Unit 6

TITLE: TECHNOLOGY TRANSFER MECHANISMS

PURPOSE: There are many mechanisms for accomplishing technology transfer from the Federal laboratories to the private sector. This unit provides an introduction to the major mechanisms that have been authorized and encouraged specifically by Congressional or Presidential action and those that have been used by universities and some Federal laboratories. Methods to stimulate and enhance laboratory interactions with industry that may lead to use of the mechanisms are also discussed.

OBJECTIVES: Upon completion of this unit, participants will:

- Be acquainted with the general technology transfer mechanisms that are available for implementation by Federal laboratories
- Have been introduced to general criteria for selecting the mechanism (or a combination of mechanisms) that is appropriate to a specific transfer opportunity
- Be aware of some suggested methods to encourage interaction with industry representatives or groups
- Have some general "rules of thumb" to guide expectations in setting up a basic technology transfer program within a laboratory.

MATERIALS:

Transparency 6-1:	Technology Transfer Mechanisms
Transparency 6-2:	Mechanisms
Transparency 6-3:	Criteria for Selecting Mechanisms
Transparency 6-4:	Creating the Opportunity
Transparency 6-5:	Attend Industry Activities
Transparency 6-6:	Sponsor Laboratory Activities
Transparency 6-7:	Innovation Factors
Handout 6-1:	Rules of Thumb for a Technology Transfer Program

REQUIRED READING: Eugene E. Stark, "Federal Laboratories: Technology Resources and Transfer Champions," a paper submitted to the symposium Leaping the Technology Transfer Barriers, American Chemical Society, 1984 (available on microfiche

LA-UR-84-2712, CONF-840805-24; NTIS Order No. DE 84016800/XPS).

OPTIONAL READING:

1. Joseph Morone and Richard Ivins, "Problems and Opportunities in Technology Transfer from the National Laboratories to Industry," Research Management, May 1982, pages 35-44.

2. F. Douglas Johnson, "Technology Transfer--A View of What Works," Journal of Technology Transfer, Vol. 7, No. 2, pages 1-4.

NOTES TO INSTRUCTOR:

1. This unit is related to Unit 5 (Key Implementation Concepts) and may be conducted together or separately. The two units together are structured in a sequence that leads to active participation in technology transfer with the private sector.

2. The emphasis in this unit is on providing an overview of the mechanisms. More detailed information on the mechanisms that are emphasized by Congress and in the Executive Order is contained in units 12 (Cooperative Research) and 13 (Intellectual Property). These units should be reviewed by the instructor prior to presenting information on mechanisms.

3. There is no descriptive catalog of transfer mechanisms. The required reading by Stark, though somewhat dated, contains a good, brief introduction to mechanisms. The optional reading by Morone and Ivins, though also somewhat dated and dealing with the experience of DOE labs, contains some useful points. The optional reading by Johnson stresses the importance of practical experience.

4. It is important to stress that the mechanisms are experimental. These may not be the only mechanisms that will emerge from technology transfer activities. It is important to be flexible and create new mechanisms that are appropriate to the particular situation that emerges.

5. The emphasis on increased interaction with industry personnel is a direct result of the importance of the "people process" concept (Unit 5). The point here is that interactions place laboratory personnel in situations that can make them aware of the needs and activities of the private sector. Most transfer activities occur as a result of some type of preliminary interaction that creates an awareness on the part of individuals of activities

that could lead to establishing a personal relationship between the parties. Once the opportunity for transfer is created, the appropriate mechanism can be selected.

ESTIMATED TIME: 30 minutes for presentation
50 minutes with discussion

Unit 6

TECHNOLOGY TRANSFER MECHANISMS

Transparency 6-1: Technology Transfer Mechanisms

NOTE: REVIEW THE PURPOSE AND OBJECTIVES OF THE UNIT.

There are many transfer mechanisms that are available to the laboratories. We will briefly identify the full range of transfer mechanisms that have been used by universities and Federal laboratories and then discuss criteria for selection, methods to encourage interaction, and the basics of setting up a transfer program.

MECHANISMS

Transparency 6-2: Mechanisms

Mechanisms are vehicles for accomplishing transfers. The major mechanisms are:

- New venture startups
- Patents and licensing
- Personnel exchanges/education/training
- Technical assistance
- Cooperative R&D agreements
- Contract research
- User facilities and equipment
- Demonstration projects (technical feasibility)
- Publications

The order of the mechanisms in this list is significant. The mechanisms are arranged according to the most active, beginning with those that are most directly related to increased commercial activity. With any particular technology, one mechanism may be appropriate. It is more likely that a combination will be used as the technology moves toward commercialization.

New Venture Startups

New venture startups are likely to occur as laboratory personnel or other entrepreneurs license laboratory technology. This is a very active form of transfer that results in immediate firm creation and job growth. Laboratory personnel may choose to commercialize the technology by forming a new company, or other entrepreneurs may form a company based on laboratory technology.

NOTE: FIRMS GENERALLY HAVE A STRATEGY OF SOME TYPE THAT ASSISTS MANAGEMENT IN SELECTING TECHNOLOGIES FOR COMMERCIALIZATION. A VERY PROMISING TECHNOLOGY MAY NOT "FIT" A FIRM'S STRATEGY AND WILL BE REJECTED. FOR EXAMPLE, IN LARGE COMPANIES, PART OF THE CRITERIA IS THAT THE MARKET (I.E., POTENTIAL SALES) MUST BE A CERTAIN SIZE (E.G., $100 MILLION). THUS, THE MARKET MAY NOT BE LARGE ENOUGH TO INTEREST THE COMPANY. THE LABORATORY MAY BE ABLE TO FIND AN ENTREPRENEUR (I.E., SOMEONE WHO WILL ORGANIZE THE RESOURCES NEEDED TO COMMERCIALIZE THE TECHNOLOGY). THE ENTREPRENEUR MAY BE A SMALL INNOVATIVE FIRM LOOKING FOR NEW TECHNOLOGY OR AN INDIVIDUAL WILLING TO START A BUSINESS BASED ON THE TECHNOLOGY. OFTEN THE RESEARCHER BELIEVES STRONGLY ENOUGH ABOUT THE TECHNOLOGY'S COMMERCIAL POTENTIAL TO FORM A FIRM TO DEVELOP AND MARKET THE TECHNOLOGY-BASED PRODUCTS. THE PURPOSE OF UNIVERSITY AND COMMUNITY-BASED RESEARCH PARKS AND INNOVATION CENTERS IS TO ENCOURAGE THIS TYPE OF ACTIVITY.

WHAT DO THE PARTICIPANTS THINK ABOUT THE INVOLVEMENT OF LABORATORY PERSONNEL IN NEW VENTURE STARTUPS?

Patents and Licensing

Patents and licenses are strongly emphasized in the recent technology transfer legislation because they provide important inducements to innovative activity. The patent system in the United States originated as a method of giving incentives to inventors to disclose (i.e., make public) their inventions. The holder of the patent has defined claims and rights with respect to the invention. Once the claims are "allowed" by the patent office, the invention is "protected" from use by others without the inventor's permission. This patent "protection" allows the knowledge of the discovery to enter the public domain and protects the rights of the inventor for 17 years.

Thus, there is an incentive to conduct research and to develop original and useful technology because others cannot simply copy an invention and sell it without the permission of the patent holder.

Permission to manufacture, sell, or use an invention or a technology is granted by the owner through a license. Licenses may be exclusive, partially exclusive, or nonexclusive. An exclusive license is an agreement not to allow more than one firm the right to commercialize a technology. A nonexclusive license may be granted to many firms, even competitors.

Licenses are generally granted for a particular application (or field or use) or as marketing rights in a particular geographic area. Part of the challenge in negotiating licenses is to determine the best way to get as wide a distribution as possible. This objective is sometimes best accomplished by granting an exclusive license, particularly if a great deal of further development work is required. In other cases, a nonexclusive license is preferable. In nearly all cases, attempts are made to limit the license to a particular application (or field of use) so that licenses can be issued to other firms for other uses. Royalty income is one measure of the success in achieving a wide distribution by granting licenses to different firms in different fields of use.

A patent does not assure that innovation will occur. Licenses are much more important in transfer activities because they are directly related to commercialization, particularly if the license terms include market performance objectives. Federal laboratories are interested in seeing that their technologies actually reach the market. It is for this reason that a firm applying to license a Federal laboratory technology must submit a commercialization plan.

Nevertheless, patents can be very useful to public sector research institutions interested in promoting transfer. Patents show tangible evidence of the ability of the researcher (or team) to produce original ideas that may have commercial potential. The patent may be a point of departure for initiating discussions concerning a license or, if further work is needed, a cooperative R&D effort that may also lead to

a license. In addition, a patent may serve as the basis for generating private sector interest in supporting a particular area of research.

NOTE: FEDERAL REGULATIONS REQUIRE THE FOLLOWING INFORMATION FROM AN APPLICANT CONCERNING THE PLANS TO COMMERCIALIZE A FEDERALLY OWNED TECHNOLOGY:

- LENGTH OF TIME REQUIRED TO COMMERCIALIZE THE TECHNOLOGY;
- AMOUNT OF CAPITAL AND OTHER RESOURCES REQUIRED TO COMMERCIALIZE THE TECHNOLOGY;
- MANUFACTURING, MARKETING, FINANCIAL, AND TECHNICAL RESOURCES AND CAPABILITIES;
- FIELDS OF USE; AND
- GEOGRAPHIC AREA WHERE MANUFACTURING AND MARKETING WILL OCCUR.

Personnel Exchanges and Technical Assistance

The next two mechanisms involve the concept that technology transfer is a people process. Personnel exchanges involve industry researchers spending time in the Federal laboratory or vice versa. The purpose is to gain insight or to transfer knowhow. Technical assistance may or may not be a formal personnel exchange, but can be accomplished by informal means among colleagues (e.g., discussions answering specific questions). This mechanism can be very important, but it is difficult to track, and the results are difficult to demonstrate.

NOTE: PERSONNEL EXCHANGES AND TECHNICAL ASSISTANCE OFFER MANY OPPORTUNITIES TO ENGAGE IN TECHNOLOGY TRANSFER AND MAY LEAD TO OTHER TRANSFER MECHANISMS, SUCH AS LICENSING AND COOPERATIVE R&D.

NOTE: PERSONNEL EXCHANGES ON A TEMPORARY BASIS MAY BE NECESSARY TO ACCOMPLISH THE DEVELOPMENT WORK NEEDED TO SUCCESSFULLY CONVERT A TECHNOLOGY TO A MARKETABLE PRODUCT.

ASK THE PARTICIPANTS IF ANYONE KNOWS OF ANY EXAMPLES WHERE THESE TWO MECHANISMS HAVE BEEN USED IN THE TRANSFER PROCESS.

ASK IF THE PARTICIPANTS WOULD BE INTERESTED IN PARTICIPATING IN PERSONNEL EXCHANGES.

ASK THE PARTICIPANTS TO SUGGEST BETTER METHODS FOR KEEPING TRACK OF LABORATORY ACCOMPLISHMENTS IN THESE AREAS, PARTICULARLY IN PROVIDING TECHNICAL ASSISTANCE TO THE PRIVATE SECTOR AND STATE AND LOCAL GOVERNMENTS.

Cooperative R&D Agreements

Cooperative R&D agreements present a valuable technology transfer opportunity for laboratories. Cooperative R&D is the use of joint resources--funds or personnel--to conduct research of mutual interest and benefit to the participating parties. Cooperative work represents a development strategy, a transfer mechanism, and an incentive for laboratories.

It is a development strategy because cooperative work provides a method for bringing patented or unpatented technology further down the development path. This work may be part of primary mission research if a firm (or firms) is interested in potential commercial applications. Such a firm may contribute funds, personnel, or equipment to assist in the development effort.

Cooperative R&D is particularly effective as a technology transfer mechanism when joint work is required to transfer laboratory expertise and knowhow to an innovating firm. Such arrangements are not based on patents but on the desire of an innovating firm to have access to one or more researchers who are pursuing technological investigations compatible with the firm's own research investigations. These relationships may lead to patentable technology over time.

It is also an incentive to the laboratory because additional income can be generated by establishing agreements with one or more firms. Often these arrangements are long-term agreements between the laboratory and one or more firms that pay an annual fee for participation.

Cooperative R&D can be accomplished at the basic research stage (and sometimes at the applied research stage) with several competing firms. Basic research that involves graduate students is very attractive to several major industry groups. Applied work is generally

carried out under a cooperative agreement with an individual firm. If the laboratory has a technology that needs more applications work and can interest a firm in funding the R&D, this offers an opportunity to accomplish technology transfer objectives in the short-term.

Contract research is very similar to short-term cooperative R&D, but may have an even more specific problem-solving objective and is usually associated with a single firm. Contract research may follow a cooperative R&D agreement.

NOTE: THE INSTRUCTOR MAY WISH TO REVIEW ISSUE PAPER IV--COOPERATIVE RESEARCH AND THE PRIVATE SECTOR; ISSUE PAPER V--COOPERATIVE RESEARCH: THE UNIVERSITY EXPERIENCE; AND UNIT 12 (COOPERATIVE RESEARCH).

ASK THE PARTICIPANTS IF THEY SEE ANY OPPORTUNITIES TO GENERATE COOPERATIVE R&D ARRANGEMENTS.

User Facilities and Equipment

The use by commercial firms of laboratory facilities and equipment is a familiar mechanism to many Federal laboratories. A fee may be required by the laboratory. In many instances, industrial firms may use unique or very expensive equipment to conduct their own research in solving fundamental research problems. Laboratory personnel may not participate at all. In other cases, joint work can be accomplished. A very interesting use of this mechanism would be to allow small companies the use of more routine equipment that may be too expensive for them to purchase to conduct R&D. With reasonable fees, this could be a highly beneficial method of assisting small innovative companies.

Demonstration Projects

Demonstration projects are familiar to many laboratories. These are projects usually undertaken to demonstrate the technical feasibility of unproven concepts that could have a major impact for an entire industry. A variation of this type of project also could be very useful to laboratories working with individual firms. The scenario would run something like this: A laboratory researcher develops a technology in the course of mission work. He thinks that the technology may have potential commercial applications, but more

work is needed to demonstrate the technical feasibility. The laboratory may interest a firm in sponsoring a cooperative R&D effort to establish feasibility. In some cases, however, it may be necessary to develop the technology to a point that will sufficiently interest a firm in making the investment in the technology. An internal demonstration project is a possible avenue for indicating technical feasibility for this purpose.

Publications

Publications that describe laboratory technologies and activities are the final mechanism that has been included. Publications by themselves do not usually accomplish direct forms of technology transfer. They are included in the list of mechanisms because they are important in the long-term form of transfer. Also, when designing a program for direct transfers, publications can serve as an important entry point to establish contacts.

NOTE: FOR LONG-TERM, INTERMEDIATE, AND DIRECT FORMS OF TECHNOLOGY TRANSFER, REVIEW THE DEFINITIONS IN UNIT 5, KEY CONCEPT 1. ALSO REFER TO KEY CONCEPT 5: TECHNOLOGY TRANSFER IS A PEOPLE PROCESS.

CRITERIA FOR SELECTING MECHANISMS

Transparency 6-3: Criteria for Selecting Mechanisms

Laboratory ORTAs and management will need to select the appropriate mechanism, or combination of mechanisms, for each potential transfer situation. For example, a good program will certainly use publications, but will not rely solely on this mechanism to accomplish transfers.

Each technology will present its own opportunity, and the method of getting it out of the laboratory and into the private sector will depend on the:

- Nature of the technology
- Nature of the industry that will use it to innovate

- Objectives of the laboratory and the innovating firm (or firms)
- Cost to laboratory and the firm
- Benefits to the firm and the laboratory.

NOTE: THESE ARE GENERAL CRITERIA THAT MUST BE APPLIED ON AN INDIVIDUAL BASIS WITH RESPECT TO A SPECIFIC TECHNOLOGY AND PARTICULAR FIRMS AND LABORATORIES. DISCUSSIONS BETWEEN FIRMS AND LABORATORY MANAGEMENT AT AN EARLY STAGE IN THE TRANSFER PROCESS SHOULD COVER THESE CRITERIA.

Accomplishing a transfer is more important than sticking to the available mechanisms. New mechanisms may be needed. Laboratories should remain open to new approaches and be flexible in experimenting with mechanisms. It is the context of the particular situation and the needs, requirements, and expectations of the individual participants that will determine whether the outcome is successful or not.

METHODS TO ENCOURAGE LABORATORY/INDUSTRY INTERACTION

Transparency 6-4: Creating the Opportunity

When we consider an active technology transfer program that focuses on commercialization and innovation, you will have noticed that with the exception of publications and some demonstration projects, all of the mechanisms require interaction between firms and laboratory personnel. Technology transfer does not occur without mutual interest and cooperation.

Obviously, very few of the mechanisms we have reviewed can be implemented without:

1. A technology transfer opportunity

and

2. An awareness of that opportunity on the part of the laboratory and industrial firms.

Interactions between industry and laboratory personnel strictly speaking are not transfer mechanisms, but are methods that may lead to using a transfer mechanism. Activities that encourage interaction can create the technology transfer opportunity. Here are a few activities that can be used to seek out and explore transfer opportunities.

First, we have activities that can be undertaken by individuals:

Transparency 6-5: Attend Industry Activities

Attend Industry Activities

- Conferences and professional organizations
- Industry technical committees
- Industry technology acquisition contacts
- Conventions, trade shows, exhibits
- Industry associations
- Visits and exchanges in industrial laboratories.

Second, we have activities that can be undertaken by laboratories:

Transparency 6-6: Sponsor Laboratory Activities

Sponsor Laboratory Activities

- Visiting scientists and engineers
- Conferences, workshops, seminars
- Technology briefings to industry management
- Industrial liaison programs
- Technical assistance
- Information bureau.

Laboratory personnel should attend as many industry activities as possible. And laboratories can also host or sponsor a number of activities to make industrial firms more aware of their technology and capabilities. These are only a few suggestions, and some laboratories already practice many of them.

Laboratory personnel can take the opportunity presented by many of their normal activities to seek out individuals and firms in the

private sector that could be interested in the laboratory's technology. The activities listed here are not transfer mechanisms, but methods to establish contacts, elicit interest, and expand networks. These activities provide the introduction to more formal methods of technology transfer cooperation.

You will also notice that these are all things that laboratories can do. Transfer opportunities can be severely hampered by laboratories complaining that they don't know what industry wants and by industry complaining that they don't know what the laboratories have to offer. It is obvious that no one will ever know unless they try to find out.

The laboratories must clearly understand several important facts:

1. It is the responsibility of Federal laboratories, not firms, to transfer Federal technologies.

2. Laboratories cannot expect firms to come to them, although many will. The laboratories must go to the firms.

3. Laboratories may need to invest time and money in their own technologies to bring them to a point that will interest industry in making the major investment required to achieve innovation.

WHAT DO THE PARTICIPANTS THINK ABOUT THESE POINTS?

BASICS OF SETTING UP A PROGRAM

With these mechanisms, criteria, and methods to increase contact with industry in mind, we can now provide a few "rules of thumb" for setting up and operating a technology transfer program.

Transparency 6-7: Innovation Factors

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1. Technology transfer must be practiced. The best way to learn it is to do it.

2. Keep an open mind. The whole field is new and experimental. The best mechanisms for transfer may not have been discovered yet. Be flexible and try new approaches.

3. Keep focused on the final objective--innovation. Orient laboratory actions toward the firm's needs--since it is the firm that will achieve your mutual objective. Create win-win situations.

4. Expect a few, small accomplishments. Grandiose plans are complicated and difficult to manage. It is better in the beginning to take on small projects and work hard to complete them. Concentrate your resources. You will show results and build confidence.

5. Develop grassroots support within the laboratory. Not many people will be interested in commercial applications. Search out the ones who are and work with them. Others will join in as they understand the intent and as small successes are accomplished.

6. Use the incentives provided by Congress and create new, less-formal incentives. Remember, recognition is as important as money. Form an inventors club or include accomplishments in intra-laboratory announcements. Devising innovative forms of recognition lends itself to creative thinking. Be imaginative and have fun.

7. Finding applications is a key success factor. You might institute training programs to develop a sensitivity toward the identification of diverse applications. Use industry contacts extensively.

8. Realize that one of the most valuable commodities that you have to transfer is knowhow, which can be transferred rapidly and at low cost. Companies may be more interested in the capabilities of your personnel and the research areas in which they are advancing than in any patented technologies that you may have to offer. Catalog your areas of expertise and your ongoing research efforts and make these available to the private sector to solicit interest.

9. Stress in your promotional literature that you have the capacity to work with the private sector. Use specific examples of working relationships with the private sector to demonstrate your willingness and capacity to work with other companies. Remember that a company will probably be unwilling to enter into any long-term transfer activities with a laboratory unless the laboratory can demonstrate that it has the capacity to respond to private sector needs.

10. Make effective use of informal measures for initiating contacts between laboratory personnel and company personnel. Remember that most transfer activities begin through the initial person-to-person contacts

established by individuals with common scientific and technological interests.

11. Seek private sector participation at the earliest stages of a technological opportunity. Remember that the private sector is in a much better position to use technological information at the early stages of technological development, before products or processes have been defined in great detail in terms of mission purposes. In addition, the private sector will be in a position to make suggestions for research modifications that can contribute to the development of a marketable item.

12. Do not expect near-term results from a cooperative research arrangement. Technological opportunities may result from the arrangement itself, and unanticipated opportunities may result from a long-term research relationship. It is more important to establish relationships from which technological opportunities may evolve than to establish relationships on the basis of technologies that are already emergent.

13. Keep a close eye on the technological opportunities emerging from these relationships and use these as a basis for establishing even stronger arrangements with the participating company.

14. Remember that technology transfer is generally not a handoff. If a technology is in the early stages of development, additional work may be required in order to put the technology in a form to solicit private sector interest. If a technology is emergent, development will usually need to take place in order to make the technology transferable. If the technology is well-advanced or fully developed, adaptation will be necessary in order for the technology to be transferred. In each of these cases, additional effort is needed. In the latter two cases, transfer should be accomplished through joint management of the technology (e.g., through a cooperative research agreement). Even in the first case (early stage development), extensive application work should not be undertaken unless the private sector has shown some interest. In all cases, technology transfer should be understood as a cooperative endeavor.

15. Finally, you are not alone. You don't have to rely solely on your own resources. It is not necessary to have all the expertise you need inhouse. If you need help, go outside the laboratory--to other ORTAs, FLC, Licensing Executives Society, Technology Transfer Society, industrial firms, industry groups, consultants,

brokers, etc. Establish networks for contacts and expertise. Networking will help you to be successful.

NOTE: DISTRIBUTE THE HANDOUT AND DISCUSS THE POINTS WITH THE PARTICIPANTS. ASK FOR ANY ADDITIONAL COMMENTS WITH RESPECT TO THE VIEWS OF STARK IN THE REQUIRED READING AND THE VIEWS OF MORONE AND IVINS AND OF F. DOUGLAS JOHNSON IN THE OPTIONAL READINGS (IF ASSIGNED).
