For Federal labs with technological missions, the "product" concept is driven by a mission goal rather than by commercial considerations. The constraints of the mission budget require the researchers to examine alternative mixtures of proven and unproven technologies in developing the performance specifications of the mission "product." Research is then undertaken to demonstrate unproven technologies. External sources will be used when they are cost-effective.

This type of lab, unlike its university counterpart, is driven by mission requirements. Its willingness to cooperate with other entities depends on being able to improve performance specifications, or lower the cost of the research required to accomplish its mission.

In summary, the private firm is motivated primarily by a desire to improve or reduce the cost of its technology mix embodied in its product concepts in order to increase its profits. A science-oriented university or public lab is motivated primarily by relevant scientific questions, finding answers to those questions, and publishing results. A technology-oriented Federal lab (e.g., NASA, DOD) is motivated to find ways to accomplish its technological mission.

Where these primary motivations intersect, there may be interest in cooperative research. Without that community of interest, regardless of what other factors are involved, there is unlikely to be cooperative research.

COMMON PROBLEMS

There are also common problems faced by each type of laboratory that can make cooperative research more attractive.

Transparency 12-12: Common Problems

Technical Competence

All technical organizations need to find ways to improve the technical competence of their staffs. Cooperative programs may be a way to expose personnel to research activities that they would otherwise not undertake. In some cases, cooperative research can be an inexpensive form of continuing education that may have substantial payoffs.

High-Technology Base

Another common problem is the high-technology base that characterizes some industries.

Transparency 12-13: High-Technology Base

The industries shown on this chart exhibit the highest total research intensity in the United States. This is defined as the total direct and indirect R&D expenditures made by the industry and its suppliers as a percent of total shipments. It is a measure of the R&D effort made by the industry itself and its supplying industries.

The greater the research intensity, the more difficult it is to advance to the next technological plateau, and this can lead to a stimulus for cooperation in and of itself. The firm simply may not have the resources to advance. This can also be true for university laboratories seeking to maintain currency in certain technological areas or for a Federal lab as well.

High-Wide Technology Base

Transparency 12-14: High-Wide Technology Base

This problem can be compounded when a high-technology industry also has a wide technology base. A high-wide technology base means that an industry depends on a greater number of high-technology inputs than is typical. These industries may have an interest in technologies that are also of interest to firms that are not their direct competitors.

For example, if you look at this chart, the aeronautics industry depends on eight out of the nine other high-technology industries from the previous chart. So, the aeronautics industry depends on virtually every other high-technology industry as measured by R&D intensity, and therefore has a vital interest in the research results in those industries. Representatives of these industries may make good cooperative research partners.

The convenient part is that the other eight industries are not direct competitors, so it may be easier for an aeronautics firm to find someone to cooperate with than would otherwise be the case.

Scale

Transparency 12-15: Scale

Cooperation may also make sense when there are scale economies in conducting research. This can happen when there are high sunk costs for research facilities. An example can be found in the aeronautics industry where private firms share facilities and technical results with NASA in order to gain access to national wind tunnel facilities. The high sunk cost of those facilities make it infeasible to have more than one in the country.

Risk

Transparency 12-16: Risk

Another common problem that can lead to cooperation is risk. Obviously, the greater the number of projects there are in a budget to solve a particular problem, the lower will be the potential risk inherent in developing a product.

In this example, we have two entities that have the same total expected payoff from their research programs. One of them has only one project. The other has four projects. They have equal probability of success overall for each project they undertake. But the risk measured by the standard deviation of those results is three times higher in the case of Entity A, which has only one project underway to solve a particular technological problem.

To spread its risk and reduce its cost, a firm might cooperate in order to get some more projects underway to solve a particular problem that it's faced with. The same might be true for universities or Federal laboratories seeking to stay on the technological edge.

INDUSTRIAL COOPERATION

Transparency 12-17: Form of Cooperation

In general, the participants' objectives will define whether or not there is a community of interest for cooperative research ventures. And this community of interest will define the type of cooperation that takes place.

At this point, let's concentrate on the private sector and look at the circumstances that would induce firms to join together in a research consortium, either as a separate group or in conjunction with a university or Federal laboratory. Two important circumstances are industry structure and technology characteristics. By understanding the private sector's approach to these circumstances, Federal labs will be in a better position to identify opportunities for initiating or tying into cooperative arrangements involving more than one firm.

Let's look first at industry structure.

Industry Structure

Transparency 12-18: Industry Structure

Consider an industry where there are few competitors and where there are one or more of the following characteristics: high sunk

costs, a license required to operate in the industry, or technology patents that are effective barriers to entry to the industry.

In these cases, competitors are unlikely to cooperate. The industry may be evolving towards a single firm or a very limited number of firms. The competitors in the industry know who the other ones are and are very unlikely to try to help them.

However, cooperation does take place in this type of industry. For example, cooperation in the aeronautics industry takes place between airframe and engine manufacturers, manufacturers and universities, firms and the NASA aeronautics programs, and universities and the NASA aeronautics programs. All of these are significant examples of ongoing cooperative activity in that industry.

Now, let's look at an industry with differentiated products. The electronics industry might be one example. Here firms differentiate their products in order to fill particular market niches. The competition is less direct because firms are able to distinguish their products enough so that the products appeal to completely different types of customers. Competitors in this case may cooperate, especially in basic science and technology areas.

In the targeted industry program for semiconductors in Japan, for example, the large Japanese conglomerates (e.g., Hitachi, Mitsubishi) cooperate on basic science research programs that are then applied by the individual firms in myriad consumer and industrial markets.

Finally, let's take a look at a circumstance where competing firms face international barriers to entry or there are subsidies in foreign markets. Here competitors may band together in order to face a common threat. An example of that type of activity is the Microelectronics and Computer Technology Corporation (MCC).

Technology Characteristics

Transparency 12-19: Technology Characteristics

NOTE: THIS LIST SERVES AS ONE SET OF CRITERIA FOR EVALUATING THE OPPORTUNITY FOR COOPERATIVE RESEARCH EFFORTS WITH MULTIPLE FIRMS.

This transparency shows the characteristics of technologies that are fairly common in cooperative research and are likely to promote cooperative research.

A wide technology base problem basically means that the firm can't cover all the bases in the industry the firm is involved in, so it may need help. Cooperation may make sense.

Multiple applications--it may be possible to find noncompetitors to cooperate with.

High cost to the next technological step--the firm's R&D budget may not be sufficeint to continue in that particular technological area, and cooperation may be in order.

Multiple directions--again a problem of coverage of all the bases needed to stay at the forefront of a technology.

Multiple disciplines may need to be integrated. It may be that the organization has insufficient technological capability in-house and needs help.

Basic research is required to reach the next technological step. In this case (for the private firm), there may be negative economic payoffs to undertaking such research, and firms may turn to the public sector for help.

Examples

Transparency 12-20: Examples

Our final transparency illustrates some examples of industries that have formed cooperative consortia and their characteristics. Please note that all of these involve direct competitors. A cooperative arrangement between a Federal laboratory and a single firm may have many of these same characteristics, but the opportunities for applied research may increase.

FUTURE DIRECTIONS

Transparency 12-21: How to Make It Happen. . .

How can we approach cooperative arrangments with industrial firms? There is no cookbook that can be followed step-by-step and result in a cooperative venture. However, there are some direct and indirect methods that can be used to generate interest from potential industrial participants.

A direct approach can be taken once laboratory personnel are aware of the commercial potential of their research programs. Although the final objective may be a commercial application, this does not mean that the work must be applied research. The best method for developing a cooperative venture is to work with industrial firms that have already expressed an interest in the laboratory's research efforts. It is important to remain flexible and to search for the common ground. Once research objectives coincide, agreements can be structured that accommodate the needs and interests of all of the participants.

Several indirect methods are also available that can lead to cooperative opportunities.

NOTE: READ INDIRECT METHODS.

Laboratories already participate in all of these activities. They can all be used to inform industrial representatives of the laboratory's interest in cooperative research projects and its willingness to work with industrial firms. The most productive efforts are likely to orginate in informal conversations between individuals.

Immediate results may not be forthcoming, but laboratory personnel can begin to establish contacts. These contacts may result in subsequent conversations or information exchange between the individuals that may eventually establish common areas of interest. It is the compatability of research objectives that leads to cooperative ventures.

The laboratory can publicize available techology and its interest in engaging in a cooperative arrangement to transfer the technology. Advertising is a method for generating interest and will be more effective if it portrays some evidence of commercial potential rather than limiting the description to the technical aspects. The primary

usefulness of advertisements is to establish the personal contact that is essential for initiating an agreement.

In looking into cooperative research opportunities, Federal laboratories should keep in mind that there are two basic types of opportunities: (1) with consortia involving more than one firm; and (2) one-on-one relationships between an individual firm and a Federal lab. From a private sector perspective, the motives and expected outcomes for these two types are quite different. In addition, there are variations within the two types that need to be kept in mind.

Research consortia are generally broad based, and one-on-one relations provide a capacity for greater focus. Although there has been much publicity about research consortia, it is probable that the one-on-one relationships will emerge as a primary transfer mechanism for Federal laboratories because they enable transfer of technological knowhow of immediate interest to individual firms and also serve as an effective mechanism for the transfer of knowhow in conjunction with licensing agreements.

Such relationships are usually based on the desire of firms to tie into the expertise of personnel in Federal laboratories who are making advances in areas of research that are important to the R&D efforts of the firm. Although such relationships may lead to the emergence of patentable technologies in the context of the cooperative arrangement, the experience of Federal labs thus far has usually been that the research results are folded into the firm's R&D effort without the Federal lab having a clear understanding of the way in which the information is utilized.

This situation exists in part because relationships between individual firms and Federal labs are in an experimental stage. As the partners grow more comfortable with each other, it is probable that the research arrangements will be more extended and that the cooperative effort will move further in the direction of applications that will be visible to both partners.

NOTE: REMOVE TRANSPARENCY FROM SCREEN.

DISCUSS WITH THE PARTICIPANTS THE OPPORTUNITIES FOR FEDERAL LABS TO PARTICIPATE IN RESEARCH CONSORTIA AND IN ONE-ON-ONE RELATIONSHIPS WITH FIRMS. USE THE REQUIRED READING BY SCHMITT AS A BASIS FOR DISCUSSING THE IMPLICATIONS OF ONE-ON-ONE RELATIONSHIPS.
