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**TEXAS SCIENCE AND TECHNOLOGY COUNCIL**

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**STRATEGIES**  
for the  
**NEW TEXAS ECONOMY**

**ADVANCING ECONOMIC DEVELOPMENT AND COMPETITIVE  
POSITION THROUGH SCIENCE AND TECHNOLOGY**

**JANUARY, 1987 AUSTIN, TEXAS**



**TEXAS SCIENCE AND TECHNOLOGY COUNCIL**

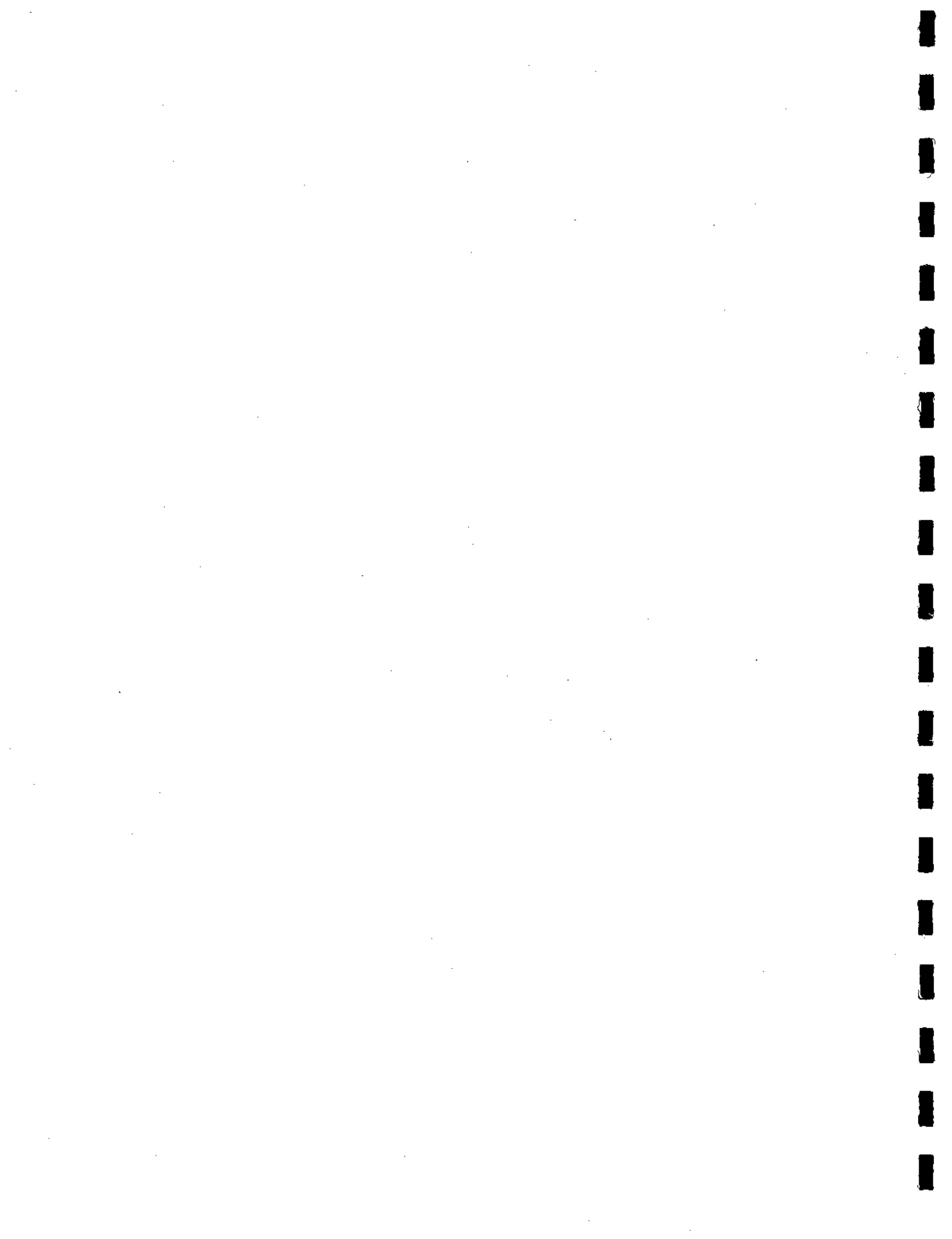
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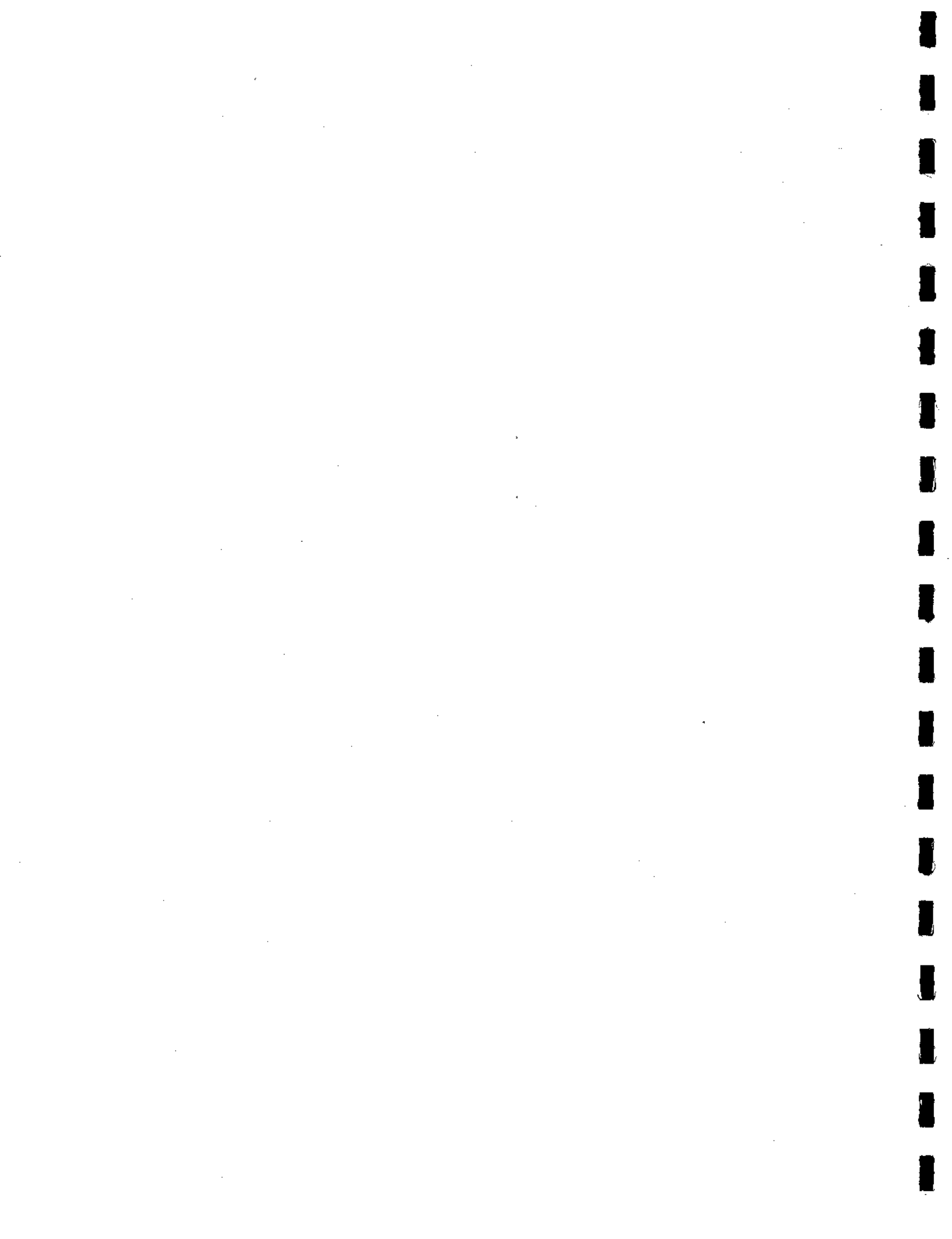
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## I. MESSAGE FROM THE CHAIRMAN

As the Chairman of the Texas Science and Technology Council, it gives me great pleasure to deliver the State of Texas' first comprehensive plan for building and balancing the state's economy from now through the year 2001.

The twenty-eight members of the Council have worked more than two years in an effort to develop a plan which addresses the following long-range goals:

- creating a new sector of the Texas economy through income from research, science and technology transfer;
- strengthening and diversifying the State's traditionally strong economic sectors (i.e., agriculture, energy, and manufacturing) through the application of technologies which will allow Texas to shift from a commodity producer to a supplier of value-added products;
- maximizing the value of the State's most important asset -- its people -- by fulfilling the promise of an outstanding educational opportunity, from kindergarten through the graduate levels of our universities, for the children of Texans no matter what their sex, religion, or ethnic background; and
- developing appropriate partnerships between the State's private and public sectors so that Texas can achieve a position of national leadership in the areas of science, research, technology and entrepreneurial growth by the year 2001.

To accomplish these highly desirable goals, major changes in the state's private and public institutions will be required. Banks will have to learn new techniques for financing intangible assets and intellectual property, farmers and ranchers will have to learn about biotechnology and marketing, oil men will have to learn about market-driven specialty products, and manufacturers will have to learn about robotics and distribution economics.

In addition to the private sector's role, state government must also turn away from its traditional attitudes about funding for education, research and economic development. New institutions, new programs and new alliances will be required if Texas is to regain a position of national leadership and achieve the objectives set forth in this plan.

The choice is clear: either Texans will put "business as usual" out of business by rising to the challenges which are presented by the Council's Plan, or the state will miss a critical opportunity to reposition its economy for growth, flexibility and competitiveness.

The members of the Texas Science and Technology Council believe strongly that the right choice for Texans is for us to take charge of our own destiny by moving ahead with the various recommendations, action plans and policy initiatives set forth below.

Respectfully submitted,

A handwritten signature in black ink, reading "Mike Waterman". The signature is written in a cursive style with a large, sweeping "M" and "W".

Mike Waterman  
Chairman  
Texas Science & Technology Council



## II. EXECUTIVE SUMMARY

In order to meet the tremendous challenge which the Texas economy faces today, it is critical that Texans throughout the State work together to regain control of the State's economic future by adopting strategies which will ensure that the State returns to a position of national economic leadership.

If Texas' leaders ignore the State's basic problems or do not act in a concerted way to solve them, the result will inevitably be a continuation of economic decline. In recent years, Texas's political leadership has become aware of the importance of a State commitment to research, education, science and technology as a means to advance economic development, even though key indicators show that today Texas is not competitive in these areas.

To capitalize on the future opportunities which science and technology offer for Texas to regain her economic momentum, the State's leadership should adopt a Mission Statement and implementing Policy Statement early in the 1987 Legislative Session. The Council's recommendations on this issue are spelled out in Section IV of this document and focus on a commitment for Texas to become a national leader in Science and technology by the year 2001, achieving preeminence in areas of special interest of the State and focusing on the application of technology to both traditional and emerging industries.

One of the keys to success will be the development of active statewide partnerships, which will help implement the State's policies and which will result in positive economic actions. These partnerships must include governments at the local, state and national levels, as well as universities and businesses of all sizes. Section V presents a full discussion of how these partnerships can benefit the State and focuses clearly on the specific areas in which governments, universities and businesses must cooperate if Texas is to realize her full economic potential.

In order to provide a mechanism for the State to set priorities and allocate resources in an efficient yet even-handed way, the Council strongly recommends that the 1987 Legislature create a public entity to be called the Texas Corporation for Science and Technology. The purpose of this public corporation would be to act not only as the primary planning and advisory entity for science and technology within the State, but also to perform a number of operational functions, including the encouragement of appropriate statewide partnerships, the focusing of the State's resources to obtain Federal programs and funding, and the leveraging of the State's expenditures for research and development. A full description of the proposed Corporation and its functions is contained in Section VI.

In its two years of work, the Council dealt with many issues in the areas of research and technology transfer. Section VII details fourteen specific recommendations for short-term action and sets out specific objectives by which the State's progress can be measured. In summary, the Council's overwhelming conclusion is that if the new Texas economy is to develop to its full potential, basic and applied research activities will

have to be sharply expanded, and the results will have to be consciously and consistently transferred to commercial markets whenever possible.

With respect to education and technical training, the Council has made six lengthy and detailed recommendations for short-term action, and these are set forth in Section VIII. Again, a series of performance-oriented objectives has also been developed in an effort to provide direction and measure results. The Council is unanimous in the position that excellence in education is central to the State's future prosperity, and congratulates all Texans who have thus far helped to begin the reforms and creative new programs which are being implemented in this critical area.

Finally, the Council has attempted to look beyond the near term and to develop several longer range ideas that will help ensure that Texas will return to a position of national economic leadership by the end of the 20th century. Section IX provides a brief look at the mechanisms and procedures which will have to be in place during the coming decade if Texas is to regain control of her economy and move on to a position of prosperity based on combining both natural and human resources through research, education, science and technology.

### III. THE CURRENT SITUATION

The Texas economy has never faced a greater challenge. The State is paying a heavy price for overreliance on its energy and agricultural industries and for the vulnerability of its manufacturing industry to foreign competition. A consensus has emerged concerning the need for new strategies to guide economic recovery but public policies essential for building the new Texas economy have lacked a central focus. Texans must regain control of the state's economic future by adopting strategies so that Texas is assured a position of national economic leadership.

Business as usual is no longer acceptable, or even possible. If Texas' leaders ignore the State's basic problems and do not act in a concerted way to solve them, the result will be a continuation of the current economic decline. It is up to Texans to choose which future they want to pursue. The current economic slump presents an opportunity for the state's leaders in government, the professions, academia and business/industry to address long-term problems and sponsor lasting economic revitalization.

A window of opportunity now exists for the public and private sectors to take significant initiatives that will help improve competitiveness, revitalize existing industries, and develop new economic possibilities. To get the job done, public policy and private sector initiatives must be targeted at eliminating weaknesses in human resources development, basic and applied research, innovative processes and technology transfer.

In recent years, political leaders have begun to recognize the importance of a state commitment to science and technology. Propositions pointing in that direction were advanced as early as May 1982 in Governor Clements' Texas 2000 Commission final report which dealt extensively with the importance of R&D to the state's future in agriculture, energy, transportation, water development and all other areas affecting economic development. Making Texas "a national leader in science and technology development" was a goal stated by Governor Mark White and typified by his efforts to attract MCC and other major technology companies, and his support for major higher education research efforts. Speaker Gib Lewis created the Legislature's first standing committee on science and technology in the 1985 session. Lieutenant Governor Bill Hobby demonstrated his support by creating an interim committee on Business, Technology and Education in 1983, chaired by Senator Chet Edwards; by initiating the Texas Advanced Technology Research Program in the 1985 session of the State Legislature; and by working to minimize cuts to higher education and to raise revenues to support education, research and economic development in the 1986 Special Session.

Many other State leaders in public and private life also have recognized the economic imperative of creating the right environment for technological innovation, including education and infrastructure improvements, support of vocational and technical training and economic stimulation for both existing industries and start-up companies.

Unfortunately, Texas has more to do to clearly be recognized as one of the national leaders in science and technology. While being an industrial power in such fields as energy, agriculture, medicine, aerospace, computers and electronics, the State lags far behind competitor states in higher education efforts in many technologies and scientific disciplines, including several that are vital to the health of established and emerging industries in Texas. Consider these indicators:

- Texas ranks third in population in the nation but 10th in total research and development (R&D) funds expended within the state.
- The level of research and development activity in Texas is about one-half of the national per capita average.
- The University of Texas System, the state's largest system, receives three times less federal R&D funds than the University of California System.
- Only one academic department in Texas, Botany at U.T. Austin, is rated number one nationally.
- Texas receives a smaller percentage of federal R&D dollars today than it did 10 years ago.
- If R&D in Texas were conducted at the national average rate, \$4 billion would be added to the state's economy each year.
- Of the 90 young scientists named to Sloan Research Fellowships in 1986, only one was from Texas, while 14 other states had two or more recipients. Similar numbers can be cited from the Westinghouse Science Talent Search.
- None of the 30 major federal laboratories is located in Texas.
- Texas ranks 45th among the states in composite Scholastic Aptitude Test scores.

These indicators can be benchmarks against which future improvement and success can be measured. And, despite these disturbing statistics, the State has ambitions and resources. For instance:

- Texas has more endowed faculty chairs in public universities than any other state;
- In 1979, there were 1,628 high technology businesses in Texas; by 1984, there were 7,541, a growth rate of 29%, compared to the six percent average in other business sectors. Each of the jobs in a technology-related business results in 19 more jobs in the economy at large; and
- Texas has one of the nation's best technical training capabilities, an accomplishment which is masked by our decentralized system of government and education.

In examining those areas where the United States holds comparative advantages in economic position against the rest of the world, the National Commission on Industrial Competitiveness recently found that only in two of eight elements did the nation have a lead: technology and human resources. In short, they argued, the U.S. is a nation that is living by its wits. And, it is in these two areas -- technology and human resources -- that Texas must fashion its future economic successes. Only in this way can Texas truly become the master of its own destiny. Fortunately, a consensus is emerging among Texas business, academic, and government leaders that, in order to seize broad-based technological leadership and to make science and technology the catalyst for future economic growth, a comprehensive strategic plan for action is mandatory.

Texas must build its new economy from within, and not depend on the traditional economic development path of attracting branch manufacturing facilities. To do the latter would perpetuate low wage jobs requiring minimal education -- a "dead-end" scenario. Instead, by depending on Texans themselves and the spread of new technologies throughout the State's economic sectors, prosperity again can be the rule. Advanced technologies combined with the traditional entrepreneurial abilities of Texans will form the base for a new Texas economy. A future featuring a poor competitive position and a stagnant or declining economy can be supplanted by a bright one characterized by expanding productivity, technological advances, and a spirit of realistic optimism. It can be done.

#### IV. TEXAS SCIENCE AND TECHNOLOGY PUBLIC POLICY

A science and technology policy for the State of Texas should be adopted by the Legislature and publicized to Texas citizens as the first of many essential steps to secure the State's economic prosperity. The Texas Science and Technology Council recommends that the State Legislature adopt the following resolution and mission statement early in 1987 to guide the state in achieving this prosperity:

WHEREAS, the economy of the State of Texas is increasingly challenged by competitive pressures in domestic and foreign markets which are influenced by a rapid rate of technological innovation; and

WHEREAS, innovations in products, services, and management are needed to bring about major changes in the makeup of the Texas economy from one based upon natural resources, to one primarily based upon advanced technologies; and

WHEREAS, the future economy of the State of Texas, based upon a high level of excellence in science, education, research and technology and upon policies that encourage competitive advantages, offers bright prospects for prosperity; and

WHEREAS, since the State's technology base is presently not strong enough to meet the demands of the new Texas economy and its requirements of economic development and diversification, the State will face bleak economic prospects if corrective action is not taken; and

WHEREAS, since Texas has a strong foundation of human, educational and business and natural resources upon which to build, resolute leadership in all levels of the public and private sectors can strengthen the science and technology base of Texas; and

WHEREAS, Texas must build a nationally and globally competitive economy by strengthening her scientific, educational and technological resources and improving their application to traditional and emerging industries; now

THEREFORE, BE IT RESOLVED that THE Texas Legislature Adopts This MISSION STATEMENT FOR THE STATE OF TEXAS:

THE STATE OF TEXAS will become a national leader in science and technology by the year 2001, and will achieve preeminence in areas of special interest to the State; and

THE STATE OF TEXAS will accelerate technology development and its application through public and private actions to strengthen education, research, innovation processes, economic development efforts, and enlightened public policies; and

THE STATE OF TEXAS will pursue these goals to achieve broad economic prosperity by improving our competitive position and creating new jobs through the development of new businesses and the strengthening of existing businesses, fully recognizing that the strongest state economies of the year 2001 will be those which have achieved educational, scientific and technological excellence.

## V. SCIENCE AND TECHNOLOGY PARTNERSHIPS

In this document, the Texas Science and Technology Council sets priorities for action built around the foregoing general statement of policy. The Council's recommendations are based on the well-grounded assumption that Texas must develop strength in science and technology in order to be innovative and economically competitive -- a sound science and technology base in the State is essential for fostering economic growth and job creation. Texas is in the advanced technology business forever, and Texans must do everything possible to encourage its development and expansion.

Over the past two years, the Texas Science and Technology Council has debated alternative strategies for advancing the State's economy. Council members well understand major national and international economic trends that will shape the Texas economy through the end of this century -- rapid technological change; heavy foreign competition and vulnerable domestic markets; and the central importance of the knowledge base, growth in value of products produced, and an adaptable, technically proficient work force. Many strategies were considered and discarded. This report contains only the end result of these deliberations rather than an analysis of why one recommendation was chosen over several alternatives. Also, in considering actions to revitalize the State's economy, the Council set aside problems that could not be resolved by directed action and concentrated on those where actions by state and local governments and the private sector would have positive impact. The report is written, therefore, as a call for comprehensive action to improve the future economy of Texas.

The Texas Science and Technology Council believes that such actions can only happen through progressive public policies and active partnerships to help implement the policies and work for science and technology development. Different levels of government must cooperate; public and private sectors must cooperate; universities and business/industry must cooperate. Partnerships for progress should be the dominant theme for enlightened public sector leadership on science and technology for economic development.

The general recommendations in this section discuss the responsibilities of principal participants in these partnerships: government at state, national, and local levels; business and industry; and universities.

### A. STATE GOVERNMENT INITIATIVES

The State's political leaders should rally around the long-term economic development strategy for Texas embodied in the plan of action contained in this report. This strategy includes:

- adoption of a Texas science and technology policy and the mechanisms to pursue it;



- strengthening university-based research;
- providing technical assistance to small businesses;
- developing new sources of capital; and
- making a wide variety of policy and infrastructure improvements.

Also, this strategy recognizes that:

- business support systems for innovation, technology development, and entrepreneurship should be developed;
- technology-based industrial development should be encouraged;
- resources for science and engineering, management of technology, and manufacturing and agricultural technology require substantial improvement; and
- science/technology resources need to be focused on targeted areas of economic need.

Developing a consensus around such issues should become a dominant priority of the 1987 and 1989 sessions of the State Legislature. This consensus can be fostered through legislation to give the science and technology-oriented economic agenda a high public profile. This agenda should be developed in the context of a balanced economic revitalization strategy that promotes a competitive, mature industry sector, a strong small business sector, a well-trained work force, a well-maintained educational structure, a better university-business-venture capital relationship, and an active interest in identifying emerging technologies important to the State's economy.

The mandates of the committees responsible for science and technology in the Texas House and Senate should be broadened to include consideration of the state's competitive economic position -- national and international. Further, such agencies as the Texas Economic Development Commission, the Texas World Trade Council, and the Coordinating Board, Texas College and University System should examine their policies and plans in light of the strategic plan presented here, to better understand and develop their roles in implementing the State's science and technology policy.

#### B. CONGRESSIONAL INITIATIVES

The Texas delegation to the U.S. Congress should give a high priority to science and technology issues as these relate to the economic competitive position of Texas. Representatives and Senators can help in the following ways:

- develop a deliberate strategy to place more Texans on federal science and technology advisory councils, both civilian and military;
- aid in establishing one or more federal laboratories in Texas;
- assist Texas universities and private industry in bidding on advanced technology federal contracts and appropriate research programs;
- work to increase the flow of federal research dollars to the State of Texas;

- advance national policies and programs to encourage scientific and technological advances;
- support federal programs to improve the quality of public and higher education;
- encourage increased federal funding to Texas science museums; and
- advance coordinated approaches for expanding the international economic competitiveness of Texas and the United States;

The Texas Office of State-Federal Relations should have a full-time staff person to facilitate coordination and information exchange with the delegation and with government, university and business leaders in Texas on research and technology development issues.

#### C. LOCAL GOVERNMENT INITIATIVES

Local governments, especially in larger urban centers, should supplement their traditional leadership in economic development with initiatives to build strength in science and technology. Working with chambers of commerce and economic development agencies, local governments can foster environments favorable to new advanced technology firms and infusion of technology in the existing economic base.

Community leaders can convene to address areas of local interest and opportunity. For example, exemplary initiatives have been taken to strengthen the infrastructure for science and technology in Dallas-Fort Worth and San Antonio. The former focused on electronics and robotics and the latter on bio-technology. Other urban areas should follow their leads in bringing government, academic, and business/industry leaders together to build science and technology strength for their respective regions in education, economic development efforts and community programs such as science museums.

An environment conducive to science and technology can be promoted by leveraging public and private funds; removing regulatory and bureaucratic obstacles to advanced technology growth; promoting local incentive programs such Adopt-a-School and TexPrep; and pressing for state and federal initiatives to improve the State's competitive position.

#### D. PRIVATE SECTOR INITIATIVES

Both the public and private sectors have definable roles to play in the economic revitalization of Texas. The public sector should not do what the private sector can do for itself. The Texas Science and Technology Council urges the State's business leaders to take their own initiatives to improve Texas' competitive position by improving the process of innovation in the State. These initiatives can take the form of political action, providing community volunteers, management planning and evaluation for schools and universities, student scholarship recognition and awards, assisting in capital formation and business-education partnership councils.

State and local policies can help create a favorable environment leading to creation of new companies and jobs. States have begun providing a variety of programs to foster application of science and technology

research, including research parks, industrial incubator facilities, financial support for start-up companies, encouragement of university faculty to commercialize their research, co-funding of academic/industrial research centers, and technical extension services to companies in Texas. The private sector can help itself by participating actively in these decision-making processes, advocating programs including scientific research and technology transfer, to benefit the innovation process, .

In working with universities, opportunities for philanthropy, personnel exchange, land and equipment donations, technology transfer, and cooperative research and development projects merit consideration. Business development in a region can be enhanced by working with universities to extend entrepreneurial assistance through small business institutes and business incubators. Business and civic advocacy for science and technology causes through vehicles such as community councils and professional associations is highly desirable.

#### E. UNIVERSITY INITIATIVES

Universities are a principal source for knowledge creation, advancement and dissemination. As such, universities are integral to developing economic competitiveness through science research and technology transfer.

By social design, professors and researchers do their work in an academically free environment where they are able to pursue all avenues of inquiry. Such freedom cannot be compromised for short-term political or economic expediency. Yet universities can still accommodate other imperatives. State universities, in particular, have obligations to the State of Texas, including work to advance the economic base on which the universities also depend. Universities should work conscientiously to meet these obligations in the context of free inquiry.

Because the free market economy and academic freedom have similar roots, there exists a reasonable basis for fraternization. Yet, clearly, each sector has a distinct point of view. Private enterprise fulfills its primary function when it makes a socially responsible profit. Universities do so when they are sources of learning and criticism. Although these two functions conflict and misunderstandings may develop, it is important that the differences between the sectors be recognized and respected so that coalitions to advance a common agenda can succeed.

Interconnections between corporations and campuses have been growing, in part, from mutually enlightened self-interest. Students have demanded a curriculum more relevant to their career interests while college and university presidents have asked the private sector for more help, both financial and in-kind. Corporate executives, more and more frequently the products of graduate educations, have demonstrated an appreciation for the powerful societal roles universities can play in teaching, research, and public service, including economic development.

For the most part, relationships between business and higher education have been largely concerned with what would most benefit universities, since universities consider themselves in greatest need. But in economic development terms, the real question is what universities could do for the

areas they serve. Application of scientific knowledge is a key to the formation of new businesses and the competitive survival of old ones. For example, use of computers, new materials, biotechnology, and communications will play a major role in determining which companies, states, and nations will lead the world economy in the next 15 years. Successfully applying these new technologies will involve the intellectual resources of Texas universities and research centers. These institutions also are important in helping to improve management practices and entrepreneurship.

University involvement in economic development is essential and may turn out to be one of the important innovations of American and Texas higher education in this century.

## VI. TEXAS CORPORATION FOR SCIENCE AND TECHNOLOGY

A Texas Corporation for Science and Technology should be established through legislation as a permanent State body, responsible for the implementation of this strategic plan and for overseeing implementation of the Texas Science and Technology Policy and many of the Council's specific recommendations. In addition to a number of operational activities which are spelled out below, the Corporation would function as the policy advisory and planning body for the State on science, technology and related economic development issues. As such, it should be insulated from political considerations to the greatest extent possible. The Corporation would be the bridge between education and economic development.

The Corporation should be governed by a Board of Directors which would have advisory and operational responsibilities. The Board should advise the Governor, executive agencies, and legislative leaders on any matter involving science and technology affecting the State's competitive position economically or technologically. The Board should be of a manageable size, appointed by the Governor, Lt. Governor and Speaker and whose members would represent the state's top technical, science and policy leaders from business/industry, colleges/universities and the professions, and should include the Chairman of the Coordinating Board and of the Texas Economic Development Commission. In addition, the Governor, Lt. Governor and Speaker of the House each would have an ex-officio position on the Board.

The Corporation would operate on start-up funds appropriated by the Legislature and contributed by the private sector. The Corporation could collect overhead costs for programs it administers which are funded by outside agencies. It is believed that start-up appropriations of \$400,000 for FY 88-89 would be sufficient.

The Board would report to the Governor and Legislature annually on the State's progress toward reaching the goals of its strategic plan, on changes needed in the strategic plan and on progress and success of programs implemented or monitored by the Corporation.

Pursuant to policies established by the Corporation's Board of Directors, an Executive Director and a very small professional staff would operate the Corporation on a day-to-day basis. Like the Council, it is anticipated that the Corporation will accomplish its work largely with the help of ad hoc project teams and task forces drawn from the State's private and public sectors.

The Corporation would have several principal functions:

- to develop partnerships around the State, bringing together leaders in business/industry, government, management and labor, research and education, and industrial development groups for the purpose of promoting economic competitiveness through science and technology;

- to promote private sector initiatives, including those developed in concert with professional and trade associations, in pursuit of the goals outlined in the Texas Science and Technology Policy;
- to provide a mechanism through which the State would pursue a small number of major science and technology initiatives, such as location of one or more major federal laboratories in Texas (see page 24);
- to support the Texas Innovation Information Network System (TIINS), a data base to promote research and technology transfer (see page 22);
- to administer the Texas Advanced Technology Program and the Permanent Research Endowment (see pages 22 and 26);
- to develop the "Texas Technology Development Centers" program (see page 26);
- to work with State government agencies to help increase their sensitivity to science and technology issues, such as by promoting a communication infrastructure policy to encourage standard format systems where information can be bought and sold efficiently and by emphasizing performance specifications in State purchasing policies, including life-cycle cost bids and openness to new technologies.
- to develop action plans for statewide research and development in energy, agribusiness, manufacturing technology, medical technology, space commercialization, electronics, international trade and a host of other existing technologies or areas of inquiry with a potentially high payoff to the State's economy thereby advancing those technologies where Texas has either a comparative advantage (current or potential) or a special interest; and
- to implement a research priority identification process.

A demonstration project undertaken for the Council indicates that a consultative process to identify research needs and opportunities in priority areas can be effective. In brief, this process involves convening review panels led by an expert in the field joined by knowledgeable people from business, universities and government. Each panel would analyze the current situation in the field of interest (e.g., advanced materials), and exchange information on research efforts, future directions of the industry, potential benefits from the research and level of resources needed.

These reports should be important inputs into developing and updating a Texas research strategy. The Corporation would assess each area's potential to enhance economic development, support infrastructure development, and support any other policy priority. These judgements need to be made by a well informed body. Once research priorities are set, then a peer review process can be used to judge between similar types of R&D proposals.

The peer review process is inappropriate for establishing relative importance of different fields of research.

The research priority identification process should also be valuable, in particular, for developing plans for funding of the Technology Development Centers and research projects funded under the Texas Research Endowment.

The Corporation is needed in Texas to give the State the strength, visibility, flexibility, and focal point to rapidly implement these and many other important science and technology development recommendations. Other states have such entities and have used them with great success. Texas' experience with leveraging the limited resources of its agencies means that the Corporation should be able to do far more with such a structure than most states could. The state with the most similar structure to the Corporation is New York which has a New York Science and Technology Foundation. The Foundation has been able to leverage private resources at more than two to one and has successfully worked with universities, small businesses and large corporations.

## VII. RESEARCH AND TECHNOLOGY TRANSFER

In order for the State of Texas to be economically competitive, the State must commit itself to world-class strength in the process of innovation -- from research to diffusion of knowledge, ending with application/commercialization.

The Texas Science and Technology Council endorses programs and policies that create the best environment for research and other aspects of the innovation process. It also endorses actions to establish incentives for research rather than mechanisms that discourage researchers from pursuing federal and other sources. Innovative researchers working in the best environment, backed by incentives, can be responsive to intellectual and other market forces. This strategy will allow the State of Texas to realize maximum return on its investment in research. The innovation process is a complex intellectual undertaking where research, technology transfer, and application are equally important. Technology transfer is the most difficult to implement, yet research is usually the most difficult element to understand because the process and result can be utterly obscure.

Strength in research is the fountainhead of the innovation upon which the Texas economy is now based. If the new Texas economy is going to develop its full potential, basic and applied research activity must be sharply expanded and consciously transferred to commercial markets whenever possible.

The Council has identified the following objectives for research in Texas over the balance of this century:

- o Immediately establish a stable source of long-term research funding (excluding line-item and special programs) that provides at least \$10 million per year by 1990 and \$50 million per year by 1995 and into the next century.
- o Increase the amount of research and development conducted in Texas to at least the per capita national average (currently \$176 per capita) by 1995 and to a level which ranks within the top 10% through 2001.
- o Establish State policies and programs to foster rapid technology transfer with ample reward to the researcher, research institution and business.
- o Close capital gaps through incentives to the private sector and through targeted public programs to provide seed financing for qualified small business start-ups and expansions, especially those that include a substantial R&D effort or the incorporation of state-of-the-art technology.



The Council has developed the following recommendations and action steps for the period 1987-1989 (listed in priority order):

#1. Indirect Cost Recovery

As a principal incentive for expanding research activity, universities should be permitted to retain 50% of all indirect cost receipts from federally/privately sponsored grants or contracts for research, upgrading research facilities and acquisition of research equipment. Retention of these funds should not result in a deduction from the state general revenue appropriations to the institution. This action would provide an incentive for obtaining externally sponsored research funding as well as critically needed funding to improve research facilities at minimum cost to the State. It would also be an incentive for institutions to obtain the maximum possible indirect cost rates from sponsoring agencies.

This recommendation should be enacted into law by the 1987 Legislature. It requires no appropriation but would provide \$25 million for academic institutions and \$25 million for medical and health schools over the biennium.

#2. Facilitate Research Equipment Purchases

Both the quantity and quality of basic and applied research at Texas universities can be strengthened through a host of changes in state legislation governing state university practice, especially by adding incentives for research. Universities should be permitted to monitor the use of these funds using fiscal accountability controls similar to those for federal research grants. Restrictions to be removed would include unrealistic travel and per diem rates as well as State Purchasing Commission purchasing reviews for research supplies and equipment. This action would result in substantial improvements in research productivity and effectiveness by reducing the administrative time necessary to oversee research.

This recommendation should be passed into law in the 1987 Legislative Session. It requires no appropriation and it will speed up faculty research projects and aid in faculty retention and recruitment.

#3. Research Funding--seed funding and basic research funding

A Research Enhancement Program should be funded to universities based on a combined factor of graduate and total faculty FTE (full time equivalent). This funding would be distributed campus-wide to be used as seed money for all fields of research. The disbursement would be determined at the campus level. This program is identical to the Select Committee on Higher Education's recommendation on seed research funding and requires legislation and appropriations of \$20 million.

Also, to fund basis research and development, the state funding formula provision for universities, entitled "Organized Research" (which has never been funded at full formula rates) should be

discontinued in favor of a Texas Advanced Research Program. Eligibility for appropriations under this program should be limited to those institutions that have graduate level programs. The proposed new formula element of cost would be established at 10% of externally sponsored research grant/contract expenditures (excluding state or institutional funds) determined during the "base period" for appropriations.

The Advanced Research Program would provide an incentive for universities to obtain externally sponsored research funding while providing a minimal base of state appropriated funds to foster development of new research programs at universities. Grants for research should be awarded to faculty members within any discipline according to campus-wide competitive peer-review procedures adopted by each university.

These two recommendations require statutory enactment and appropriations in the 1987 Session. The Research Enhancement program should be funded at \$20 million for the biennium and the Texas Advanced Research Program would should be funded at \$50 million for the biennium based on 10% of externally funded research in the 86-87 biennium. Both programs would show at least a 2:1 return on research over two to four years and a compounded 2:1 indirect benefit to universities' local economies over two to three years. Longer term benefits cannot be quantified. Both programs will also aid in faculty recruitment and retention.

#### #4. Include Research in Faculty Workload Definitions

Research activity should be recognized as a legitimate part of a faculty member's workload under state law, and more release time for faculty members should be provided to initiate and carry out research projects. Generally, incentives need to be built into the State funding formula for higher education to both advance their research activity -- basic and applied -- as a core university function, and to encourage cooperative research and affiliate arrangements among universities, government agencies, and business/industry.

This recommendation should be enacted in the 1987 Session and requires no appropriations. It will aid in faculty recruitment and retention as well as promoting additional faculty research, a valuable asset in classroom and laboratory teaching.

#### #5. Technology Transfer

Close collaboration among universities, industry, and government should be encouraged to promote technology transfer. Incentives should be instituted to encourage faculty members to work with the private sector, such as maximizing the commercialization of university research through high incentive intellectual property rights policies. Intellectual property policies (such as the model policy developed by the Council) must be strong and flexible enough to provide Texas universities with the ability to exercise a full range of options to transfer technology.

Other ways to improve transfer of technology include establishing industry advisory groups to campus research projects and supporting technology transfer programs on campus, especially the Center for Technology Development and Transfer (CTDT) at U.T. Austin and the Technology Business Development Center (TBD) at A&M, which includes INVENT. Both are legislatively mandated technology transfer programs.

This recommendation requires adoption of strong, clear intellectual property policies at all of our Texas universities. The Council has proposed a model policy to all the public universities and after careful review believes that the U.T. System policies are the best operational model in Texas. Support for technology transfer programs requires a change in campus culture, better communications between businesses and universities, internal financial support and continued legislative appropriations to TBD.

#6. Texas Innovation Information Network System (TIINS)

TIINS was developed in response to early interest by the Science and Technology Council in a statewide data network to assist in technology transfer and research support. It was sponsored by the Governor's Office and Texas Economic Development Commission with additional early support from the Texas Engineering Experiment Station, Gulf Coast Small Business Development Center and INFOMART. Over 2000 university data files have already been entered, and 2000 more will be added to the system in early 1987. The Network will operate through regional centers--seven are already in place. Data bases being developed include university researchers, industry research activities, business and professional services, educational services and capital sources. The files are accessed through a key word thesaurus developed under a National Science Foundation grant.

TIINS will be run on a self-sustaining basis through user fees as soon as development of the series of data bases is completed. This is projected to take between two and four years. With state seed funding for development work, the system can be operational with 12 months and completely developed within 18 months. Seed funding requirements are approximately \$500,000 for the biennium. The Council recommends that this seed funding be appropriated as a means for creating a truly public/private partnership in the very near term.

#7. Texas Advanced Technology Program--Applied Research Funding

A Texas Advanced Technology Program should be created and funded at a level of \$50 million per biennium by 1990 as the successor to the Texas Advanced Technology Research Program. The research funded under this program would be for applied research directed at aiding the Texas economy. Grants should be allocated on a state-wide competitive basis with a 1:1 matching requirement and should be administered by the Texas Corporation for Science and Technology.

The Texas Advanced Technology Research (TATR) program, enacted in 1985, provided much needed funding (\$35 million) for higher education research in fields important to the Texas economy. The administration

of that program was an experiment that was handled expeditiously and with a minimum of red tape. By all accounts, the 87 research projects that were funded appear to be proving their merit and several already have begun to show commercial potential.

The Science and Technology Council reviewed the process used to disburse TATR funds. The Council's interest was in suggesting improvements in the process in the event that the program is refunded or extended in some fashion. Over a dozen suggestions were made but the most important recommendations, (which should be applied to the Texas Advanced Technology Program), are to:

- a. Determine the relative merits of fields of research by establishing research priorities prior to establishing the project review criteria. The Research Priorities Strategy (page 15) is one possible method which can be used to do this.
- b. Require that funding requests include a source of leverage (e.g., 1:1)
- c. Open the competition to private universities and other institutions of research excellence (medical schools, non-profit research institutes).
- d. Put Texans on the peer review panels -- preferably at least 51%.
- e. Fund collaborative research proposals (multi-institution proposals should receive priority).

This program does require legislative enactment. It is the same program as that recommended by the Select Committee on Higher Education in funding and mission research.

#### #8. Capital Formation

It is vital to improve the means of capital formation in Texas for general business development as well as for venture capital and technological innovations. Texas has a conservative banking community (relative to small business financing); a young venture capital industry; a private investor community unused to technology-related investing; a dearth of state and local business start-up assistance programs; and a homestead law that prevents individuals from using their personal equity for early-stage financing. To foster new business start-ups, especially those riskier technology-related companies, new sources of funding are needed along with improved access to existing financing sources. Right now, seed money for start-up firms is the State's most critical capital need.

The most needed changes and proposals are (in priority order) to:

- a. establish a State-chartered system of SBIC's (small business investment corporations) to provide seed capital and expansion capital;
- b. defer franchise taxes for start-up companies with negative cash flow;
- c. amend state securities regulations to allow full disclosure instead of "merit review" in securities registrations;
- d. reform tort law and/or insurance regulations to reduce insurance costs to businesses;
- e. allow state pension and trust funds' participation in investment or loan guarantees for small and medium-sized businesses within the State, including high risk technology companies (eg. the Texas Growth Fund);
- f. establish a system of communication and crosstraining between bankers, investment bankers, venture capitalists, attorneys and accountants relating to innovative financing mechanisms and structures,, the expectations of each on the other, the idiosyncracies of technology-related start-up companies, and so forth; and
- g. amendment of the homestead law to allow an individual access to part of his or her equity without undermining fundamental protections.

All but one of these recommendations requires legislation. The Council believes that recommendations 8a-e need to be implemented in the 1987 Legislative Session. Only the franchise tax deferral has revenue implications.

#### #9. Federal Research Funding

Texas receives less than the national per capita average in federal research funding. We need to achieve a level at least at the national average. This can be aided by the following efforts:

- 1(a) Compiling a complete list of all of the major federal-level academies, boards, advisory groups, peer review panels, etc. and a list of the Texans serving on those bodies;
- (b) Identifying additional Texans qualified to serve; and
- (c) Developing a plan to get more Texans appointed to these positions.
2. Ensuring that the financial support exists for Texas appointees from public universities to participate in federal -level activities.

3. Formally targeting several major projects/programs for which Texas could actively compete and use the strength of state cooperation to win.
4. Marketing our existing interdisciplinary programs to the White House Office of Science and Technology Policy for funding under their proposal to build on existing innovative programs.
5. Improving routine contact with the Texas Congressional Delegation and broadening our Washington network, especially with funding agencies. By working closely with the new Texas Corporation for Science and Technology, the Texas Office of State-Federal Relations in Washington D.C. can be of particular assistance in this effort.

This recommendation requires consistent and clear communication with the Texas Congressional Delegation, Office of State-Federal Relations, and contacts in the White House. Its implementation is already underway as a result of efforts by the Council and others and should be supported continuously.

#### #10. Research Universities

The prominence of Texas research universities is critical to the broadening of the State's economic base. Achieving excellence in State centers of university research is paramount. Duplication of research and graduate training programs must be minimized to conserve limited resources while, at the same time, maintaining the benefits of competition and geographic dispersion. To enhance the quality of faculty, students, research facilities, and graduate programs, the State's major research universities, especially those in the State's major urban areas which are responding to the region's economic development needs, should be designated as the principal comprehensive research centers of Texas. Other universities should be designated as non-comprehensive but "targeted" research universities with research specializations of optimal quality in selected fields. Changes in the State's funding system should be made to provide the additional resources required by these research institutions.

#### #11. Engineering Excellence Fund

The Engineering Excellence Fund was established by the Legislature in 1983 but has never been funded. This fund was designed to support critically needed equipment purchases at public universities. Engineering laboratories are plagued by lack of sufficient funding to obtain state-of-the-art equipment essential to education and research.

Appropriations of at least an initial \$2-3 million should be made to this fund.

#12. Texas Research Endowment

A permanent research endowment should be established by the Legislature to provide stable, long-term research funding for university, university consortium and university-private consortium research efforts. Research grants would be awarded from the interest generated by the endowment and would have to be matched by federal or private monies in most cases. The fund could also be used to provide seed money or essential state support for major research program or center proposals which would have positive economic impacts on Texas.

The Endowment should be built from the state's share of future OCS revenues as well as gifts, appropriations and revenues from the commercialization of research funded by the endowment. No research grants should be made until the corpus of the Endowment Fund reaches \$50 million.

The Endowment fund should be administered by an existing State trust fund and the interest income should be disbursed through the Texas Corporation for Science and Technology.

#13. Texas Technology Development Centers

A series of Texas Technology Development Centers should be developed to support interdisciplinary and sometimes multi-campus university-affiliated research centers. Each center would consist of university/private sector research teams focusing on specific technological research problems chosen by local industry-government-university board. Beginning in September 1987, this program should be funded at \$5 million per biennium, matched by an equal amount from other sources. Centers should be self-supporting within five years. This program should be administered by the Corporation.

#14. Research Facilities

A comprehensive plan should be developed for academic and other research facilities based on the State's economic future, industry profiles, and labor force needs. In this process, a wide range of sources and techniques for funding these facilities should be explored, including leveraging private funds, bonding and debt financing, lease-purchase arrangements, and use of indirect cost funds. The Coordinating Board, Texas College and University System should seek ways to improve facilities designs, construction, and space management practices to reduce costs, incorporate best current practice, and achieve best use of existing facilities.

The following are brief summaries of major research-related issues addressed by the Council. Other topics such as biotechnology, medical technology and space research also should be analysed to establish the potential for research in these fields to have a highly positive economic impact on Texas. Such analyses should be undertaken by the Corporation.

#### A. Manufacturing Technologies.

The stability and long-term growth of the manufacturing sector of the Texas economy is vital to future prosperity of the State. Efforts must be made to enhance the competitiveness of manufacturing companies now in Texas, and to create conditions that encourage the addition of more such companies and associated jobs. To accomplish this objective, Texas should assume a leadership role in development of the advanced manufacturing technologies, and the related qualified labor force, that are expected to revolutionize manufacturing in the U.S. during the next two decades. Manufacturing is the nation's highest "value added" sector and manufacturing based on high R&D inputs has the highest value added of all economic sectors.

Advanced manufacturing technologies not only have potential to stimulate new business enterprises, such as robotics and information systems, but they are also fundamental to improving the economic prospects of established businesses, whether "high-tech" or "low-tech", because they improve product quality, reduce costs, and increase profits. They represent a primary area of emphasis of national research programs by both NSF (National Science Foundation) and DOD (Department of Defense) because of the critical need to increase the competitiveness of U.S. products in world markets.

University-based programs, such as the Advanced Robotics Research Institute in Fort Worth, manufacturing engineering at Texas A&M and U.T. Austin and emerging research groups at other universities provide effective mechanisms for the State to develop advanced manufacturing technologies as well as the trained engineers and scientists needed to support Texas companies in adapting and profiting from these new technologies. Such university/industry programs are extremely important to the future economic development of Texas, and they should be strongly supported through Legislative appropriations and the encouragement of State leaders.

#### B. Agricultural Research

Texas agriculture has been well supported by research and development aimed at providing technology specifically tailored to the wide-ranging needs of the state. Now, Texas agriculture needs an infusion of new technology to restore its vitality and to allow it to grow and compete successfully in domestic and international markets. This need comes at a time when the potential for providing new technology from the basic biological and computer sciences has never been greater. Opportunity and need meet each other at a critical time for Texas agriculture.

Revolutions in biotechnology and computers, among other innovations, provide major opportunities to use the breakthroughs in science and technology to revitalize production agriculture and related agribusinesses. Texas can also increase its income from agriculture by developing new industries which can add value to raw agricultural products through processing and manufacturing food, textiles, lumber, and other consumer goods. Research in the basic



agricultural sciences is laying the groundwork for advanced technologies that will spawn a new series of high technology industries, adding another dimension to the State's long history of success in agriculture and agribusiness. These industries will emerge with close relationships to the institutions of higher education where agricultural research is being conducted today.

To capture these opportunities, a research agenda has been formulated. The agribusiness and related services that would be generated by the following research initiatives, combined with advantages of more efficient production and increased market share, would boost Texas output by \$9 billion to \$12 billion annually.

To facilitate the emergence of new agricultural industry in Texas and to support existing industry, the Council's Agribusiness Task Force recommends the following action agenda for state government and related institutions of higher education:

- Expand support for agricultural research and extension that develops and transfers critical technology;
- Create incentives for food and fiber processing and new biotechnology industries in Texas;
- Improve efficiency of soil and water resource use;
- Develop new and alternative crops for Texas;
- Develop agro-robotic systems for Texas agriculture;
- Develop a self-sufficient urban agriculture industry;
- Remove economic, regulatory, and institutional barriers to agribusiness;
- Work with industry to improve transportation and marketing of agricultural raw materials and processed products;
- Revise and modernize intrastate transportation laws and regulations; and
- Help rural communities develop new income bases as the structure of Texas agriculture changes.

#### C. Energy Technologies

Texas has been a world leader in oil and gas production, the manufacture and export of oil and gas production equipment and production of related petrochemical products and byproducts.

With the decline in production (since 1972) and the instability and decline in oil prices, Texas has experienced serious economic dislocations which have been felt throughout the State's economy. These events have directly hurt oil production workers, the machine

tool industry, production equipment manufacturers, related service industries, banks and many others.

However, two-thirds of the oil and gas discovered in Texas is still unrecovered. Only with continued research and technology development will the oil and gas industry be able to make that difficult production cost-effective and physically feasible. In addition, we need better, more certain and thus, less expensive ways of finding oil and gas to enable any revival of our exploration effort.

The Council believes that a concerted, coordinated research program among energy producers would provide the critical mass and the private sector leadership to improve the competitive position of our energy producers. An MCC-like energy research consortium might be formed to conduct this work.

In a related field, a specific market-driven research strategy needs to be pursued to support the chemical and petrochemical industry to improve their ability to develop new, high-value added products, especially small batch and specialty chemicals that are not likely to be produced by foreign competitors. Although materials science and engineering programs are not as strong in Texas universities as they should be to support this important Texas industry, there is a potential for Texas companies to produce more electronics-related chemicals and thus have one key Texas industry increase its sales to another key Texas industry, a benefit to both. Other opportunities for vertical and/or horizontal integration within the energy industry in Texas should be explored.

## VIII. EDUCATION AND TECHNICAL TRAINING

Texas has become a national leader in education reform. The importance of a skilled, adaptable workforce is widely recognized as a keystone of the next Texas economy. Deficiencies in the State's education system have been tackled over the last two years and creative remedies are being put into place.

The Texas Science and Technology Council endorses education reform -- striving for excellence is central to future prosperity -- and congratulates the leaders who have made reform possible.

State leaders and citizens alike should renew their support of kindergarten through twelfth grade (K-12) education reform in Texas, as embodied in House Bill 72, and support efforts to update and upgrade public education to meet the needs of our fast-changing society. They should also support the goals of the Select Committee on Higher Education to improve higher education's funding structure, curriculum and research efforts to meet Texas' long term needs and to achieve excellence.

The Council has identified the following objectives for education in Texas over the balance of this Century:

- o Earn a top 10 national ranking for Texas' primary and secondary education throughout the 1990's.
- o Raise the academic achievement of minorities and females above the national average, with special emphasis on science and engineering interests and involvement.
- o Become the leading state in the nation for gifted and talented education by 1992.
- o Implement performance expectations and incentives (including compensation packages ranked in the 90th percentile nationally) which will attract, retain and inspire quality teaching and research.
- o Implement a delivery system for adult literacy, technical training, and life-long learning that is tailored to meet the particular needs of Texas businesses.

The Council has developed the following recommendations for action for the period 1987-1989 (in priority order):

### #1. Gifted and Talented Education

Much greater attention must be given to gifted and talented education throughout Texas. Gifted and talented students are a

neglected segment in Texas education today. By emphasizing special educational programs for these students, the potential payoff to the state is enormous at only a reasonable investment. The science and technology base of the State will be constructed by its brightest students, yet the 150,000 most intelligent students in Texas are comparatively ignored.

Gifted children are those identified as having unusually high ability intellectually, creatively, physically, or in leadership. Five percent of the population is gifted. Of the 150,000 gifted children in Texas, 27,000 are in some kind of gifted program. However, these programs vary greatly. The majority are taught in regular classrooms where overworked teachers rarely have time to devote to every able student. Gifted students receive little or no attention at the elementary level, while programs at the secondary level consist mainly of advanced placement classes. A gifted student usually does not perform well in a lock-step school routine.

These children are one of Texas' most important resources, yet many do not reach their potential. Many gifted children become so alienated and so bored that they simply turn off at an early age. Without early identification and special programs, they lose interest and hope, and society loses their potential contributions. Approximately one-third of all high school dropouts are gifted and talented.

Funding of Gifted and Talented (G/T) programs in Texas is minimal: \$50 per student in 1985-86, to be increased to \$52 for 1986-87. Ninety percent of G/T programs are for grades 3 through 8.

Specific recommendations of the Council on this subject are:

- a. Mandate that the needs of gifted children be served by every school district. Presently, G/T education is left to the discretion of each school district. Texas is doing a good job of educating its physically and mentally handicapped. Now it must turn its attention to the Gifted and Talented students, one of the state's finest resources.
- b. Allow the G/T student options for flexibility, a choice as to how he or she acquires mastery of skills. He or she should be given high school credit for college courses, approved science center/museum courses, correspondence courses, home study, and testing out of courses, as long as the student shows mastery of skills. A standardized test should be used to prove the student's skill level. However, the test should not be so difficult that no one can pass it, thereby eliminating the need for a G/T program. These flexible options should be available to the student and his/her family, not solely at the discretion of the school as is presently done.
- c. G/T classes should be small classes and should be funded by the State.

- d. G/T programs should be extended down to kindergarten and first grade, for the earliest possible identification of the gifted. This human resource cannot be reclaimed late in the educational experience. Gifted boys are lost by the third grade, and gifted girls are lost by the fifth grade.
- e. State funding for G/T programs should be increased by 50% per student in FY 1988-89.
- f. Funding for the Institute for Teachers of the Disadvantaged Gifted and for the Texas Governor's School should be continued beyond 1987 to provide continuity.
  - An Institute for Teachers of the Disadvantaged Gifted was initiated with four summer institutes around Texas for primary school teachers, training them to identify and teach the gifted. It is funded by Chapter Two funds, with no future beyond 1987).
  - A Texas Governor's School was approved by the State Board of Education on January 11, 1986. The school is a pilot project to serve 100 rising juniors who have participated in state-approved gifted or honors programs at the secondary school level. It is both tuition-free and residential. The first School was held at the University of Texas at Austin from June 22 to July 19, 1986. It is also funded by Chapter Two funds.
- g. A Texas Math and Science High School should be created and local magnet schools should be expanded. There is a special Science High School in San Antonio that is showing great success and there are many other local magnet schools also showing good results.
- h. Require students in colleges of education in Texas state universities and colleges to take courses in G/T education. At present, they are all required to take courses in teaching the handicapped and in special education. Training in identifying and teaching the gifted should be required as well.

These measures require legislation, appropriations and State Board support. Full cost estimates need to be established by the Texas Education Agency (TEA) and the Legislative Budget Board.

## #2. Continuing Education

Shortages of company-specific courses, of courses not for degree credit and of night courses for degree credit are serious problems for those needing continuing education and retraining. Remuneration of university faculty does not offer an incentive for involvement in continuing education and there are insufficient faculty to meet those

special needs. Community colleges and TSTI offer the most flexible arrangements for retraining and less advanced coursework. Continuing education and training for engineers, scientists, and related professionals need to be made widely available, including audio and video courses available in remote locations. A full range of options to use telecommunications more effectively needs serious investigation. Rules and incentives need to be adjusted to encourage universities to offer continuing education convenient to all types of students. Corporate commitments to course development and attendance are crucial to justify substantial faculty staffing changes.

Most continuing education can be run on a self-sustaining basis but policy priority and initial infrastructure investments are needed.

### #3. Technician Training

Technicians trained to a high level of sophistication are a major factor in attracting advanced technology industries, but a severe technician shortage exists now in the State. In order to begin building a state-wide capacity for technician training, a community college or Texas State Technical Institute (TSTI) campus in each of the State's five largest metropolitan areas should be designated to develop and promote advanced technical training. These advanced technical training programs should be funded with matching state and private-sector dollars and should have a capacity for coordinating customized job training. With additional support and coordination, Texas will have one of the strongest technical training programs in the nation.

In addition, vocational training through the community college system and TSTI System in rural and smaller urban areas merits additional emphasis. Application of new technologies to industry in the Valley, Panhandle, and the East and West Texas regions is vital for the health of the state's economy. Short-term programs and two-year colleges are the best entities for disseminating these technologies.

Image appears to be a reason that more Texans do not seek technical training. A special campaign should be launched to build the image and understanding of technical training and subsequent job opportunities.

### #4. Technology Education

Technology education in the public schools of the state should be enhanced. The industrial arts profession has recently recommended to the Texas Education Agency and the State Board of Education that the large high school industrial arts program in the State be upgraded to technology education. They recommend changing from industrial arts to technology education for grades 9-12 to fit with the new technology education curriculum for 7th-9th grade. The Council concurs. The technology education continuum from 7th-12th grade will cover state-of-the-art technology in areas such as computer-aided drafting (CAD), robotics, computer numerical control, lasers, fiber optics, and computer integrated manufacturing. The curriculum will provide

students an excellent opportunity to test in the laboratory science and math concepts learned in their academic classes.

This change can be implemented by the State Board of Education without legislation. Technology Education should be funded through the vocational foundation school program with no new revenues required except \$5 million dollars statewide for laboratory equipment purchases.

#### #5. Women and Minorities in Science and Engineering

Greater efforts are needed to increase the number of students taking advanced science and math courses in high school. However, special state effort is required to increase the number of women and minorities entering professional fields in science, mathematics and engineering. A smaller percentage of girls participate in higher level science and math courses than boys, and girls get lower SAT scores in science and math areas than boys, despite entering school with high math aptitude. The major impediment to girls' participation in science and math areas is a lack of encouragement and attention from parents, teachers and counselors. A similar situation exists for minority students who need encouragement to take advanced courses. Both are currently underrepresented in advanced courses, even though demographic projections show that the state will be dependent upon these groups in the future.

Special programs are especially needed to encourage girls and minority pupils -- male and female -- in primary grades to take science and mathematics courses throughout grades 9-12. The Texas Education Agency should develop state-wide strategies for this purpose. Scholarship programs in two and four-year institutions of higher learning will further encourage them to enter the science and engineering professions. Private sector initiatives may be especially effective in meeting these needs. For instance:

- (a) The proposed Engineering and Applied Science Recruitment Fund should be created which would publicly match private donations made to the fund in the previous biennium. The fund would be used to encourage girls and minorities to pursue college degrees in science and engineering fields.
- (b) Guidance counselors should receive training in assisting girls and minorities to improve their self-image. Counselors must also encourage them to remain in math courses beyond Algebra II, to take Trigonometry and Calculus, and to take some form of chemistry, biology and physics.
- (c) Women and minority engineers, mathematicians and scientists should visit elementary and junior high schools as both role models and speakers. Field trips for students to visit work sites would help them learn about math and science related career options.

- (d) The PREP Program in San Antonio and Texas Alliance for Minorities in Engineering (TAME) are existing examples of private partnership programs to further science, engineering and math education in Texas for minorities which deserve continued support.

#### #6. Science and Mathematics Education

(a) The quality of K-12 science, mathematics, and technology education should be further upgraded. This will require involvement of teachers, local community leaders, school board members, university personnel, and parents. New teaching methods, especially those involving computer-aided instruction, are a priority as are new teacher training techniques for math/science education. All teachers should earn their degrees in academic disciplines, including the sciences, before certification to practice in the classroom is awarded.

(b) Market forces are such that industry will actively recruit individuals with science, math and engineering bachelor degrees. To compete for quality teachers in these subjects, schools should provide higher pay to science and math teachers.

(c) Two primary problems have created a critical need to improve teacher education programs for science and math teachers -- a severe shortage of teachers certified in science and math and a lack of training to deal with the new curriculum requirements. Continuing education programs for science and math teachers are needed to update them on techniques, equipment, advances in science, etc. The private sector should take an active role by providing summer programs for teachers, providing expertise and equipment and even providing volunteers or exchange employees to teach on a substitute, part-time or full-time loan basis. The Council endorses the Texas Alliance for Science, Technology and Mathematics Education, a public/private partnership to foster cooperation across the state by acting as a clearinghouse for local Alliance activities such as a teachers' summer work project and teacher-scientist partnerships.

(d) Although the minimum science and mathematics requirements mandated in the recent education reforms are strongly supported by the Council, provisions should be made to encourage students to go beyond the minimum. To help promote this and find ways to advance local science and mathematics education generally, local area task forces of mathematic, science, and technology experts should be convened to advise school boards on regional needs. Quality programs in science, mathematics, and technology education should be fostered by these local groups and the Texas Education Agency.

(e) Examples of corporate sponsored efforts are Tandy's and Tracor's programs to honor top science and math students and teachers, and corporate participation in the Adopt-a-School program. By providing incentives in a very public arena, such programs can educate the public to the importance of science and math and encourage community



support for those subjects. Parental support of students' course choices and performance is a key reason to find a way to involve parents. Science museums also have provided programs for teacher in-service training as well as for students.

(f) Students deficient in necessary science and math skills need to be identified before they sign up for college courses. The Coordinating Board has recommended that college entrance testing in reading, writing, and math be implemented at the time of college acceptance or registration. The Council also recommends testing in science. Such testing may become an incentive to students to take more high school science and math courses.

Recommendations 6 a,b,c and f require legislation which should be enacted no later than 1989 and b should be passed this session. Specific cost estimates are needed from TEA and the Coordinating Board (eg., recommendation 6f is estimated to cost \$2 million per year). Costs for higher pay for science teachers should be shared between the State and local districts. Avenues for the private sector to provide salary supplements to teachers should be allowed.

## IX. PROGRESS THROUGH 2000 A.D.

IF Texans make the hard choices required of them in the 1980's, Texas will be a prosperous state taking a leadership role in domestic and international affairs by the year 2000, a bellwether state where innovative ideas are given a fair test in an atmosphere of true public/private partnership.

The Texas Science and Technology Council commends the priority actions listed in this report to the governmental, academic, and industrial/business leaders of the State. These actions compose a critically needed strategic plan upon which the new Texas economy can be constructed. If enacted, the plan will place Texas at the forefront of technological innovation in the U.S. and the world. This will, in turn, make the Texas economy extremely competitive in world markets -- a most desirable position for the State's prosperity.

In addition, future Texas economic development policies and strategies must incorporate and compliment the State's science and technology policies (and vice versa). There must be an effective, well-directed, innovative, aggressive economic development agency in Texas. The State must also establish international research and trade linkages which will provide the infrastructure and network necessary for Texans to compete in a global marketplace.

The specifics of what we must do during the 1990's cannot be spelled out more specifically at this time. Those recommendations not achieved in the next five years must be implemented by 1995. Many of the specific recommendations outlined in this report already have been drafted into legislation. Budget constraints in 1987 and for FY 88-89 are severe, but immediate investments in our future are essential if we are to forestall future revenue shortfalls due to continued economic decline.

The planning process started by the Texas Science and Technology Council must become a continuous process, annually monitored, adjusted and updated to take advantage of new opportunities, ideas, challenges, and evolutions in the Texas economy. As Texas gets closer to 1990, specific steps needed in that decade can be more clearly designed. Until then, all currently recommended actions should contribute to the goal of building and balancing Texas' economy.

These initial efforts combined with actions taken in the 1990's will shape the Texas economy for decades to come.

\* \* \* \*

APPENDIX A: Texas Science and Technology Council

THE STATE OF TEXAS  
EXECUTIVE DEPARTMENT  
OFFICE OF THE GOVERNOR  
AUSTIN, TEXAS

June 21, 1984

EXECUTIVE ORDER  
MW- 24

ESTABLISHING THE TEXAS SCIENCE AND TECHNOLOGY COUNCIL.

WHEREAS, creation of new industries from emerging technologies and improvement of traditional technologies will improve employment opportunities in Texas; and

WHEREAS, Texas has strong research capabilities in many colleges and universities around the State; and

WHEREAS, Texas is the headquarters of the Microelectronics and Computer Technology Corporation and a national leader in the field of microelectronics and computer technology; and

WHEREAS, Texas should take a leading position in the nation in fostering research and development and advanced technology development; and

WHEREAS, Texas ranks tenth in total research and development expenditures in the United States but third in total population; and

WHEREAS, there is an identified need for the State to focus on research and development and technology transfer and to develop State policies to foster this development; and

WHEREAS, Texas can only achieve a position of preeminence if there is an active partnership among government, academia, and the private sector;

NOW, THEREFORE, I, Mark White, Governor of Texas, under the authority vested in me, do hereby create and establish the Texas Science and Technology Council, hereafter referred to as the COUNCIL.

The COUNCIL will consist of not more than thirty (30) members appointed by the Governor who shall serve two year terms and at the pleasure of the Governor. The Governor shall designate a Chairman from the membership who shall serve in that position at the pleasure of the Governor.

The COUNCIL may create working committees.

The COUNCIL shall research, develop and report to the Governor the means available to the State of Texas to become a national leader in science and technology development.

It may do this by:

1. Reviewing and recommending policies that would increase, in absolute terms, the amount of basic and applied research conducted at state colleges and universities and in the private sector;
2. Analyzing and proposing State policies and actions that promote technology development and technology transfer;
3. Reviewing educational support systems in primary, secondary, and higher education including teacher training, curriculum, and incentive for public/private interchanges;
4. Proposing and analyzing State policies that promote ready availability and accessibility of venture capital;

5. Recommending policies for university ventures which are potentially self-sustaining;
6. Reviewing and recommending mechanism for direct State investment in high technology development; and
7. Studying and making recommendations on any other issues which directly pertain to improving the State's competitive position in the areas of science, research and development and technology development.

The COUNCIL shall meet at least once each quarter. The Chairman, with the advice of the Governor, shall establish the agenda for the COUNCIL meetings. The COUNCIL shall provide a written report to the Governor semi-annually and shall provide recommendations for legislative action to the Governor by November, 1984.

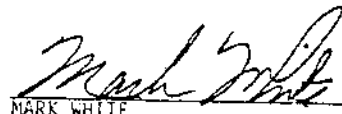
The members of the COUNCIL shall serve without compensation but may be reimbursed for reasonable and necessary expenses incurred in the performance of their duties.

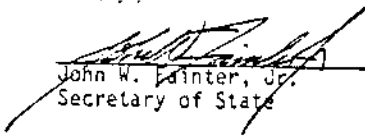
The Governor's Office shall be responsible for providing staff support as necessary for the COUNCIL and also for directing the staff activities.

This executive order shall be effective immediately and shall remain in effect until modified, amended or rescinded by me.

Given under my hand this 21st day of  
June, 1984.



  
MARK WHITE  
Governor of Texas

  
John W. Painter, Jr.  
Secretary of State

Filed in the Office of  
Secretary of State

JUN 26 1984

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\* Arthur Hansen, former Chancellor  
of A&M served from 9/84-7/86

Bob Kirk, former CEO of LTV  
served from 9/84-9/85



