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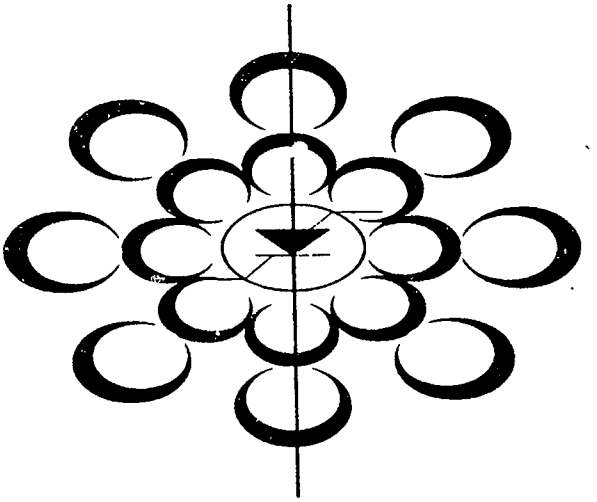
ABSTRACT

Recognizing the importance of technology transfer to economic growth, the U.S. Economic Development Administration (EDA) provided the Colorado Advanced Technology Institute (CATI) with a grant to coordinate the development of a plan for using technology transfer in Colorado's economic development. The plan, outlined in this report, describes the broad infrastructure development that would facilitate technology transfer within Colorado, encompassing the diverse views of an emerging technology transfer coalition in Colorado that is composed of people and organizations who use technology transfer as a tool in their work. To evaluate the actual extent, understanding, and needs of technology transfer in Colorado, CATI conducted two surveys: one sent to 2,379 Colorado companies with a response rate of 18.7%, and the second to 307 local, state, and federal economic development and technology transfer organizations, with a 30.3% response rate. Based on the survey results, 15 recommendations are detailed, organized into 4 categories: General, Informational, Financial, and Educational. The plan's recommendations aim to enable the emergence of characteristics identified as underlying successful public and private sector initiatives in technology-based economic development, and strengthen Colorado's economy. Two appendices provide citations to 11 subcontracted background studies and information about 9 model demonstration project plans. (MAS)

COLORADO TECHNOLOGY TRANSFER PLAN FOR ECONOMIC DEVELOPMENT



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by

The Colorado Advanced Technology Institute
1625 Broadway, Suite 700
Denver, Colorado 80203
(303) 620-4777

FOREWARD

Development of the Colorado Technology Transfer Plan for Economic Development was funded by a United States Economic Development Administration grant. The grant made it possible to involve many people and organizations in the development of the Plan.

The Plan was created through a broad-based process. Several Colorado Technology Action Consortium (COTAC) member organizations participated in development of the grant proposal as well as the development of this Plan. These subcontractors include Dr. Lawrence K. Anderson of the Colorado Institute for Technology Transfer & Implementation (CITTI), Ms. Karen Eye of the University of Colorado's Business Advancement Center (CU-BAC), Mr. Karl J. Dakin, Esquire of Karl J. Dakin P.C., and Mr. Hugh Blevins of the Colorado Technology Transfer Center (CTTC). Their contributions took the form of studies, surveys, technology transfer models, and program designs which are set forth in Appendices A and B. In addition, many people participated in the Colorado Technology Development Planning Forum. The participants represented universities, federal laboratories, public and private business assistance organizations, and economic developers. They offered a variety of excellent ideas which are reflected in the Plan's fifteen recommendations.

I would like to thank the CATI Commission, who approved this Plan, and thank the Executive Director of the Colorado Advanced Technology Institute (CATI), Dr. Phillips V. Bradford. Assembly of the Plan was made possible by Jennifer Stone Gonzalez and the CATI staff.

Sue Morgan

Sue Morgan
Deputy Director and Project Manager
Colorado Advanced Technology Institute

February 16, 1994

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INTRODUCTION

The playing field of commerce has leveled considerably since the post-World War II period when the United States dominated world markets. In the past, the U.S. market alone was so affluent that many companies prospered by serving only the American market. Today, however, foreign industries have overtaken many U.S. industries in both foreign and U.S. markets.

U.S. competitiveness is of keen concern as Americans perceive their standard of living decreasing, not only in comparison to traditional trading partners but to industrial competitors relatively new to world markets. A key to retaining an American leadership position is competing effectively in twenty-first century markets. Technology will be one of the premier factors, if not the premier factor, to successfully participate in the lucrative markets of the next century. The nation that thrives in high technology is going to have a superior material standard of living vis-a-vis other nations and a larger say in the conduct of world affairs.

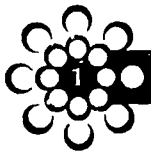
Power and influence inevitably flow to the countries most adept at fostering discovery and the advancement of technology into the marketplace. The same can be said for individual states within the United States. Therefore, many states and local governments are aggressively positioning themselves to participate in successful techonomic development. Adeptness, however, depends not only on the collective ability of a state's scientists to make headway in the laboratory, but also on the collective prowess of its engineers and business people in developing and marketing incipient technologies in a commercially successful way.

This plan recommends a number of actions the State of Colorado should undertake to make technology transfer a central part of its strategy in positioning itself for the next century. We will emphasize that technology transfer in its broadest and most effective implementation must contain elements of planning, marketing, and financing, as well as technology. Colorado has an excellent opportunity to become a world leader in technology transfer. It is an opportunity which can bring economic benefits to many sectors of society — from the research laboratories in Colorado's universities, federal laboratories, and hospitals, to the offices of expanding high-technology companies, to classrooms, manufacturing sites, and rural Colorado.

WHAT IS TECHNOLOGY TRANSFER?

There are many ways to describe technology transfer. It is often described as a process; as an economic development tool; or as the movement of a process, component, method, system or idea from one entity to another. Technology transfer includes a range of formal and informal transactions among Federal laboratories, U.S. businesses, universities, and state and local governments. Product development, product improvement, and improved manufacturing processes are results of proven technology transfer.

In the technology transfer process, a technology typically will move through several stages in order to reach a commercial form suitable for marketplace sales: from concept, to research, development, manufacture, distribution, sale, and then use. The recipient of a technology may directly apply the technology, or may exploit the technology by transferring it on to others. This process is driven by the market's perception that it will benefit from the application of the technology. "Technology pull" represents an initiation of the transfer process by the market. "Technology push" represents an initiation of the transfer process by the developer of the technology.



The benefits of successful technology transfer are broad. Revenues accrue each step of the way from basic research through applied research, to development, marketing, manufacturing, and then distribution. For example, revenues accrue to the creator of the technology, to the manufacturer of the technology, and to the distributor and retail seller of the technology. Although technology is often blamed for the loss of jobs, technology is also responsible for much new job creation. In addition, the technology may bring consumers an enhanced quality of life. It may also result in the reduction or eradication of public problems, as well as the reduction of publicly supported government operating costs.

Technology transfer is a subcomponent of economic activity, though it is much greater than a single transaction. Collectively, technology transfer can be thought of as a kind of system. Like any dynamic system, technology transfer contains many potentially disconnected elements that are interdependent. For example, a national rail system cannot function without standardized track gauge and car-coupling designs, without adequate managerial and accounting procedures, and without a systematic information network to provide management with data about the location and speed of trains and the contents of their cargo. Requirements for technology transfer — if innovations are going to solve fundamental problems in the marketplace — must solve the problem of bottlenecks, and must bridge the gaps between development, finance, and marketing operations that are both costly and time-consuming.

THE COLORADO TECHNOLOGY TRANSFER PLAN FOR ECONOMIC DEVELOPMENT

Recognizing the importance of technology transfer to economic growth, the U.S. Economic Development Administration (EDA) provided the Colorado Advanced Technology Institute (CATI) with a grant to coordinate the development of this plan. This plan we've created describes the broad infrastructure development that would facilitate technology transfer within Colorado.

The plan encompasses the diverse views of an emerging technology transfer coalition in Colorado that is composed of people and organizations who use technology transfer as a tool in their work. This emerging coalition includes manufacturers, private sector business providers, small business owners, inventors and scientists, economic developers, non-profit organizations, small business incubators, institutions of higher education, federal laboratories, and government at all levels.

SUMMARY OF RECOMMENDATIONS

We offer fifteen recommendations organized into four categories: General, Informational, Financial, and Educational. Implicit in the recommendations is the need to build on existing resources. We strongly advocate that all members of the technology transfer coalition coordinate their activities and continually seek increasing cooperation in serving their clients, the citizens of Colorado. Avoiding fragmentation and unnecessary duplication are two key factors in reinventing government, as well as in successful competition in world markets.

GENERAL

1. Integrate recommendations of this Colorado Technology Transfer Plan for Economic Development into the planning of the Colorado Advanced Technology Institute (CATI), and other Colorado economic development activities.

2. Focus State economic development activities and programs on specific industries.

INFORMATIONAL

3. Develop an easy-to-use, widely available computer database that catalogs information about existing technologies, technology experts and technology transfer assistance.

4. Promote existing information system resources to better distribute information and expertise.

5. Expand the Colorado Technology Transfer Directory.

6. Provide expert teams to rural areas to make on-site assessments of company needs.

FINANCIAL

7. Encourage utilization of existing investment incentives such as tax credits and enterprise zones for technology companies.

8. Investigate the establishment of some type of bridge financing for Small Business Innovation Research and Small Business Technology Transfer Research grants.

9. Support technology based small business incubators.

10. Foster mechanisms that can provide financing to small technology businesses.

11. Create complementary mechanisms to existing resources that provide information on investment opportunities in technology companies.

EDUCATIONAL

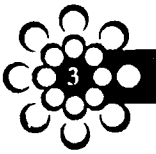
12. Support broader general education about technology transfer and pro-competitiveness economics.

13. Develop a general awareness among citizens about the benefits of technology transfer and the role it plays in U.S. and Colorado competitiveness issues.

14. Increase knowledge of the best technology transfer practices.

15. Support and document model technology transfer projects that can set examples for others to follow.

Each of these recommendations is explained in more detail later in this Plan.



BACKGROUND:

THE CREATION OF THE COLORADO TECHNOLOGY TRANSFER PLAN

The recommendations have been endorsed by the CATI Commission. The ten-member Commission is comprised of seven private-sector voting members appointed by the Governor, and three ex officio members representing the Colorado House, the Colorado Senate and the Colorado Commission on Higher Education.

The next section describes how the recommendations were forged through an extensive process that included background studies, surveys, a Planning Forum, as well as the on-going contributions of the Colorado Technology Action Consortium.

A United States Economic Development Administration (EDA) planning grant provided 74% of the funding for the development of this State plan. CATI provided the remaining 26% of the funds. The joint funding supported the creation of "a State technology transfer plan to guide the integration of technology transfer development into economic development planning throughout the State."

BACKGROUND STUDIES

The funding also supported several background studies:

- A benchmarking study of the best technology transfer practices.
- A communications needs assessment relative to technology transfer issues.
- A survey of the extent and accessibility of available technology transfer education.
- A process description for telecommunications-based rural economic development.
- Illustrative stories about the technology transfer process and what technology transfer achieves.
- The design, development and testing of a model to coordinate proposals for technology transfer funds in response to federal requests for proposals (RFPs).
- An assessment of the current and future impacts of technology-based manufacturing, research, and development activities on the Colorado economy.
- The development of a duplicable process for the selection of model technology transfer projects, and the development of implementation plans for three to five demonstration model projects.

A listing of these studies and their authors is provided in Appendix A.

SURVEYS

To evaluate the 'ual extent, understanding and needs of technology transfer in Colorado, CATI conducted two surveys. One was sent to 2,379 Colorado companies and had an 18.7% response rate. A second survey was sent to 307 local, state, and federal economic development and technology transfer organizations and had a 30.3% response rate.

A number of other surveys were conducted for the background studies. For instance, a survey was conducted for the benchmarking study of the best technology transfer practices. It was distributed to sixty of the best technology transfer practitioners, and had a response rate greater than 75%.

THE COLORADO TECHNOLOGY DEVELOPMENT PLANNING FORUM

The background studies and the survey results were discussed and analyzed at the Colorado Technology Development Planning Forum held June 16, 1993. Invited participants included members of the Colorado Technology Action Consortium and the representatives of other relevant organizations. Eighty-eight people participated. The morning sessions were devoted to presentations about technology transfer issues as defined by the studies, as well as presentation of the survey results. The afternoon sessions, facilitated small-group discussions, were designed to obtain lists of goals and recommendations for accelerating technology transfer in Colorado.

THE CONTRIBUTIONS OF THE COLORADO TECHNOLOGY ACTION CONSORTIUM

It is important to note that the EDA grant is partly a result of on-going work by the Colorado Technology Action Consortium (COTAC). COTAC is a non-hierarchical network initiated in late 1991. It is made up of two hundred thirty members representing federal laboratories, universities, private sector business service providers, private business, small business incubators, economic development entities, and state and federal government agencies. COTAC's goal is to develop cooperative, coordinated activities within Colorado conducive to dynamic techonomic growth. CATI, Colorado's science and technology development agency, acts as COTAC's organizational and administrative network node.

The COTAC process begins when one or more COTAC members identify an opportunity in technology transfer, or a problem, often some kind of barrier to technology transfer. Self-selecting teams meet to talk about solutions, develop plans, and identify resources. Often, these resources are a pooling of existing resources brought by the team members. Every plan for action begins as a boot-strapping, self-funded activity. Each viable idea and plan then takes on a life of its own, and is guided by the vision, resources, and energy of the team members.

COTAC's value is three-fold. First, COTAC provides a legitimizing mechanism under which many organizations can work together in a turf-free, non-competitive environment. Second, COTAC serves an invaluable communication function in the creation of an emerging coalition of people who use technology transfer as part of getting their jobs done. Third, COTAC teams address needs within Colorado that no single participating

organization has the resources to provide. COTAC makes Colorado's technology transfer pie bigger through cooperation, coordination, outside funding, and infrastructure development.

The following are a few examples of various COTAC committees' achievements:

- The Proposals Committee developed the proposal for this Economic Development Administration planning grant which has culminated in this Colorado Technology Transfer Plan.
- The Defense Conversion Committee coordinated twenty Colorado Technology Reinvestment Project proposals for the U.S. Advanced Research Projects Agency and generated two proposals of its own.
- COTAC has printed three editions of the Colorado Technology Transfer Directory which profiles companies and individuals involved in the technology transfer process, the kinds of work they do, and the services they can provide.
- A subcommittee of the Federal-State-Local Committee developed a plan to provide training for business advisors to help them identify when technology could benefit their client businesses, to select appropriate technology resources, and to understand tools for technology transfer acquisition. The committee secured funding for this plan from non-state revenue sources.

COTAC demonstrates the advantages of creating mechanisms that promote the sharing of information and resources, that foster cooperation among various institutions and organizations, and that enable participants to maximize existing resources.

We want to emphasize that successful technology transfer involves the private sector, institutions of higher education, federal research organizations, non-profit organizations, and government organizations at all levels. The traditional roles played by these organizations determine, in large part, how each sees its role regarding technology transfer. These organizations may also see chances to create new roles for themselves as public awareness and funding for technology transfer increases. One consequence of multiple organizations seeking to define roles regarding technology transfer is the opportunity for either debilitating overlap or duplication, or for coordination and cooperation. The fifteen recommendations that follow all stress the creation of mechanisms and roles which foster coordination and cooperation.

RECOMMENDATIONS

GENERAL: AT ISSUE IS HOW THE STATE OF COLORADO DESIGNS A TECHNOLOGY TRANSFER STRATEGY THAT IS PRACTICAL, COST-EFFECTIVE, AND FEASIBLE.

Our first two recommendations advocate that the State utilize existing strengths and resources.

1. **Integrate recommendations of this Colorado Technology Transfer Plan for Economic Development into the planning of the Colorado Advanced Technology Institute (CATI), and other Colorado economic development activities.**

2. **Focus State economic development activities and programs on specific industries.**

   To make the best use of State government's limited resources, Governor Roy Romer's Five Year Economic Development Strategic Plan recommended targeting specific industries as a component of a strategic plan. This helps in focusing attention and resources on particular segments of the economy rather than on the whole, perhaps providing a greater chance for State programs to make a difference. We concur. CATI's legislation directs CATI to focus on not more than four technology areas. Those currently selected by the CATI Commission are biotechnology, information technologies, advanced materials, and applications technologies.

   Though there should be equitable access to State assistance for technology transfer possibilities wherever market pull emerges, there should also be clear agreement by State economic development programs on technology-based industries which are priorities for development and growth. In addition, intermediary organizations should be encouraged to make their resources and services available to these targeted industries.

INFORMATIONAL: AT ISSUE IS HOW TO IMPROVE THE WAYS COMPANIES ACCESS RESOURCES THAT CAN PROVIDE TECHNOLOGY ASSISTANCE.

Technology transfer is a dynamic process. As such it necessarily requires links or relationships not only among and between individuals but also among and between a variety of institutions. The stronger, more complex, and more diverse the web of relationships, the more an innovator is likely to have access to market opportunities, the greater his/her chances of solving problems expeditiously, and ultimately the greater chance of success for the new venture.

Moreover, in a competitive environment, start-up and expanding companies do not have the luxury of time. They cannot afford to reinvent the wheel. If problems are not solved expeditiously, then the venture is in trouble. Time, the competitive metric of the 1990s, is compressed even further for technologically innovative companies. Product life cycles are short, and obsolescence is a constant concern. Consequently, new companies benefit from the ability to solve problems quickly — whether the problem is a technological hitch, an engineering difficulty, a financial constraint, or marketing limitation.

Yet, often times companies lack information on where to go for help, and although there are many qualified experts with the ability to assist companies, they are not perceived as readily available. Resources and contact people to provide technical assistance need to be available across the State.

Today, however, the information superhighway opens up new possibilities to share information and knowledge. Numerous organizations are developing the products that will travel the information highway, and the products that will aid people in navigating the highway. The following four recommendations urge that the State make coordinated statewide technology information systems a central part of its strategy to expedite technology transfer in Colorado.

3. **Develop an easy-to-use, widely available computer database that catalogs information about existing technologies, technology experts and technology transfer assistance.**

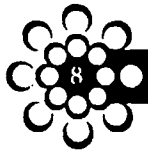
   Successful technology commercialization results from an innovation process that integrates the exchange of technical information and concept development with market and business implementation decisions. A database of technical expertise available within Colorado-based federal laboratories, institutions of higher education, and the private sector should be developed. The indexing system should organize information about technology transfer projects into several categories including: Consultants, Faculty Expertise, Licensable Technologies at University, Industry and Federal Laboratories, and Strategic Partners. The database should also include:

   - Sources of technical assistance to access and search national and international commercial and public databases for industry, scientific and marketing data.
   - Sources of business assistance to integrate technology and expert information with market, finance, and business considerations.

   In addition, simple mini-feasibility assessments should be available to initiate an understanding of market needs. The database should be made widely available through SuperNet.

4. **Promote existing information system resources to better distribute information and expertise.**

   Colorado SuperNet is the current electronic network available to connect service providers, businesses, and researchers to national and international networks through e-mail, and to free, low-cost, and subscription databases available at universities and federal agencies. GATEWAY is the State-developed system which links all Small Business Development Centers and rural economic developers to each other and to the Office of Business Development, as well as to regulatory, local demographic and state public financing information. Denver Metro Network is the State-developed system which links Denver economic development offices to share information about prospective relocations and available commercial facilities. BRAIN, Business Research and Information Network, conducts database searches for businesses using SuperNet, NASA Recon, and commercial database systems to obtain technical, market and business information. BRAIN also provides training and assistance to BRAIN Associates (SBDCs, Chambers of Commerce, and economic development offices) to help them provide information access services locally.



Business and manufacturing assistance is offered through Small Business Development Centers, the Mid-America Manufacturing Technology Center, and the Rocky Mountain Trade Adjustment Assistance Center. Five Colorado agencies are affiliated with the Mid-Continent Technology Transfer Center and offer technology transfer services including access to expertise in federal laboratories and universities. These agencies are the Colorado Advanced Technology Institute (CATI), the CU Business Advancement Center (CU-BAC), the Colorado Institute for Technology Transfer and Implementation (CITTI), the Colorado Innovation Foundation (CIF), and the Pueblo Business and Technology Center.

These existing information systems should be exploited to make expert help more available. However, they require some support from the State to more widely market their services. Continued coordination of these services through COTAC is recommended.

5. **Expand the Colorado Technology Transfer Directory.**

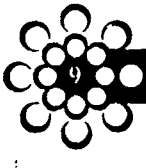
The Directory is currently published by COTAC. It includes listings for the public and non-profit sector service providers, private consultants, and faculty experts. We recommend that the State institute a mechanism that will periodically, perhaps annually, update and publish the directory. The Directory should be distributed statewide to business assistance resources such as Chambers of Commerce, economic developers, and Small Business Development Centers.

6. **Provide expert teams to rural areas to make on-site assessments of company needs.**

Individuals with specialized skills could be made available to diagnose companies' needs and to provide expert help. The teams would be drawn from specialists in marketing, management, technology, international trade, and finance. An initial diagnosis would be made by skilled staff. Then an implementation plan, perhaps with a fixed cost proposal, would be developed. Specialists would be used as consultants to complete the work with the firm. This on-site, diagnostic process would be similar to that employed by the Mid-America Manufacturing Technology Center which provides technical assistance or could be executed by MAMTC itself. These expert teams should provide a broad range of services to rural start-up, expanding and existing companies.

FINANCIAL: AT ISSUE IS THE DEMAND FOR NEW AND INCREASED SOURCES OF FINANCING FOR TECHNOLOGY BUSINESSES THAT ARE UNABLE TO OBTAIN FINANCING THROUGH EXISTING DEBT AND EQUITY SOURCES.

While capital is the lifeblood of emerging companies, we recommend that the State foster mechanisms that address unmet financing needs of small technology businesses. Tax credits, bridge financing, industry-specific small business incubators, and mechanisms to provide information on investment opportunities all present various advantages. Each must be supported.



7. **Encourage utilization of existing investment incentives such as tax credits and enterprise zones for technology companies.**

8. **Investigate the establishment of some type of bridge financing for Small Business Innovation Research and Small Business Technology Transfer Research grants.**

   The federal Small Business Innovation Research (SBIR) program's competitive awards fund research at small R & D firms. The Small Business Technology Transfer Research program (STTR) is a three-year pilot program created as an extension of the SBIR program. The STTR program allows partnerships between small firms and non-profit research institutions, university or federally-funded research centers. A major and frequent problem is the delay between receipt of an award notice and receipt of the funds. An interim State program to provide some sort of bridge financing should be investigated. The State should also work with the federal government to eliminate the untimely delays.

9. **Support technology based small business incubators.**

   Incubators are an important factor in dealing with risk aversion. The incubators should expand their services to both potential and current tenants. There is a need for incubators to provide better access to equity funds and micro loans for their clients.

10. **Foster mechanisms that can provide financing to small technology businesses.**

    Community Development Banks, Small Business Investment Corporations, and the Colorado Advanced Technology Enterprise, Inc. should be promoted as sources of small technology business financing.

11. **Create complementary mechanisms to existing resources that provide information on investment opportunities in technology companies.**

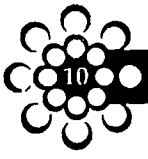
    These additional sources of information about investment opportunities should be made easily available to individual investors.

EDUCATIONAL: AT ISSUE IS PEOPLE'S LIMITED UNDERSTANDING OF WHAT TECHNOLOGY TRANSFER IS, HOW IT IS ACHIEVED, WHAT BENEFITS IT BRINGS AND HOW IT RELATES TO ECONOMIC DEVELOPMENT.

Our educational recommendations advocate that Colorado focus both on technical education, and on raising the public profile of technology transfer. We need to improve the skills of those individuals performing technology transfer activities, and need also to increase the number of people with technology transfer skills.

12. **Support broader general education about technology transfer and pro-competitiveness economics.**

    Technology commercialization is critical to effective competition in today's global markets, yet many individuals and organizations are unaware of or do not understand the processes involved. Further, technology transfer educational efforts



have lacked a common focus, leading to divergent educational materials among different sources of technology transfer education: federal, higher education, and commercial training.

It is important to increase the knowledge of the "science of technology transfer" particularly since technology transfer requires highly specialized skills and knowledge. For example, a technology transfer manager must be adept at a number of various skills including:

The identification of technology, ascertaining what the inventor has to sell, analyzing its characteristics and attributing value.

The identification of prospective markets to those who would be interested in how the technology is able to provide a potential solution to a problem, or who ultimately could benefit from the commercialization of the product.

The validation of technology to prove that it functions as intended.

The sale of technology which depends to a great extent on the professionalism of the seller's presentation, and on his/her ability to negotiate the price.

The actual transfer of the technology which involves exchange of information, documents, prototypes, personnel and training services relevant to the technology.

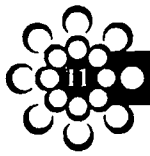
In addition, given the range and complexity of financing alternatives in today's marketplace, innovators and companies need to be able to understand the alternatives and to determine which may be best for them. The ability to perceive and appreciate what companies give up and what they get through any particular financial option is important in launching and developing a new venture.

Therefore, there is a strong need for education and training to be provided by institutions of higher education, professional organizations, all levels of government, and the private sector. We recommend the creation and wide dissemination of an introductory course on the benefits of technology transfer. We also see the need for the development of curricula on technology management tools and skills. Aimed at business practitioners, it would instruct people how best to access and manage resources and to obtain assistance.

13. **Develop a general awareness among citizens about the benefits of technology transfer and the role it plays in U.S. and Colorado competitiveness issues.**

CATI has already begun a public information program to increase awareness about technology transfer and its benefits. We recommend it be continued and given additional support. Explanations in the popular and business press of what technology transfer is, and examples of how it is accomplished, will help people understand technology transfers' economic role and marketplace benefits.

To increase general awareness of technology transfer, success stories and case studies should be disseminated in media packages through the Technology Transfer Society,



CATI, and the universities' public relations departments. These stories should highlight such things as how a given technological innovation solves a practical problem, how public and private sectors work cooperatively to bring a new technology into the marketplace, and how the commercialization of a technology contributes to Colorado and U.S. economic growth.

14. **Increase knowledge of the best technology transfer practices.**

There is no fixed formula for technology transfer success. Yet, if productivity gains are to come from technology transfer, people must be made aware of how others are applying new tools to existing processes. We recommend that the best technology transfer practices continue to be identified, and that information about best practices be implemented as they are demonstrated.

15. **Support and document model technology transfer projects that can set examples for others to follow.**

Appendix B sets out several model demonstration projects which are either in the implementation or planning stages. They serve as representative of technology transfer opportunities in Colorado. We recommend that the following criteria be used in the selection process for future projects: 1) Projects should be duplicable; 2) Projects should demonstrate collaboration with existing resources; 3) Projects should have a significant economic impact; 4) Projects should designate a single project leader. Other desirable criteria are: 1) Relative ease of implementation; 2) Availability of matching funds; 3) Uniqueness; 4) Suitability.

CONCLUSION

Knowledge and innovation are the key engines that drive an economy's expansion. However, while innovation in the laboratory is important, it certainly is no guarantee of effectiveness in the marketplace. Moreover, markets, left to themselves, do not always do the best job of fueling new knowledge. Decisive strategic competencies, therefore, lie in quickly marshaling and shifting people, money, and other resources to seize upon opportunities in emerging markets. Today, Colorado has an outstanding opportunity to emerge as a leader in technology transfer, an opportunity which can bring economic benefits to many sectors of society.

The Colorado State government already plays an important role in supporting education and research. Now, it needs to take an equally active role in enabling the private sector, federal research organizations, non-profit organizations, and government organizations to work cooperatively to create new knowledge in the laboratory and to develop and market incipient technologies in a commercially successful way.

The Office of Technology Assessment has identified three commonalities seen to underlie successful public and private sector initiatives in technology-based economic development:

1. An organizational culture that promotes a common civic perspective and a positive attitude about the attributes and prospects of the region;

2. An environment that nurtures leaders, both public and private, who combine an established track record for innovation and entrepreneurship with a broader view of their community's resources and promise;

3. A network of business/civic advocacy organizations that attracts the membership of top officers of major companies and receives from them the commitment to work on efforts of mutual concern, including cooperation with the public sector.

The recommendations contained in the Colorado Technology Transfer Plan for Economic Development will enable the emergence of these three characteristics, and will strengthen Colorado's economy in many different ways.

Decreasing U.S. competitiveness in world markets results in decreasing expectations in achieving the "good life," rising sentiments for technology and economic protectionism, and negative economic impacts. We want the opposite to hold true, and believe that it can hold true if the State makes technology transfer a central aspect of its economic strategy.

APPENDIX A:
Subcontracted Background Studies

The Colorado Advanced Technology Institute published a limited number of the following reports in March 1994. These may be requested by writing to CATI, 1625 Broadway, Suite 700, Denver, CO 80202. Please list which report(s) you wish to receive and include your address and telephone number. After the CATI supply is exhausted or after June 1, 1994, the reports will be available from the Colorado State Publications Library, Room 314, State Office Building, 201 East Colfax Avenue, Denver, CO 80203-1704, (303) 866-6725, or from any of the 19 State Publications Depository Libraries.

Dr. Lawrence K. Anderson, Principal Investigator, and Brian Gurney, Research Associate "Final Report in Benchmarking Best Practices in Technology Transfer," (December, 1993).

William Charland, "The Impact of High-Tech Industries," (December, 1993).

Douglas Cook, "Technology Transfer Communication Needs Assessment," (July 6, 1993).

Karl Dakin, "Criteria For Selection of Colorado Technology Transfer Demonstration Projects," (1993).

Karl Dakin, "Technology Transfer Educational Curriculum Plan for the State of Colorado," (1993).

Karen Eye, "A Model for Coordinated Projects and Proposals," (September, 1993).

Karen Eye, Principal Investigator, and Gary R. Horvath, Research Associate, "1993 Colorado Technology Survey, Research Related Information; A Report Defining Research Activities and Technology Transfer Interests of Colorado Companies," (April, 1993).

Karen Eye, Principal Investigator, and Gary R. Horvath, Research Associate, "1993 Colorado Technology Survey, Company Development Plans and Needs; A Report Defining Technology Needs of Colorado Companies," (April, 1993).

Karen Eye, Principal Investigator, and Gary R. Horvath, Research Associate, "1993 Colorado Technology Survey, Service Providers; A Report Defining Technology Needs and Resources," (April, 1993).

Dr. Jennifer Stone Gonzalez, "Colorado's Technology Transfer Success Stories: Communicating Innovation and Change," (February, 1994).

Sandra Tullos, "Highlights of the Role of High Technology in Colorado's Economy," (June, 1993).

APPENDIX B:
Model Demonstration Project Plans

Some of these plans were developed directly as a result of the Economic Development Agency grant. Other plans were developed as a part of COTAC and CATI activities and are included here as representative of technology transfer opportunities in Colorado.

The Colorado Connection is in the early stages of implementation, as is Technology Associates of Colorado. The Colorado Rural Telecommunications Project is an ongoing CATI project, and the COTAC Market Assessment Program is an on-going COTAC project. Some funding for the Technology Tools for Service Providers project has been secured. The others require funding for them to be initiated.

Colorado Connection

The Colorado Connection is designed to demonstrate strategies to coordinate, develop and promote existing technology and business services in order to improve company access and increase technology commercialization. Its goals are to create a more coordinated technology deployment network, increased industry awareness of benefits of technology application, a state database of technical expertise, and a system of local business advisors trained to help client companies recognize technology opportunities and to access appropriate resources.

Colorado Rural Telecommunications Project of the Colorado Advanced Technology Institute

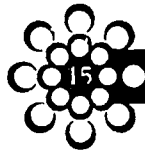
The Colorado Rural Telecommunications Project is an on-going project which provides technical assistance to communities interested in developing strategic plans to promote rural development through telecommunications. The communities involved with the program are eligible for a small seed grant to launch one of these projects. An annual statewide workshop serves as a forum for the communities to share the results of their planning efforts.

COTAC Market Assessment Program

COTAC has implemented a pilot project to provide market assessments for technology companies using MBA students with engineering degrees and, preferably, private-sector business experience.

The Establishment of Physical and Social Networks for Technology Insertion Using the Technology Information Environment for Industry (TIE-In)

This project intends to match specific user needs with established technical solutions that exist in National Laboratories. This pilot project will demonstrate the feasibility of deploying technologies to manufacturers with on-line access to technical application tools. Since TIE-In is a new mechanism for technology transfer, this project will define new roles and processes that providers of technologies, network connections, and technology transfer extension services can use to support effective deployment of technologies through TIE-In. The physical connectivity for these connections will be provided by the coordinated efforts of long-established network service providers. The social connectivity network will be developed through the collaborative efforts of a National Laboratory, network service providers, and an extension service provider aimed at providing value-added services to the end-user.



The National Telecommunications/Multimedia Center (NT/MC)

The Center is designed to develop an international preeminence in the areas of multi-media authoring tools, distribution systems, multi-media products, and presentation of training and education. It would principally focus on uses of existing and emerging technologies to facilitate the communications and information access needs of government, industry and academia. The NT/MC would convert existing land, buildings, facilities and equipment at Lowry AFB from defense to commercial applications. NT/MC would provide a forum to debate national policy issues, establish standards, complete product testing, educate and train key skill positions, fund transfer activities, match technologies and organizations, and provide consumer information on emerging products.

Rocky Flats Transition — A Plan for the Implementation of the Transfer Process for Rocky Flats Technology and Resources.

This is a transition plan for employees, technologies, and facilities at Rocky Flats. It proposes a Technology Transfer Resource Center that would be instrumental in commercializing resources at Rocky Flats. The center would foster economic activities to supplant the economic loss to the community while making Rocky Flats employees business owners, a group at the higher end of the Colorado income scale, and make the United States a more economically competitive nation through technology transfer.

Technology Associates of Colorado

This consortium of technical professionals is planned to provide improved and more cost effective technology application consulting capabilities for small and medium sized technology sensitive companies in Colorado through consolidations of existing consulting capacities. It can provide full service teams of engineering and technology application specialists to solve business problems. It helps defense companies develop commercial product strategies. It pools marketing and administrative support among these activities to meet customer needs.

Technology Tools for Service Providers

This program proposes to plan, produce, deliver, and evaluate training for business advisors to build their knowledge and practical skills in identifying technology needs of business clients, in accessing appropriate resources, and in understanding tools used in the transfer process. A one-day training symposium in the Spring of 1994 will be accompanied by follow-up assistance to help attendees apply new skills. The project will produce coordinated instructional materials which will be tested and evaluated at the symposium, evaluated for practical application in follow-up contacts after the symposium, and revised for a final product.

TechStart™ Entrepreneurial Support Program.

The TechStart™ Entrepreneurial Support Program is designed to provide short-term, high-intensity support to displaced workers starting new companies and to defense contractors redirecting business units, by helping its clients to define viable product concepts, to assemble business teams, and to develop strong business plans.