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TECHNOLOGY TRANSFER MANUAL FOR RESEARCH INSTITUTES
IN DEVELOPING COUNTRIES*

Prepared by

M. Rorke, UNIDO consultant

* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

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PREFACE

The authors wrote this document for Research Institute personnel in developing countries. More specifically, we designed it to meet the needs of scientists and Research Institute staff interested in transferring technology from their institute into the hands of an individual or firm capable of bringing the technology to market locally, regionally, or internationally. While the document focuses on the mechanics of transferring technology, the authors assume throughout that such transfer will benefit a local economy significantly.

In our experience with Research Institutes, we found scientists and engineers comprising the research staff had more experience with the marketplace—and potential technology transfer—than they recognized. An extension of that finding means research institute staff may be in a better position to transfer technology than they believe at first thought. Therefore, the most important requirement is for research staff committed to economic development to learn the basics of innovation and technology transfer—a task we have undertaken by writing this document.

Once research staff have a clear understanding of the innovation process, the role (e.g., inventor, entrepreneur, technology transfer agent) they wish to take in the process, and the strategies a research institute can employ to transfer technology, staff members can begin to organize for technology transfer. Proceeding directly to organization without these clear understanding ultimately wastes time and energy.

A technology transfer—at the strategic or tactical level—is embodied in a document most often referred to as an agreement. In reading this document, you should understand the agreement is the end of the road and not the beginning; thus, the authors deal with agreements toward the end of this document rather than at the beginning.

Marcia L. Rorke
Varda Main

CHAPTER 1***THE INNOVATION PROCESS***

If participants in technology transfer thoroughly understand the Innovation Process and its implications, their ability to achieve successful technology transfers will significantly improve. This chapter discusses the Innovation Process and specific technology transfer considerations in implementing technology transfer tasks.

INTRODUCTION

The first task for Research Institute scientists and engineers if they want to transfer technology, is to develop a technology transfer strategy based on a thorough understanding of the innovation process as well as technology transfer techniques for moving a technology into a marketplace in a sustained manner. Strategies for technology transfer include licensing, strategic alliances, and joint ventures. For the purpose of this document we assume technology will be transferred to an entrepreneur or existing firm rather than assuming a researcher will form a new firm around a technology.

The most basic understanding everyone must gain is that only the technology moves from idea, to product definition, to commercial product (i.e., a product, process or service), and that the person associated with the technology may exit the process at any time.

Indeed, three very different kinds of personalities dominate the three stages comprising the innovation process: technical, entrepreneurial, and managerial. The first stage depends heavily on the technical skills innovators (i.e., inventors, scientists, researchers, engineers) with ideas for new and/or improved technologies bring to the innovation process. The second stage depends primarily on the risk taking habits of entrepreneurs whose great joy is building new companies. And, the third stage of the innovation process (which embodies full commercialization of technologies in large markets) depends almost entirely upon the skills of managers as separate and distinct from the skills possessed by inventors and entrepreneurs.

THE INNOVATION PROCESS

The innovation process¹ is best understood as a chain of events that starts with product definition and ends with sustained market penetration. During this process, new products and processes can spin-off, new markets are supplied, and a sound infrastructure develops as management shifts from innovator to entrepreneur to manager. Hence, the innovation process is a system including technical, market, and business infrastructure development steps that innovators must take. (Table 1 depicts this process.) Participants should recognize that the steps of the process happen concurrently or simultaneously. Technical, market, and business development steps cannot be separated as easily in real life as they are in the table. Nor can the "skills required" or "personnel involved" columns of the table be separated from the developmental steps. In short, the pace must be kept up across many fronts at the same time. Several other considerations drawn from the table should also be reviewed.

Table 1 shows the innovation process occurring in three distinct phases: inventive, entrepreneurial, and managerial. Every new technology must progress through these stages to reach commercialization. The tasks in each column must be completed by the end of each stage. All the tasks within that stage must be completed in parallel fashion by the end of each stage, and all the tasks within that stage must be completed before entering the next stage. When new applications or spin-offs occur, an experienced technology manager takes the new technology to the top of the columns to check that the new product/process meets market needs, can be built, has sufficient market potential

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The substance of this section is taken from a monograph titled Licensing in the Federal Laboratories in preparation for the U.S. Department of Commerce. The authors, Ed Astolfi, B. I. Friedlander, and M. L. Rorke, agreed to this use.

to warrant continued development, and so forth. If you accept this model of innovation, which differs from technical or business models, it is obvious that a different person or organization may manage each stage of development for one technology moving through the innovation process. For example, a Research Institute researcher (hereafter referred to as an inventor or innovator) might create a technology that he cannot—for a variety of reasons—develop completely. This researcher or inventor might well sell, license or even give the technology to an entrepreneur with strong business skills to form an entrepreneurial team.

The "skills required" and "people involved" columns represent the resources an innovation manager must bring to bear at each step in the innovation process to achieve commercialization. It is important to note that the inventor of a technology seldom continues in charge of a successful project through the entrepreneurial stage. If one examines the skills required to complete each stage, it becomes clear that few people can "stretch" their skills to cover the requirements of two stages. Indeed, the popular literature is replete with stories of those who have tried to make this stretch and failed. Building a project team is one way to acquire the needed skills and is a prerequisite for an inventor's continued participation. Looking at the innovation process in this way also leads to the conclusion that multiple organizations can participate in bringing new products and processes to market. For example, an R&D group may well undertake the function of the "innovation" block or may participate as a primary actor throughout the technical development process. A private sector firm with strong marketing capability may elect to contribute the market and business infrastructure components to the process, making it possible to bring a new technology to market. This kind of cooperation, a cooperative venture, usually contains an agreement that spells out how the partners will share the responsibilities and profits generated by the new technology.

While the innovation process chart is a static depiction, the process is both dynamic and repetitive—a point some people are only beginning to concede. Concurrently conducted model or prototype development programs and market analyses can yield results that cause interactive changes and require the repetition of technical steps. Market research may change designs that may change engineering requirements, which may change performance characteristics, and so forth. An innovator with an eye fixed firmly on the marketplace will design ease of manufacturing and selling into a technology very early in this process, while those fixated on technology are likely to reach the marketplace with an over-engineered, complicated technology few customers will buy or use. The common corporate concern with letting technology run away with this process illustrates the imperative of solving this particular problem.

Transitions between innovation process stages constitute critical "go/no go" benchmarks. The two gaps on the innovation process chart represent two points at which all activities within a stage should be completed horizontally (more about this shortly). Entering each of the next two stages will require substantial investments of capital as well as human resources. This is an excellent point at which to take stock of a project and decide, dispassionately, if there is sufficient financial or other reason to go forward.

These stage breaks also indicate the points at which project leadership is likely to change because they are the approximate points at which each leader is likely to stretch his skills too far. The inventor with strong technical skills yields leadership to an entrepreneur with strong business start-up skills and a different perception of risk than the technologist. Then, an entrepreneur must yield to a manager whose strengths lay in managing larger corporate structures and who perceives risk far differently than either an entrepreneur or an inventor. Each leader exhibits different skills, seeks different rewards, and perceives different risks. In these instances of risk and reward, the old adage "one man's meat is another man's poison" should be etched clearly in your mind. And the idea of building a team early in the innovation process should be viewed as imperative.

TABLE 1: THE INNOVATION PROCESS

Innovation Stage: Product Definition to Engineering Prototype

Technical Development	Market Development	Business Development	Skills Required	People Involved
Product Definition	Define Market	Decide to Develop; Find Money	Initiation to Technical	Investor Leveror
Working Model	Define Three Points of Competitive Difference; Pricing Strategy	Find More Money	Technical to Engineering	Investor Local Technicians Friends as Leverors
Engineering Prototype Test Refine	Identify Market Barriers Decide to License or Venture	Find More Money Protect: Patent/ Trade Secret Start Business Plan	Engineering Legal Market Analysis; Capital Acquisition	Investor Engineer Patent Attorney More Investors Market Analysts Business Planner

Entrepreneurial Stage: Prototype to Production

Technical Development	Market Development	Business Development	Skills Required	People Involved
Production Prototype Scale Up Test Refine Production Engineering Product Safety Engineering	Full Market Analysis and Plan Niches Barriers Pricing Competition Cost Data Distribution Method Alternative Product Applications Risk Analysis Sales Projections	Find Big Money Complete Business Plan Team Business Market Size and Federal Regulations Average Insurance Trace Production Feasibility	Engineering Production Product Safety Entrepreneurial Financing Marketing Cost Analysis Legal Management	Investor (?) Entrepreneur Investors Engineers Production Safety Attorneys Patent Corporate Accountants Consultants Marketing Business Management Financial Insurance Brokers Trade Union Officers
Limited Production Qualification Testing Marketing changes	Contact Customers Commence Distribution Seek Product Endorsements Follow-up Sales Advertise Publish in Technical Journals	Find Big, Big Money Start-up Business Build Plan Buy Equipment Hire Foreman and Labor Arrange Product Service Purchasing Transportation Record Keeping	All of the above -PLUS- Specialty Engineering Systems Engineering Sales Analysis Supervisory	All of the above -PLUS- Foreman Labor Sales People Specialty Engineers Systems Engineers
Full Production Start-up	All of the Above -PLUS- Expanded Distribution Analyze Competitor Response	All of the Above -PLUS- Monitor Costs Finance Cash Flow Deficit Refine Production System	All of the Above -PLUS- Delegation Market Forecasting Strategic Planning Long-Term Financial	All of the Above -PLUS- Expanding Management Sales Labor Force Increasingly Complex

Managerial Stage: Production for Major Market Penetration

Technical Development	Market Development	Business Development	Skills Required	People Involved
Product Improvement New Products Sustained Growth	Complexities Intensity		Complex Management	Entrepreneur (?) Fully Bureaucratized Management R&D Staff National Investment Firm

Another issue to consider is that the more resources assembled during the invention stage, the fewer problems are likely to occur in the later stages. If you consider this point as a demand for team-building and planning, you will find technology commercialization and/or transfer easier.

Many other points need clarification before proceeding. The innovation process demands management geared to dealing with change. By definition, the innovation process creates new structures, new procedures, and entails acquiring new resources. Any change in one column is likely to cause change in another. Moreover, the proliferation of skills and personnel required to successfully develop an innovation require managing change. If you cannot manage change effectively, the project will—in the long run—manage you. This outcome most likely will result in extraordinary development costs and/or a technology with no market.

Furthermore, innovators can only succeed when innovation managers harness technical, marketing, and business structure development together. While technical, market, and business tasks need not be carried out in absolute parallel at each individual step within the individual stages, deviations from reasonable parallel development can seriously jeopardize the potential for success.

All looping—repetition of tasks—should be confined within stages to reduce both costs and risks. For example, moving to production prototype without obtaining an appropriate commitment of financing or completing a market analysis may result in spending an inordinate amount of money to find there are no paying customers out there in the marketplace or that manufacturing equipment is too expensive.

In successful projects, market analysis and technical development are symbiotic and proceed harnessed together. Engineers need the results of market analyses to optimize product design; marketing personnel need performance and cost data to formulate marketing strategies. Diversion of capital to pursue technically-driven product development at the expense of gathering sound market information constitutes the "fatal flaw" most common to innovation projects.

Operating parameters and design specifications must be "frozen" as technical products move from engineering prototyping to production prototyping. This "freeze" is vitally important for three reasons: 1) it minimizes the complexity of production engineering, 2) it speeds the notoriously slow process of production engineering, and 3) it avoids the severe cost penalties incurred with even modest retooling to accommodate design changes. Technical personnel avoid this warning persistently. Several negative consequences may result from ignoring this caution: 1) disproportionately high production costs, 2) delayed market entry, or 3) premature market entry yielding high customer service costs, poor customer relations, or later redesign that requires stopping production after market entry—just when demand should be its greatest.

Successful innovation demands that one maintain an attitude of being "in business." An innovation project manager must place business interests ahead of any fascination with the technology. Finding pleasure in research and product development is, of course, a useful trait for an innovation manager. Nevertheless, the single-minded pursuit of that pleasure inevitably translates into commercialization problems. Every manager must face the possibility that, at some point, sound judgement will require abandoning a technology rather than pouring more money into a doomed project. Planning for that contingency requires establishing business benchmarks and a framework for calculating opportunity costs. Those focused on technology often fail to establish even the most rudimentary benchmarks or cost-benefit analyses for determining whether the ultimate product—or a particular technical approach to the product—is warranted. This gap in basic planning not only directly threatens resources already committed, but it can also affect the way outsiders such as vendors, prospective employees, or new investors will deal with management. Sound business

practice, reasonable benchmarks, and a ready knowledge of "how it pencils" yield both tangible and intangible benefits to an innovation project.

Successful commercialization, whether achieved by establishing a business or by transferring the technology, heavily depends on reducing the risks outsiders perceive. This principle holds true whether those outsiders are customers, potential investors, licensees, or new job applicants. It is important to stress here that perception can often exercise more power than reality. The benefits of a healthy cash-flow can be offset dramatically if potential investors perceive lax financial responsibility as they examine poorly constructed financials. Or, the advantages of excellent engineering can be lost on a customer who perceives inadequate market knowledge. The successful innovation manager reduces perceived risks by knowing as much as possible, at any given technical stage, about the market, production process, and financial needs of his project. Moreover, the successful manager reduces that knowledge to easily comprehensible, general summaries that convey a solid grasp of technical, market, and business knowledge.

This brings us to our last point about the innovation process. The innovation manager must understand the languages of technology, markets, and business infrastructure elements (e.g., law, labor, personnel matters) to coordinate and direct project participants. This task is often more difficult than developing the technology. Someone must personally perform the work necessary to encode and decode materials from specialized vocabularies in these three professional areas. Without the innovation manager's willingness to perform this function, progress through the innovation process becomes impossible. In the early days of a venture, all decision making and planning is likely in the hands of one person. Later, as responsibilities are delegated, managers must be able to understand the results of staff work in order to proceed.

TECHNOLOGY TRANSFER TASKS

Seven special attributes of technology transfer within the innovation process follow.

- **Commercialization Planning Controls Technology Transfer**

Lack of management control produces unbalanced projects and causes delays in the innovation process. The first task in establishing project control during concept development is to set "go/no go" milestone reviews that correlate technical, market, and organizational infrastructure progress and planning. This plan must focus on moving the technology out of the Research Institute into the hands of an individual or business with the skills to compete development, launch the product, and move it into customers' hands.

- **Technology Transfer Requires Transition Planning**

The most fragile points in the technical development process occur as project leadership changes, and the burden of transition planning in technology transfer necessarily falls most heavily on the party making the technology handoff.

- **Market Knowledge Drives Technical Development**

Market analysis justifies movement into commercial technical development. For industry decision makers, in fact, only market knowledge can justify investment in commercial technical development. Such knowledge includes documentation of: user needs, market size, industry keys (market-specific purchasing decision criteria), three points of product

differentiation tied to industry keys, pricing strategy, analysis of best practices and trend forecasts, identification of market barriers, and the analysis of competition and substitution options.

- **Technology Transfer Depends on Matched Capabilities**

Success in joint R&D ventures, technology licensing, and direct technology transfer depends heavily on the fits that smooth transition. Successful handoff occurs when partners complement each other in the following ways: combined resources marshal all the capabilities and personnel listed in the innovation process chart; all parties agree on thresholds for market size, pricing, and product placement; the parties arrange transition through organizational units of similar scope and scale; all parties share (or at least understand) perceptions and assessments of risk; and all parties agree on priorities and levels of commitment.

- **Industry Drivers Control Industrial Technology Transfer**

"Business Potential" offers the only acceptable rationale for industrial technical innovation. Market data—not technical data—justify investment in technology development. Engineering success, field tests, and technology demonstrations can only produce commercial development after filtering through screens of market analysis and calculations of return on investment. Supplementing technical data with market information significantly improves prospects for direct technology transfer.

- **Technology Transfer Involves Human Barriers**

Technical innovation makes for changes in work patterns, supplier lists, training needs, customer bases, regulatory requirements, pay scales, and changes in any of a host of other human impact areas. Such human impact factors can erect major barriers to commercialization of new technology. Human impacts and potential human impact barriers require definition and evaluation in the same way as technical development, market analysis and infrastructure planning.

- **Technology Transfer Must Address Risks**

Addressing perceived risks furnishes the single most important task in promoting technical innovation, and market uncertainties pose the most critical risks for industry decision makers. Market knowledge must justify any investment in commercial technical development, but no engineering knowledge or technical data can reduce perceived risks that arise from market and business uncertainties.

All in all, a broadened understanding of the innovation process significantly improves the chance of commercial success. Certainly, arming yourself with knowledge that reduces anxiety and uncertainty among potential partners while enhancing the formulation of plans contributes to more soundly reasoned commercial efforts. In many cases, especially among those pursuing technology transfer, even marginal improvements in understanding and in attitude can work wonders in reducing seemingly insurmountable difficulties to manageable proportions.

SUMMARY

A thorough understanding of the innovation process, embedded within a commercialization plan to negotiate the process pursuing a well defined strategy will yield a pool of potential partners for research institute personnel as well as a good idea of the appropriate moment to transfer a technology. The next chapter deals with the tasks comprising transferring technology from a research institute to an organization capable of completing the development and product launch.

CHAPTER 2***THE TECHNOLOGY TRANSFER PROCESS***

The technology transfer process is multi-faceted. This chapter presents and examines two components of the technology transfer process: 1) identifying a research institute's technology that is appropriate for transfer, and 2) developing a relationship with a potential partner. Suggested procedures and checklists are provided as appropriate.

INTRODUCTION

The technology transfer process constitutes one task within the innovation process. Many entrepreneurs and established businesses have the capacity to bring new and improved technologies to the marketplace, but they may lack the capacity to develop those technologies themselves. In many cases Research Institutes may serve as technology suppliers to these new and expanded businesses.

Technology transfer is a multi-step process and any or all of the steps may occur in any particular transfer. These steps include:

- Finding out what is available and what is needed
- Adapting technology to the needs of the recipient's and the marketplace
- Marketing
- Evaluating available technologies, and potential partners
- Pricing technology
- Evaluating technology transfer risks
- Establishing a negotiating position
- Negotiating the technology transfer
- Transferring the technology
- Maintaining a long-term relationship with a partner
- Assessing a long-term arrangement

IDENTIFYING TECHNOLOGY FOR TRANSFER

More broadly, technology within a research institute must be assessed and then a relationship established with a potential technology transfer partner.

Finding Out What Is Available And What Is Needed

The first step in the technology transfer process consists of determining who has what to offer and who needs what. From your point of view it is essential to understand what you have to offer. While this may sound trivial and/or obvious, it is usually be more complex.

For example, an organization performing basic research may see itself in the business of producing research results. In order to produce research results the organization probably had to acquire some specialized equipment. This equipment may be quite costly to purchase and maintain and may require highly skilled staff to operate it. At the same time, there may be small businesses needing access to such equipment on an occasional or periodic basis which cannot afford to buy the equipment or to train the staff trained to use it. The research organization may offer the use of specialized equipment as a service to the community. Thus, a research organization could be in the business of producing research results, as well as offering time/services on a piece of specialized equipment.

Once you have developed a detailed list of what is available and what is needed, items on the list should be grouped into categories such as:

- Technology under development
- Technology ready for transfer
- Products under development
- Inventory ready for transfer
- Processes under development
- Processes ready for transfer
- Services available
- Facilities available

To construct a technology inventory, the Research Institute staff must identify the research work that is being performed or has already been completed. This information should than be classified in terms meaningful to potential users and technology uses described in a clear, concise manner. The level of detail required for each technology will be determined by the use to which you will put the information. Creating and maintaining a technology inventory is an on-going process. Information on available research should be collected and assessed periodically; otherwise it will rapidly become out-dated and lose its value. A sample technology inventory survey form is given in Table 2 on the following page.

An expertise inventory can be made by identifying the skills of each staff member and grouping those skills in a matrix. This matrix will give a quick picture of the type and depth of expertise available at an Institute and guide you in identifying the services you may provide for the community.

A facilities inventory lists the types of facilities available as well as conditions under which they are available for non-Institute personnel to use.

An inventory of marketplace needs is likewise needed. This will consist of problems requiring technological solutions, and technologies in use that could be improved by:

- Reducing cost
- Increasing production efficiency

- Improving use of locally available, raw materials
- Reducing health, safety, and/or environmental hazards
- Producing products that meet consumer needs and are of high quality

A complete assessment of technology transfer opportunities must take into account competing technologies already in the marketplace, not just what is available from a particular supplier.

Adapting The Technology to The Market Needs

Technologies are brought to a marketplace because a businessman perceives a need for that technology. If a businessman has planned well and extensively and has researched the needs of a target market, then there may well be a viable business based on that technology.

Even with the best planning, you may find that a technology that appeared appropriate for a particular application is not quite what is actually needed. You may also find upon launching a new technology into a market that, since conducting your market research, market needs have changed.

When the technology recipient contributes to the planning process throughout the technology development phase, there is a strong likelihood that the resulting technology will meet his needs. In cases where your partner is adopting a technology without having an opportunity to influence the development process, the "fit" between the technology and the recipient's needs may be questionable.

There are many situations in which you will need to modify a technology to meet the changing needs of a recipient and/or of the marketplace. Ideally any technology transfer agreement anticipates such needs and sets forth conditions under which the parties will work together to develop required technology modifications.

Marketing

Once you have gathered sufficient information on available technologies and needed technologies, you must let potential technology recipients know that these technologies, products, processes, and/or services are available.

There are many ways to inform potential recipients of what you have available. These include:

- Written materials
- Demonstrations
- Talks/seminars by the research staff
- Creating a partnership or joint venture with another organization to either demonstrate the technology or to bring the technology to the marketplace on a trial basis.

TABLE 2: Sample Technology Inventory Survey Form

1. Name of the technology
2. Name(s) of the inventor(s)
3. Short description of the technology
4. What is the technical stage of development
 - idea stage
 - ready for testing
 - testing completed
 - ready for manufacturing
5. Is development continuing
6. How much money has been spent to date on developing this technology

The specific technology and its potential applications will determine which marketing methods are best for advertising the availability of the technology to the target market.

EVALUATING AVAILABLE TECHNOLOGIES AND PARTNERS

A technology can only be brought successfully to the marketplace if it works, if it fulfills users' needs, if it is transferable, and if technology recipients have the resources, labor, and financing necessary.

You need to assess or value in-house technologies to determine whether they are worth bringing to the attention of potential technology recipients. You should also assess the skills you bring to a proposed technology transfer arrangement.

At the same time, potential technology recipients need to determine what technologies they need to take advantage of opportunities in the marketplace. They must also assess the resources (labor, raw materials, equipment, financing) that will be needed to bring the technology to the marketplace and determine which of those resources they (the recipients) can provide. Recipients also need to determine which resources they cannot provide and to find out where those resources may be obtained.

Tables 3, 4, and 5 present checklists that can be used to evaluate, respectively, available technologies, suppliers, and potential recipients.

Pricing the Technology

Setting the price for a technology, product, process or service is a crucial step in the business planning process. If, for example, a product is priced too high relative to the benefits it provides the purchaser, then it will be difficult to get anyone to buy the product. If on the other hand, the product is priced too low, although one may achieve a high sales volume, the sales revenues may be less than the costs to produce the product and bring it to market.

**TABLE 3: CHECKLIST FOR EVALUATING
AVAILABLE TECHNOLOGIES**

1. What does the technology do?
2. What are the potential applications for this technology?
3. Does the technology perform reliably in the intended application?
4. How is this technology different from existing technologies?
5. Is the technology affordable?
6. What additional funds, if any, are needed to complete work on this technology?
7. Does the use of the technology require specialized skills, materials or equipment?
8. Are all necessary skills, materials and equipment available locally?
9. Does the technology solve an identified problem/need?
10. Will users need to be educated about the technology before they will use it?
11. Will the technology be easy to market or difficult to market?

12. **What are the benefits of using this technology?**
 - **Cost savings**
 - **Reduced health risks**
 - **Reduced safety risks**
 - **Reduced environmental risks**
 - **Reduces labor needed**
 - **Uses locally available labor and/or materials**

13. **Are there any special regulations that must be followed in order to use the technology?**

14. **Are there any disadvantages or risks associated with using the technology?**

15. **Will the market for this technology increase or decrease in the near future?**

16. **What are the anticipated changes in the market needs relating to this technology?**

**TABLE 4: CHECKLIST FOR EVALUATING
TECHNOLOGY SUPPLIERS**

1. Does the supplier have the technical ability to transfer the technology to the recipient?
2. Can the supplier provide the necessary training?
3. Can the supplier provide the necessary on-going assistance?
4. Can the supplier provide the necessary supplies and materials?
5. Does the supplier understand the needs of the technology recipient?
6. Is the supplier truly committed to the technology?
7. Will the supplier be a good working partner for the term of the agreement?
8. Can the supplier provide the necessary documentation?

TABLE 5: CHECKLIST FOR EVALUATING POTENTIAL TECHNOLOGY RECIPIENTS

1. Does the recipient understand enough about the technology?
2. Is the recipient an appropriate recipient for this technology?
3. Does the recipient have the technical ability to use the technology?
4. Does the recipient have the business skills to develop and implement a business plan regarding this technology?
5. Does the recipient have adequate financing for the intended use of the technology?
6. Does the recipient have the necessary equipment and materials for the intended use of the technology?
7. Is the recipient fully committed to a long-term working relationship?
8. Does the recipient have experience in similar types of technology transfer arrangements?

market. In this case, it will be difficult for the business to remain in operation very long! Thus, an effective price is one that a purchaser deems reasonable and affordable, that will at least cover the seller's operating expenses, and that will provide a modest profit.

If a similar product is already selling in the marketplace one should compare the benefits of that product with the benefits of the new product you intend to launch. Then the price of the existing product can be adjusted up or down to reflect the different value of the new product.

If there is no similar product already being sold, it is more difficult to arrive at a reasonable price. The technology seller should be able to easily determine the volume of sales at a specific price required to cover the costs of producing and marketing the product. A survey can be done of potential purchasers to get a feel for what they would consider a reasonable price for the product. The survey could be conducted by telling the purchaser about the new product's features and asking them what they would be willing to pay for such a product. Alternatively, purchasers could be given the product to use for a short period of time, or be given a demonstration of the product, and then asked what price they would be willing to pay.

Evaluating Risks

Many different types of risk may be associated with any transfer of technology. Each risk must be assessed by answering questions such as:

Technological Risks

- Can the technology be reasonably expected to perform reliably over a specified period of time?
- What is the probability of a malfunction?
- What is the expected nature of the malfunction(s)?

Health and Safety Risks

- Are there potential health or safety hazards to producers, sellers, or consumers of the product that may result if the product malfunctions?
- Are there potential health or safety hazards to producers, sellers, or consumers due to materials contained within the product, (e.g. are toxic gases given off by the product over time?)
- What health and safety regulations must the product conform to and what are the consequences of non-conformance?

Environmental Risks

- Is anything in the production, distribution, and/or use of the product harmful to the environment?
- What environmental regulations must the product conform to and what are the consequences of non-conformance?

Business Risks

- How reliable are predictions of the potential market for the product?
- Will the product generate the anticipated revenue stream and what are the consequences if it does not?
- Can the manufacturer reasonably expect to meet the market demand for the product in a timely fashion?
- Is there a reliable supply of materials and equipment needed to produce the product?
- Is there a reliable supply of skilled labor to produce, market, and service the product?

Social Risks

- Are there any social/cultural factors that will prevent customer acceptance of the product?
- Will consumers understand the product, or must they be educated to use it and to understand its benefits before they will purchase it?

Political Risks

- Are there any political factors that will affect the seller's ability to bring the product to market, or the purchaser's ability to buy and use the product?

Establishing a Negotiating Position

After evaluating the technology, and each party's respective position, each party should decide independently what his ideal vision of the technology transfer arrangement would look like. This original negotiating position will be refined to represent a "win-win" situation for both the seller and the buyer. In other words, both parties need to come away from signing the transfer agreement believing that they have been treated fairly and that they will benefit from participating in the transfer arrangement.

There are many issues that should be addressed in establishing a negotiating position. The technology transfer agreement will need to describe the obligations of all parties to the agreement: e.g. who is getting rights to what technologies, for what use, as well as the amount and timing of payments. Chapter 5 presents a short description of issues that should be covered by a technology transfer agreement.

DEVELOPING A TECHNOLOGY TRANSFER RELATIONSHIP
Supporting the Technology Transfer Agreement

The actual transfer of a technology can occur in many ways. For the transfer to be a success for both the supplier and the recipient, the technology must be transferred in a way that enables the recipient to implement the transferred technology.

The simplest way to effect a transfer would be to somehow put the technology in a box and send it to the recipient. It is easy to understand why this method will not work in many situations. When the recipient receives the box he will likely require, at the very least, instructions on how to assemble and use the technology.

For a recipient to receive and successfully implement a technology he will require at least the following in addition to the technology:

- Thorough documentation describing
- how to use the technology
- hazards that can occur from improper manufacture, assembly and/or use of the technology

- Information on where to get
- assistance if the technology does not work as expected
- necessary supplies
- Guidance on
- problem diagnosis
- troubleshooting techniques
- Availability of on-going consultation with the technology supplier
- Training, as needed, to help the buyer make and sell the technology
- Expertise in
- developing strategies for using the technology
- business planning
- marketing

You may be responsible for supplying all of the above to the recipient. In entering into a technology transfer arrangement it is important for the recipient to carefully determine what he will require in order to implement the technology. At the same time, you must understand all the components you will be responsible for transferring to the recipient.

Maintaining the Long-Term Relationship Between Parties to the Technology Transfer

All successful technology transfer arrangements create an on-going relationship between the parties. This relationship will last, at least as long as the term of the technology transfer agreement. As with any relationship, its quality will be determined by both parties' willingness to make the relationship a success.

The developer/supplier and the recipient need to set-up and maintain communications that permit an open exchange of ideas, needs, concerns, and other feedback, because the technology transfer will only be successful if each party is willing to provide reasonable assistance to the other party. This assistance may take the form of troubleshooting, helping solve problems, or creating modifications/improvements to the technology.

A good working relationship between a technology developer/supplier and a technology recipient need not end with the expiration of the technology transfer agreement. The parties should look to see if there are other profitable ventures on which they can work together.

Assessing the Technology Transfer Arrangement

Research Institute personnel should periodically assess the benefits of technology transfer arrangements. In this way one can quickly identify and solve problems before they become damaging. Periodic assessments will also enable you to identify factors that work well within the technology transfer arrangement and to ensure that those success factors are maintained and, if possible, enhanced.

The measure of success in a technology transfer arrangement is a function of the expectations one has in entering into the arrangement. In successful projects indicators are always defined at the start of a technology transfer arrangement. A listing of success indicators might include:

- Revenues received by the supplier
- Sales volume of the recipient
- Adoption rate of the technology in the marketplace

- **Extent of adoption of the technology in the marketplace**
- **Cost-savings realized from use of the technology**
- **Number of jobs created through use of the technology**
- **Health, safety or environmental hazards reduced by using the technology**

CHAPTER 3***THE TECHNOLOGY TRANSFER AGREEMENT***

All negotiations involve some level of compromise by each of the parties involved. This chapter describes some important issues that require resolution during a technology transfer negotiation.

INTRODUCTION

Technology buyers and sellers rarely view the technology transfer arrangement in the same way. Therefore, the negotiation process typically requires several compromises between the vision of each party in order to reach a mutually acceptable and beneficial arrangement.

During any negotiation, each representative must: 1) listen carefully to the needs, concerns, and suggestions of the other party; 2) clearly explain one's own needs, concerns and suggestions; and 3) continuously seek clarification to ensure that when agreement is reached both parties have agreed to the same thing.

Many issues need to be defined, resolved, and detailed in a technology transfer arrangement. This chapter provides an introduction to these issues. A more detailed discussion of negotiating technology transfer arrangements, including sample agreements, may be found in the following publication:

Guide to Negotiators of Technology Transfer in the African Region:
Guy Lambert-Daynac
United Nations Industrial Development Organization
Report IPCT.161 (SPEC.)
13 May 1992

TERMS OF TECHNOLOGY TRANSFER AGREEMENTS

Although each agreement must be tailored to meet the specific requirements of a specific deal, some terms and clauses are standard. A description of standard elements of technology transfer agreements follows.

Definitions

A good working relationship is founded on mutual understanding of the conditions of your technology transfer arrangement. It is, therefore, important to ensure that all parties define words in the same way. A simple misunderstanding in the meaning of a word or phrase (e.g., improvements to the licensed technology) may result in a breakdown of working relations at a later date.

Statement of Objectives

All parties to the technology transfer arrangement must participate in defining the arrangement's objectives. Once these are written, the parties can refer to them throughout the life of the agreements. This will help you to identify any needed changes in the objectives during the course of an agreement.

Description of the Technology to be Transferred

A detailed description of the technology to be transferred should be developed. This description must be sufficiently detailed to clearly identify items included in the transfer and related work that is not included. In this way, everyone clearly understands what they will give/get and not give/get.

Grant of Rights to the Technology

Once the technology to be transferred is clearly defined, you must identify the rights you will grant to the technology recipient. These rights can be grouped as follows:

- To make/manufacture
- To use
- To disclose to others:
 - by publication
 - in a marketed product
 - in a service manual
 - as sub-license to a third party
- To lease
- To sell

In order to transfer the rights to use a technology, it must be protected by one or more of the following:

- Patent
- Copyright
- Trademark
- Design mark
- Trade secret

The conditions under which a recipient can exercise his rights of use during the negotiation must also be defined. These conditions include:

- Exclusive rights

The technology recipient is the only entity that will have rights to the technology during the lifetime of the agreement

- Sole rights

The technology recipient and the technology developer/supplier are the only entities with rights to the technology during the lifetime of the agreement

- Non-exclusive rights

The technology supplier may grant similar rights to any number of technology recipients

- Irrevocable rights

The technology supplier cannot rescind rights granted under the technology transfer agreement during its lifetime

- Revocable rights

The technology supplier can rescind the rights granted under the technology transfer agreement should certain conditions, defined in the agreement, occur

- **Unlimited territorial rights**

The technology recipient can exercise his rights to the technology on a world-wide basis

- **Limited territorial rights**

The technology recipient can only exercise his rights to the technology in the geographical regions specified in the technology transfer agreement

- **Field of use rights**

The technology recipient can only exercise its rights to the technology in the fields specified in the technology transfer agreement. A field may be defined in whatever way is needed to clearly define where the recipient may or may not exercise its rights to the technology. For example, fields of use may be defined as a specific market within the allowed geographical region. Thus a recipient may only be able to market a technology to farmers who grow plants. Another technology recipient may have the right to market the same technology to farmers who raise animals.

Payment Terms and Schedule

You, the technology supplier, will expect to receive something in return for transferring your technology. The agreement may require a recipient to pay you a certain amount of money on a specified schedule. Alternatively, payment could be made by the recipient transferring his own technology to you, or by providing materials and/or labor.

The technology transfer agreement should clearly specify the type and amount of payment as well as a schedule for its receipt by the technology supplier. Monetary payments may be determined in a number of ways including:

- **Payment of the total price in one lump sum at the time of the technology transfer**
- **An up-front, partial payment at the time of the transfer, with subsequent payments of a pre-arranged amount, paid on a pre-arranged schedule**
- **An up-front, partial payment at the time of the transfer, with subsequent payments determined by a variable such as a specified percentage of the sales made by the technology recipient**
- **No payment at the time of the transfer, but with future payments either on a pre-arranged basis or based on a variable such as sales of the technology recipient**

The technology recipient should maintain financial records demonstrating he has correctly calculated and met his financial obligations to the technology supplier.

Reporting Obligations

The technology transfer agreement will usually set up a periodic schedule for information exchange between parties to the agreement. This exchange may be in the form of discussions or

written reports. This schedule allows progress reports, questions, concerns and ideas to be exchanged throughout the lifetime of an agreement.

Deliverables

Each party has certain obligations under the technology transfer agreement to give something(s) to the other. These items are called "deliverables". The agreement contains a time schedule for delivering these items which may include:

- The technology
- Training courses
- Consulting services
- Written documentation, e.g. users manuals, reports
- Specified numbers of products
- Supplies and other materials

The technology transfer agreement may require the technology supplier to help solve problems during the course of the agreement. Usually the amount of assistance is capped. For example, the agreement may state that a supplier will provide up to 50 hours of assistance during the lifetime of the agreement, and that assistance above and beyond the 50 hours will be available at a specified hourly rate.

The technology supplier may continue research work in the area of the transferred technology during the lifetime of the technology transfer agreement, and the agreement may state that you are required to transfer the results of this on-going research as well. Such research results usually are called "improvements". Similarly, if the technology recipient is going to perform research work in the area, he may be required to transfer his improvements to you.

Confidentiality Requirements

Published information, or information otherwise readily available to the general public, is defined as information in the "public domain". Information not in the public domain is called a trade secret. Trade secret information is information known only to a limited audience and is protected by keeping the information secret. In this way one company can keep another company from, for example, producing the same product, and becoming a competitor in the marketplace.

A technology transfer agreement must identify any information being transferred that will be maintained as a trade secret. It should also detail how to protect a trade secret, and the conditions for keeping information confidential. One typical condition specifies that the technology recipient can only disclose confidential information to certain individuals under specified conditions.

Contact Person

It is always a good idea to identify the main contact person within each party's organization. This will ensure that information flows correctly between the organizations.

Warranties

Technology suppliers most often provide warranties for technology being transferred. These warranties constitute legally-binding assurances that, for example:

- The technology supplier is the legal owner of the technology in question
- The technology meets certain stated specifications
- The supplier will provide all information/documentation required for a technology recipient to effectively exercise the rights granted in the agreement
- The specified use(s) of the technology by a recipient will not infringe any legal rights to the technology of another party

Duration of the Agreement

Both parties need to agree on how long the technology transfer arrangement will last. This is called the term of the agreement.

Procedures for Renewal or Termination

The technology transfer agreement should permit the parties to extend an arrangement beyond its original duration. For example, the agreement could specify that the parties will meet six months before the end of the agreement to decide if they wish to continue the arrangement for additional five years. Note that both parties need to agree to any extension of the term of the agreement.

One always hopes that a technology transfer arrangement will yield a good working relationship. However, unforeseen problems may occur to make one party wish to end an agreement before the end of its term. Agreements should identify acceptable conditions for early termination of an agreement.

Conflict Resolution

If problems do occur in a working relationship, the parties should try to work out their problems before considering terminating their agreement. It is always wise to describe in the agreement how the parties will resolve their problems. In some agreements an objective person (i.e., someone who does not work for either party) may be asked to listen to the concerns of the supplier and the recipient, and then offer an opinion about how to settle a dispute.

Governing Law

The laws and regulations of one city, state, or country may not be the same as those of another city, state, or country. Therefore, it is necessary for an agreement to state which laws the agreement follows.

IN CONCLUSION

Any technology transfer agreement should describe the arrangement in sufficient detail so that everyone knows what to expect and what is expected of them. The most important issues one must consider when negotiating technology transfer agreements are identified above. At the same time, it is crucial to remember that each agreement may be somewhat different. The issues covered by different agreements, therefore, may be different in specific ways. Always take time to carefully consider which issues need to be covered by an agreement. It is easy to negotiate an issue before signing the agreement. It is very hard, if not impossible, to change one after the agreement is signed.

CHAPTER 4

ORGANIZING FOR TECHNOLOGY TRANSFER

Roles and responsibilities of a Technology Transfer Office and of Technology Transfer Agents are described in this chapter. Both are crucial to the development and execution of technology transfer agreements. The high cost of acquiring rights to specific technologies can be a significant barrier to accessing needed technologies. Therefore, developing nations should look to technological solutions available locally at reasonable costs.

INTRODUCTION

The ability to create jobs and wealth using locally developed technologies is an important part of developing national self-reliance and sustainable economic growth. Simply providing funds to develop technologies in Research Institutes does not guarantee that those technologies will be developed for use within the country. Technology development can be a very costly and time-consuming process. However, when it is complete, significant additional financing and time may be necessary to adapt a technology to meet market needs. To maximize the chances of technology uptake and use within a marketplace, a system stimulating interaction between developers and users of technology must be in place.

Government financed Research Institutes are well positioned to play a pivotal role in developing a nation's technological capacity. A technology transfer function within Research Institutes may serve as a network for sharing ideas, problems, solutions, resources, and other information between technology developers and technology users within an individual community, across a nation, and across national borders.

THE TECHNOLOGY TRANSFER FUNCTION

The activities in which a Research Institute Technology Transfer Office may engage are multi-faceted. Internal activities focus on developing cooperation and support from Institute staff. External activities focus on ensuring local adoption of technologies.

INTERNAL ACTIVITIES

The internal activities of the Technology Transfer Office may be grouped as follows:

- Information gathering
- Communication
- Education/training
- Technology transfer administration
- Developing and maintaining policies and procedures.

Information Gathering

In order for the Technology Transfer Office to be effective, the Office must have an up-to-date understanding of those technologies already developed by Institute staff, as well as, technologies under development. The Office can only seek those users for technologies after a pool of available technologies has been identified and assessed. Similarly, the Office must understand the expertise of Institute staff in order to identify the consulting services that the staff can provide. Institute facilities available for use by non-Institute staff on a one-off or periodic basis must also be identified and assessed. Technology, expertise, and facilities inventories are discussed in more detail in Chapter 2.

Communication

Typically, researchers seek to develop new knowledge and solutions to problems rather than to "re-invent the wheel." Therefore, they need access to knowledge developed elsewhere as well as information about problems still requiring solutions. This type of information needs to flow between researchers at a single Institute, between Research Institute staff and colleagues at other organizations, and to those who have technology needs.

The Technology Transfer Office should seek to establish opportunities for information flow between different groups within the Research Institute as well as between Institute staff and groups outside the Institute if those avenues do not already exist.

Education/Training for Research Staff

Researchers may consider the funder of their research, in most cases the government, as their prime customer. As the emphasis of their research shifts to developing technologies with more immediate application, the definition of customer needs to shift. Although the government may continue to fund the research work, the prime customer should become the end user of the technology. There is a saying that "the customer is king." Thus, it is critical that you listen carefully to your customers, or potential customers, as they express their needs.

The roles and responsibilities of research staff vary from one Research Institute to another. At certain Institutes there may already be well-defined roles for research staff as developers of research intended to serve the needs of identified groups or markets. These researchers will work in an environment in which there is on-going interaction between potential users and technology developers. Marketplace needs define the research that will be undertaken and the direction in which the research then progresses. In this working environment there is an understanding of and respect for the prime customer—the technology user.

At other Institutes, researchers work in a more isolated environment. In such cases, a Technology Transfer Office may need to provide information/training sessions for the researchers, to help them understand who their customer is, why it is imperative to listen to one's customers, and how to incorporate the needs of the technology producers and users into the research planning and development processes.

It is essential that researchers understand the important roles of 1) disseminating technologies as quickly and as widely as possible, and 2) trans-ferring technologies to entrepreneurs and established businesses to foster job and wealth creation, are complementary ones. A researcher should not have to choose one role or the other. For as the business proverb tells us:

'To share an asset, usually it must first be divided. But knowledge is one of the few assets that multiplies as it is shared.'

Technology Transfer Administration

Technologies are transferred to a recipient under some form of binding, contractual arrangement. These arrangements establish long-term relationships that require monitoring and administration. The Technology Transfer Office should have a technology transfer administration function. This function will include:

Maintenance of transfer arrangement records. The terms and conditions under which a technology is transferred will be detailed in some form of a legally-binding agreement for which a record-keeping system must be established. Any such system should permit accessing the information by the technology transferred as well as by the recipient organization. These records must be maintained at least for the lifetime of the agreement. In some cases it may be necessary to retain the agreement documents beyond the lifetime of the agreement for tax, liability, or regulatory purposes, or because it is a stipulated condition of the agreement. From an historical context, agreements also provide important information on how specific technologies were transferred and the types of

relationships established between the technology supplier and recipient. Thus, from a business planning perspective, there may be benefit from retaining these records for longer time periods.

Monitoring Performance of Research Institute Obligations. Each technology transfer agreement will describe the obligations of the Research Institute to provide certain information, products, processes and/or services to the technology recipient. Obligations of a Research Institute may include:

- Transferring knowledge
- Providing services
- Providing a specific quantity of a product
- Training in the use of a technology, product or process
- Providing on-going problem solving help
- Providing on-going help in developing technology applications
- Transferring subsequent improvements to a technology

The Institute's staff must clearly understand both the obligations and the schedule for meeting these obligations. The Technology Transfer Office management is then responsible for explaining the terms of the transfer agreement to the research staff and for providing, as appropriate, periodic reminders of what those obligations are.

A tracking system is also required to monitor the performance of the obligations of the technology recipient. The obligations may include:

- Periodic reporting on the stage of development and/or marketing of the technology
- Recording the transfer of improvements to the technology back to the Institute
- Periodic payments for the rights to use the transferred technology

Developing Policies and Procedures

Many internal activities of the Technology Transfer Office focus on establishing and maintaining an infrastructure to facilitate the transfer of technology from the Research Institute to technology recipients/users. In order to ensure that the technology transfer mission of an Institute is fulfilled in a consistent manner and to ensure that technology recipients are treated fairly, the Technology Transfer Office will need to develop and articulate policies and procedures under which technology transfers can occur.

EXTERNAL ACTIVITIES

The external activities of the Technology Transfer Office are grouped as follows:

- Information gathering
- Information dissemination
- Matching/finding solutions to needs/technology problems
- Packaging technologies to enhance their transfer and adoption
- Negotiating technology transfer arrangements
- Maintaining the technology transfer relationship

The first four external activities represent the marketing activities necessary to bring technology developers into discussion with potential technology recipients.

Information Gathering

In order for a technology to be adopted in a marketplace it must fulfill a market need defined by the person who will buy the technology. For example, while you might envision immediate applications for a new method to stop sand dunes from progressing across the landscape, it is harder to envisage immediate applications for new and improved satellite tracking technology in a rural, agricultural marketplace. Thus, developers of technology and those who will use technology must communicate with one another in an open, honest, on-going manner.

The Technology Transfer Office should establish and maintain regular communication channels between technology developers and users. These channels allow both groups to share ideas, problems, known or proposed solutions to problems, and knowledge of resources. The information gained in this way permits researchers to incorporate knowledge of immediate technology needs into their research planning processes. It also permits research funding organizations to prioritize projects so that more funds and research effort are expended on areas of immediate concern to the marketplace.

Gaining information on market needs at the time new research projects are planned is not sufficient by itself to ensure that research results will actually meet market needs. If the research project takes a long time to complete, the needs of the marketplace could change. In such cases, the resulting technology may completely solve yesterday's needs, but not those of today.

On-going interaction with potential users during the course of developing research can help a researcher address a user's needs. For example, as a technology solution develops, it may trigger ideas from the user regarding possible sources of raw materials that can be used to produce the technology locally. Or, user's comments may demonstrate that a developing product may solve a problem in the lab, but the product may be too heavy to carry into the fields where it actually is needed.

Information Dissemination

Just as it is essential for researchers to have on-going interactions with potential technology users, likewise it is essential that people who may use technologies are aware of the activities of the Research Institutes since Research Institutes are a source of technology, expertise, and facilities. If individuals and businesses are not aware of Research Institute activities, it becomes next to impossible for them to access the help they need. Research Institutes, in short, must market themselves.

Marketing Research Institutes to potential technology users is often a responsibility of the Technology Transfer Office. To do this job, the Office needs to provide individuals and businesses with information—written in terms comprehensible to the reader—about the Institute's technology, staff, and facilities. It is important to remember that an entrepreneur who has the ideas and drive to take a new technology to market often will not have the scientific training to understand all the technical details of the technology.

Marketing an Institute is an on-going task as the staff, facilities and technologies available through the Institute may change constantly. Therefore, one must carefully plan the best way to advertise. In some cases, brochures and newsletters can alert interested parties to available services. In other cases, it may be necessary to disseminate information through hands-on demonstrations repeated in many communities across the potential market area. Demonstrations allow potential technology users to ask questions on the spot. This instant feed-back may be an important factor in

overcoming one barrier to technology adoption—lack of understanding by entrepreneurs/businessmen of what the technology can do for a business.

Matching Solutions to Needs

Once the information gathering and dissemination channels are in place, the Technology Transfer Office will be well-positioned to act as a technology broker (i.e., matchmaker between those who have technologies to transfer and those who have problems that require a technological solution) and as matchmaker between those with technology problems and those with the expertise to solve the problems.

Technology brokering can only be successful when the technology broker has ready access to information about the technologies, expertise, and facilities available, about the problems in need of solutions, and about the businesses already serving particular market niches. If an individual broker is handling a small number of technologies and talking to a limited number of people in the marketplace, the broker may be able to keep all the necessary information in his head. As this is not often a realistic scenario, a Technology Transfer Office must develop an information management system. Information will need to be cross-indexed by technology, potential applications for the technology, and by market needs.

Packaging Technologies

To be successful a technology recipient must be able to manufacture and sell a technology for the transfer. This ability to implement a technology may be defined differently in different situations, and it may include any or all of the following skills/capabilities:

- Thorough understanding of how the technology works
- Ability to modify the technology to meet existing and future market needs
- Access to materials needed to manufacture the technology/product, as well as the financial capacity to buy and deliver a sufficient quantity of raw materials
- Ability to access equipment necessary to manufacture the technology/product and financial capability to build and maintain a manufacturing facility
- Ability to hire and, if necessary, to train staff at an affordable cost, to manufacture the technology/product
- Ability to hire and train marketing/sales staff who will promote the technology/product in the marketplace
- Ability to distribute the technology/product to the customers

Although technology developers may perceive their role as limited to conducting research, in practical terms, developers may need to "put themselves in the place of a technology recipient" in order to facilitate the adoption of technology in the marketplace. In other words, the developer must seek to identify needs and barriers to technology transfer from the viewpoint of a technology recipient. Once these needs and barriers are identified, a researcher can address them. For example, a particular technology may not be adopted because potential users find the technology too complicated. This barrier may be overcome by offering a short training course to demonstrate how the technology works.

Technology adoption can be greatly facilitated by "packaging" the technology with additional components needed by technology recipients and/or users in order to actually use the technology. The "packaging" may change with time, with application, and with the type of technology user. The Technology Transfer Office should review "packaging" on a regular basis to ensure that as many barriers to technology adoption are removed as possible.

Negotiating Technology Transfer Agreements

Once a potential recipient is identified for a particular technology (i.e., product, process or service) the Technology Transfer Office and the technology recipient must agree to the conditions under which the technology will be transferred or the service provided. Each party begins by separately determining his requirements for the "successful" technology transfer. This should serve as the starting point for discussing actual transfer conditions.

It is important for everyone to remember that a technology transfer arrangement can only be successful if both parties feel that they are treated fairly. Thus, any negotiated arrangement should ensure that both parties receive equal treatment. For example, if a recipient can cut the cost of producing a product currently sold by incorporating a new technology available from the Research Institute, then the payment fees for the use of that new technology should reflect the savings a recipient achieves through its use.

Everyone negotiating a technology transfer arrangement must be patient. Each party has his own needs. It is important to allow sufficient discussion time to identify and understand the needs of the other party; it is also important to clearly understand and communicate your own needs. Listening is an essential skill in being an effective negotiator.

A checklist of issues that should be considered in negotiating a technology transfer arrangement is presented in Chapter 2.

Maintaining Relationships

Once the parties agree on the terms and conditions of a technology transfer agreement the Technology Transfer Office prepares a legally-binding agreement for signature by the appropriate representatives of each party. Signing the agreement represents the start of a new phase in the parties' relationship. In this phase both parties must cooperate to ensure that the recipient is able to manufacture and sell the transferred technology.

The Technology Transfer Office now needs to maintain periodic contact with the Institute's partner. This contact allows the Office to monitor the recipient's performance of obligations under the technology transfer agreement. These obligations could include:

- Periodic reporting to the Research Institute on market acceptance
- Reporting on barriers to market acceptance
- Periodic payments to the Research Institute

By maintaining regular contact with the technology recipient, the Office will be able to identify new market needs and/or problems early. This contact enables the Research Institute to respond in a timely fashion to the recipient's and the marketplace's changing needs. In some

situations the Office will need to remind the technology recipient that a payment or other obligation is overdue.

THE TECHNOLOGY TRANSFER AGENT

From the above description of a Technology Transfer Office, it is clear that a well-planned infrastructure is a necessary component of success. Once established, the infrastructure will only be effective if the Office is staffed by people with appropriate skills.

The diverse activities of the Technology Transfer Office indicate that such an office requires a diverse staff. Some of the necessary skills may already be available from staff working in other offices within the Research Institute. For example, information/records management may already be provided on an Institute-wide basis through a central office. For start-up and small Technology Transfer Offices, it may be advantageous to determine what duties can be performed by other work groups already functioning within an Institute. As a Technology Transfer Office grows, it may become necessary to set-up administrative and policy work groups dedicated exclusively to the needs of the Office.

Skills

Technology brokering activities are unique to a Technology Transfer Office. In staffing this function one should seek people with the following skill sets.

General Understanding of Science and Technology

Research Institutes conduct research in many areas of science and technology. A technology broker needs to have an understanding of science and technology broad enough to grasp the general concepts of any research project underway within an Institute. It is neither necessary nor possible for one broker to understand all technologies in great depth. Should the marketing or negotiating of a particular technology transfer require discussion at a complex scientific level, a technology broker should turn to the more specialized researcher for assistance.

Excellent Communication Skills

A technology broker needs to effectively communicate with many different audiences. These audiences may vary from individual farmers with little or no understanding of a particular technology to representatives of large corporations who have detailed technical knowledge. Large corporations usually require that written documentation be developed to record verbal communications. On the

other hand, a rural farmer may not know how to read. Thus, brokers must have well developed written and verbal communication skills.

Excellent Listening Skills

A technology broker will spend substantial time seeking applications for existing technologies and gathering information on current market problems and needs. A broker must be skilled at both listening and asking questions. In many cases, the person needing a technology may not fully understand what his need is; he is simply aware that something is not working correctly. It is up to a technology broker to ask the questions needed to identify the essence of a problem/need.

Excellent People Skills

A technology broker will need to interact with many different people. He must be sensitive to the different cultures and *modus operandi* of these people/groups.

Technology Transfer/Licensing Skills

A technology broker must understand the different ways in which a technology may be transferred and be able to analyze both advantages and disadvantages of each method for each proposed transfer.

Marketing Skills

A broker must understand the marketing process, including how to conduct marketing research, how to establish a marketing position, and how to launch the product.

Business Skills

A broker must understand how a business operates, the business planning process, and business risks involved in a proposed technology transfer. Then he must weigh the perceived risks against expected returns to the Institute. Finally he must decide if the risks are worth accepting.

Management Skills

A technology broker needs to possess basic management skills including people, project, time, and financial management skills.

Self-motivation

A broker will need to spend a lot of time talking to Institute researchers to clearly and thoroughly understand the available technology. He must communicate with entrepreneurs and other potential customers to learn what is needed in the marketplace. There is no formula to determine who a broker should talk to when. A broker will need to be self-motivated, constantly seeking out new avenues for acquiring and disseminating information on technologies available and technologies needed.

Organizational Skills

A technology broker must organize and access large quantities of information. It is essential therefore that a broker be well organized and pay sufficient attention to detail to ensure that information is properly recorded and categorized.

ORGANIZATIONAL PLACEMENT OF A TECHNOLOGY TRANSFER OFFICE

A Technology Transfer Office can report to any number of functions within an organization. Placement of a Technology Transfer Office will be determined by the size and complexity of an Institute and by the importance of the technology transfer function to the overall mission of the organization. Technology Transfer Offices may report to any of the following individuals/offices within an organization:

- President
- Vice President/Director for Strategic Planning
- Office of Sponsored Research and Grants
- Vice President/Director of Marketing
- Vice President/Director of Research

When determining the reporting structure for a Technology Transfer Office, it is crucial that it be given adequate authority, flexibility, funding, access to information, staff, and sufficient time to perform the duties of the Office successfully.

NEXT STEPS

It is most rewarding for everyone involved to see a technology move out of a laboratory and be used in the marketplace. This *Technology Transfer Manual for Research Institutes in Developing Countries* provides an overview of the tasks necessary in taking an idea, developing it, and turning it into a commercial success. Systematically working through the steps of the innovation process and the technology transfer process should greatly enhance the likelihood that a particular technology will become a market success.

There is a lot of literature available on different aspects of technology transfer. A few good references are provided in the Reference List below. These references are all available free of charge. Another excellent source of information and assistance is through professional societies. These societies usually have relatively inexpensive membership fees and provide members with excellent journals. A few, representative societies are also given in the Reference List.

REFERENCES

The following are good general references on innovation, technology transfer, and commercialization. They are available free of charge.

From Invention to Innovation: Commercialization of New Technology by Independent and Small Business Inventors

U.S. Department of Energy
Report DOE/NBB-0087
Washington, D.C.
U.S.A.

Guide to Negotiators of Technology Transfer in the African Region: With Special Focus on the Agro- and Agro-related Sectors

Guy Lambert-Daynac
United Nations Industrial Development Organization
Report IPCT.161(SPEC.)

Supplying or Acquiring Technology: A Canadian Business Guide

Industry, Science and Technology Canada
Business Services Centre
265 Queen Street
Ottawa, Ontario
Canada

Technology Networking Guide: Canada

Technology Networking Guide: International

Industry, Science and Technology Canada
Business Services Centre
265 Queen Street
Ottawa, Ontario
Canada

both guides list organizations, professional societies, and sources of reference journals and newsletters on technology transfer

The Basics of Licensing

The Licensing Executives Society

available from:

Chairman, Small Business Committee
Licensing Executives Society
638 Prospect Avenue
Hartford, CT
U.S.A. 06105-0819

The following are representative professional societies dealing with technology transfer, licensing, and technology commercialization. Membership information can be obtained by writing to the addresses given below.

Association of University Technology Managers

71 East Avenue, Suite S
Norwalk, CT
U.S.A. 06851-4903

Licensing Executives Society
638 Prospect Avenue
Hartford, CT
U.S.A. 06105-0819

Technology Transfer Society
611 North Capitol Avenue
Indianapolis, IN
U.S.A. 46204