DEVELOPING TEXAS' TECHNOLOGY-BASED ECONOMY

Report of the Texas Science and Technology Council

April 1998

April 30, 1998

Dear Governor Bush,

The Texas Science and Technology Council is pleased to deliver to you this repo
Texas' growing technology-based economy and recommending ways to strengthe
leader in creating high-tech jobs. The report demonstrates that technology is the sta
that we must address future workforce challenges to continue to grow.

Workforce issues are the most serious problem facing Texas' technology industries. While technology is the economic force driving the state's economy, more technology workers are needed in order for our economy to continue to grow. The state currently faces a workforce shortage and a skills gap that will undermine our economic and technological competitiveness unless our state adopts programs to address this need.

Therefore, the Committee recommends that government, industry, and educators build a consensus to endorse and implement two important programs:

- The Texas Advanced Placement Incentive Program: Texas' existing AP Incentive Program has increased the number of high school students proficient in math and science. This successful program should be expanded to every high school in Texas and should offer more incentives to teachers to train in AP curriculum and to students to take and pass these college-level courses.

- Texas High-Technology Curriculum for Community Colleges: Texas' community colleges must play a vital role in training and educating the workers of tomorrow. Model programs exist in several Texas community colleges that emphasize basic math, science, and interpersonal skills, along with industry-tailored courses for technology industries. These programs should be expanded and implemented across the state.

In addition to workforce issues, we must be proactive and take other steps for Texas to remain the fastest-growing technology state in the U.S. These steps include the following:

- Increase funding for the Advanced Research Program and Advanced Technology Program (ARP/ATP). The Texas Legislature created these highly successful programs in 1985 to encourage new basic research in our universities. Funding has remained constant since 1985 at $60 million per biennium. Program funding should be increased to $90 million to keep pace with inflation. New appropriations should be earmarked for applied research projects that collaborate with private industry efforts and the development of a matching program administered by universities.

- Adopt a franchise tax credit for research and development activities. The Texas Legislature should adopt a franchise tax credit for companies involved in research and development activities in Texas. Texas' competitiveness in attracting and retaining advanced technology-based industries would be enhanced by offering this credit. The franchise tax credit will also encourage the development of new technologies, generating more high-tech jobs.

- Establish the Texas Institute of Science and Technology. While numerous organizations in Texas have promoted science and technology development over the past decades, none has developed into a long-term, sustainable organization. A new entity would provide leadership, advice, and direction to the Legislature, and could identify, support, and promote technology-based opportunities for Texas. This entity should be privately funded but encouraged by the state.

- Develop a statewide information and marketing campaign. A marketing campaign could encourage more Texans to enter the technology workforce. This campaign could target communities not well represented in the high-tech workforce, in particular African-Americans, Hispanics, and people with disabilities.

Respectfully,

Vin Prothro
Vin Prothro
Chairman

Skip Porter
Skip Porter
Vice-Chairman

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TEXAS SCIENCE AND TECHNOLOGY COUNCIL

MEMBERS OF THE TEXAS SCIENCE AND TECHNOLOGY COUNCIL

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Executive Director
Texas Department of Commerce

Mr. Padget Alves
Vice President
Sprint Corporation

Mr. Roger James Benavides
Vice-President and CFO
Contemporary Constructors, Inc.

Dr. James Laurence Caldwell
Advisory Engineer
International Business Machines (IBM)

Ms. Nancy Chang
President & CEO
Tanox Biosystems

Dr. Paul Ching-Wu Chu
Director, Texas Center for Superconductivity
The University of Houston

Ms. Cynthia Comparin
Division President
ALLTEL

Mr. Terry Conner
Partner
Haynes and Boone, L.L.P.

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DSC Communications Corporation

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President, Information Systems Division
Operational Technologies Corporation

Dr. Marye Anne Fox
Vice President for Research
The University of Texas at Austin

Dr. Brendan B. Godfrey
Director
Armstrong Laboratory

Dr. C. Roland Haden
Vice Chancellor & Dean of Engineering
Engineering Program
Texas A&M University System

Mr. Bill Hammond
Chairman, Texas Workforce Commission

Mr. William J. Huffstetler
Business Development Director
Lockheed Martin Corporation

Dr. Franklyn G. Jenifer
President
The University of Texas at Dallas

George Kozmetsky, DCS
Chairman, IC2 Institute
The University of Texas at Austin

Mr. L. Lowry Mays
President/CEO
Clear Channel Communications

Dr. Gary D. McCaleb
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Vice President, Abilene Christian University

Mr. William Bruce Mitchell
Vice Chairman
Texas Instruments (retired)

Mr. Dave Perdue
Commissioner
Texas Workforce Commission

Dr. W. Arthur Porter
President
Houston Advanced Research Center (HARC)

Mr. Charles Vincent Prothro
Chairman of the Board and CEO
Dallas Semiconductor Corporation

Mr. Ron Robinson
President and CEO
Texaco Technologies

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President & CEO
Southwestern Bell Technology Resources

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Sr. Vice President
Technology & Corporate Development
Compaq Computer Corporation

Mr. Van H. Taylor
President & CEO
Southwestern Bell Technology Resources

Mr. Danny Lee Vickers
President/Founder
EDM International

Dr. Paul Ray Vaughn
Professor and Chairman
Dept. of Agricultural Education & Communications
Texas Tech University

Staff:
Jim Glotfelty
Governor's Policy Office

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Many Texans assisted the project by testifying before the Council, reviewing the draft recommendations, providing advice and assistance, and supporting the ongoing efforts to successfully complete the Report.

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We extend our sincere thanks to all of the participants in the meetings and activities that were essential to the formulation of the recommendations in this Report. We also hope that they will stay involved in the Council's implementation projects.

INTRODUCTION

On September 19, 1996, Governor George W. Bush created the Texas Science and Technology Council. Governor Bush requested that the Council review Texas' science and technology industries, determine what barriers inhibit their growth, and recommend ways to overcome those barriers. In announcing the Council's creation, Governor Bush stated:

> The Science and Technology Council will develop a long-term plan for science and technology development in the Lone Star State. Science and technology businesses will generate much of America's economic growth and job creation in the coming years. The Council will provide a forum for ideas to enable Texas to become the national leader in science and technology research, development, and product creation.

The Council is composed of 26 of the state's leading chief executive officers, university and government officials. The diversity of the membership provides the Council with a broad understanding of issues facing our state.

During the past year, the Council has examined many issues related to the state's competitive position in science and technology-based industries. This Report describes the Council's conclusion that workforce issues are the largest barrier to continuing the economic growth of Texas' technology-based economy.

EXECUTIVE SUMMARY

BACKGROUND AND FINDINGS

Technology Has Transformed Texas' Economy

Technology has created new industries for Texas and stimulated the growth of existing ones. Many of the state's traditional industries—agriculture, chemicals, and petroleum—today depend heavily on technology. Technology is the economic force driving much of Texas' current wealth and job creation. In fact, Texas is outperforming the national economy and leads the nation in high-tech employment.

We define high technology as: 1) industries that create high-tech goods and services, and 2) industries that apply technology to create other goods and services. Core high-tech industries include computer manufacturing, software development, information services, telecommunications, biotechnology, petroleum engineering, and aerospace.

Texas Leads The Nation In High-Tech Employment

Our state's technology-related industries have been growing at about twice the rate of the Texas economy as a whole. According to the American Electronics Association's recently published "Cyberstates" report, Texas is the nation's second largest employer in computer, microelectronics, and telecommunications industries, second only to California. Technology is spread out all over the state in Dallas/Fort Worth, Austin, Houston, San Antonio, Lubbock, and El Paso.

Further, Texas' high-tech employment growth is accelerating. In 1996 alone, Texas added almost 39,000 new high-tech jobs, more than in the five years between 1991 and 1995.

A Skilled High-Tech Workforce: The Future Of Texas

Texas' economic future is clearly tied to the continued growth of high-tech industry. However, the Science and Technology Council has become increasingly concerned that the technology sector will not be able to sustain its growth rate due to an increasing workforce shortage. Industry needs for skilled, high-tech workers are growing faster than our state's workforce pool.

A study conducted by the George Bush School of Government and Public Service at Texas A&M showed that Texas companies believe that workforce issues are the state's most significant barrier to future growith. The study found that:

- Texas faces a growing workforce shortage. Over 60 percent of the companies surveyed had unfilled technology jobs.
- Texas' workforce has skills deficiencies. Over 90 percent of companies identified some skill gap in their current high-tech workforce.

Industry requirements for skilled technology workers are clearly growing faster than our state's workforce pool. The Council believes that Texas currently has between 26,000 and 34,000 technology-related job vacancies. Moreover, projections show that the state will need to fill over 130,000 new positions in the technology workforce by the year 2000.

The Root of the Problem: The Education and Training of Texas' High-Tech Workforce

Strong math and science skills are the foundation for high-technology jobs. Texas schools are not producing sufficient numbers of high school graduates with adequate science and math skills. The National Assessment of Educational Progress (NAEP) mathematics results show that Texas ranks under the national averages for math, with 47 percent of Texas 8th graders scoring below basic achievement levels. Results from the Texas Assessment of Academic Skills (TAAS) tests confirm these national results. These studies show that students lose interest and under-perform in math and science in junior and senior high school.

The less interested that high school students become in math and science, the less likely those same students will be to pursue college degrees in related fields. It is no surprise, then, that between 1992 and 1996, the number of bachelor's degrees in engineering and computer science awarded by Texas universities remained flat while job demand increased.

COUNCIL RECOMMENDATIONS

Low student performance statistics, the lack of interest in science and math in our state's junior and senior high schools, and flat graduation rates for university science degrees have combined to create constraints on the workforce available to support Texas' technology industry.

To address these problems, the state must adopt programs to better train and educate workers and to encourage more Texans to enter the technology workforce. The Council recommends two highly successful programs to meet the state's workforce development challenge:

- Implement a statewide, incentive-based Advanced Placement (AP) program in every Texas high school. The AP Incentive Program will increase the number of high school graduates with math and science skills.
- Adopt the Texas High-Technology Curriculum in all of Texas' community colleges. Using an industry-created curriculum, this training program will help to increase the number of qualified high-tech workers.

RECOMMENDATION #1: ADVANCED PLACEMENT: CREATING THE MATH- AND SCIENCE-LITERATE STUDENTS NEEDED FOR THE HIGH-TECH WORKFORCE

Advanced Placement consists of voluntary, college-level courses taught in high school. The College Board in New York administers AP. The AP curriculum is local; the AP exam is national, pegged to high academic standards with measurable results. Students scoring at least a 3 out of a possible 5 on national AP exams receive credit at more than 2,900 universities in the United States.

Texas currently has a modest, though very successful, AP Incentive Program in place. This program has already made a difference in improving the proficiency levels of high school students. In 1997, over 34,000 Texas high school graduates passed at least one AP exam.

The Council's proposed AP Incentive Program seeks to triple the number of AP exams in math, science or English with passing scores in five years. In 1997, Texas high school students passed 34,000 AP math, science and English exams. The Council recommends that the state establish a goal for 2002 of increasing the number to 100,000. In support of this goal, the Council also proposes to increase the number of AP math and science teachers from 2,500 to 10,000 by the year 2002. Further, the number of school districts offering AP courses must be increased from the current level of approximately 50 percent to 100 percent, to include all districts and high schools.

AP Incentive Programs

The goal of an AP Incentive Program is to increase dramatically the number of students taking and passing AP exams by offering monetary incentives at three levels: the teacher, the student, and the school. The essential elements of a successful AP Incentive Program are:

- Training, support, and incentives for teachers. The College Board provides outstanding teacher training, and incentives provide extra pay for extra work. AP teachers also teach non-AP classes, which improves the level of instruction in an entire school.
- A system of incentives for students to take and pass AP exams.
- Pre-AP courses starting in the 7th grade to assure that students will be ready for the more demanding high school courses. Vertical team teachers give students the early training they need to take the more difficult high school courses.
- Support and incentives for schools to build strong AP programs.

A model AP Incentive Program is being successfully deployed in the Dallas Independent School District (DISD), the country's eighth largest school district with an 88 percent minority enrollment. The DISD offers AP courses in English, Calculus, Statistics, Computer Science, Biology, Chemistry, and Physics. In nine of the district's high schools, the AP incentive program reached 17 percent--3,000--of all juniors and seniors, quadrupled passing scores, and dramatically raised the number of women, African-American, and Hispanic students passing AP tests.

AP Recommendations

In 1993, the Texas Legislature adopted an AP program similar to the DISD program in many essentials, called the Texas AP Incentive Program, that has not yet been funded. The Council strongly recommends that the state fund that program now. The cost of the program is small in comparison with the $172 million Texas appropriated in the current biennium to pay for remedial courses for students in community colleges and four-year universities. A statewide AP Incentive Program in math, science and English will prepare students to do college-level work and save the state money by reducing the need to fund expensive remedial courses.

RECOMMENDATION #2: COMMUNITY COLLEGE HIGH-TECH TRAINING PROGRAMS

Community colleges nationwide and in the state of Texas have assumed the obligation to train a large part of the workforce. Texas community colleges are well-suited to new high-tech training programs for the following reasons:

- They are easily accessible to almost everyone.
- They already enroll a major percentage of Texas' higher education students.
- They reflect the ethnic diversity of Texas, enrolling 55 percent of all minority students.
- They are already heavily involved in workforce training.
- They are committed to expanding distance education.

The Council recommends that Texas community colleges, in collaboration with technology-based businesses, adopt a statewide basic technology curriculum. Community college/industry collaboration has led to successful model programs in many areas of the state. These programs outline and identify the basic skills needed by technology companies, with some courses tailored to the needs of specific industries.

Developing and Implementing High-Technology Training Programs at Community Colleges

Experience implementing such programs in Texas colleges has shown that to develop a successful program, six fundamental areas must be addressed. The most important of these is curriculum. In order to effect a real technology workforce development initiative in the state, it is essential to impact the curriculum in the college. In existing, successful programs, 80 percent of the courses are common across disciplines, including communications, interpersonal skills, math, and technical topics. The remaining 20 percent are specialty curricula/degree programs developed by each community college according to the industries prevalent in that region of the state.

Additional areas to be addressed in implementing community college training programs include faculty training, laboratories, enrollment, student retention, and job placement.

The Science and Technology Council recommends that Texas community colleges statewide adopt the Texas High-Technology Curriculum, with 80 percent of the courses being common across colleges and disciplines, and 20 percent being regionally adapted to meet local needs. Courses in the Texas High-Technology Curriculum should be transferable among all community colleges in the state.

ADDITIONAL RECOMMENDATIONS TO SUPPORT WORKFORCE DEVELOPMENT GOALS

The Council recommends the following to support the AP and Technology Curriculum programs above and to ensure Texas' continued high-tech leadership and economic growth:

- Increase funding for the Advanced Research Program and Advanced Technology Program (ARP/ATP). The Council recommends this program be appropriated $90 million per biennium to foster the continued promotion of advanced research in Texas' universities. This program, created in 1985, is highly recognized and has been extremely successful. The funding level for this program has remained constant since the original 1985 appropriation. We recommend a portion of the new funding be allocated to institutions for matching money to encourage participation in research sponsored by the private sector and the federal government, and the remaining funds be used to increase the dollars in the ATP/ARP programs for basic research.

- Establish the Texas Institute of Science and Technology. While numerous organizations in Texas have promoted science and technology development over the past decades, none has developed into a long-term, sustainable organization. A new entity would provide leadership, advice, and direction to the Governor and the Legislature and could identify, support, and promote technology-based opportunities for Texas. This entity should be privately funded but should work closely with state government institutions.

- Adopt a franchise tax credit for research and development activities. The Texas Legislature should adopt a franchise tax credit for companies involved in research and development activities in Texas. Texas' competitiveness in attracting and retaining advanced technology-based industries would be enhanced by such a credit. The credit will also spur the development of new technologies, new products, and new jobs.

- Develop a statewide information and marketing campaign. A marketing campaign could encourage more Texans to enter the technology workforce. This campaign could target communities not well represented in the high-tech workforce, such as African-Americans, Hispanics, and people with disabilities.

SUMMARY

These programs—essential if Texas is to remain a high-technology leader in the nation and the world—should be implemented through regional partnerships between government agencies, businesses, educational institutions, and private foundations. Most major urban areas already have such partnerships that can expand to other regions of the state and become the backbone for implementing the Council's recommendations.

In addition, the Council recognizes that other programs and solutions are being proposed and implemented by educational institutions and organizations. We fully support these other programs. The state will not succeed in meeting our workforce needs with one program. Each idea implemented has a place in making our high-technology future strong.

PART 1: BACKGROUND

FROM COWBOYS TO COMPUTERS: TECHNOLOGY HAS TRANSFORMED TEXAS' ECONOMY

"Historically, Texas has been known for its cowboys, oil barons, and real estate tycoons. But in recent years, the state's image has changed. Texas is now regarded as home to computer wizards and technical engineers."

—Federal Reserve Bank of Dallas

Texas has always been on the leading edge of developing industries. Just as the discovery of oil at Spindletop changed our state earlier this century, the technology revolution has transformed Texas in the last decade.

Technology has created new industries and stimulated the growth of existing ones. While the tractor and the oil well provided yesterday's tools to leverage our natural resources, computers, telecommunications, and other technologies provide today's means to develop high-tech products and services.

Texas' traditional industries—agriculture, chemicals, and petroleum—use technology to create new products and services and to reinvent existing ones. Texas' new growth industries—computers, semiconductors, telecommunications, computer-related services, multimedia, and software development—are all technology driven.

Technology is the economic force driving much of Texas' current wealth and job creation. This section shows how technology has stimulated economic growth in every part of the state and has helped to revive the Texas economy.

What is High Technology?

This report uses a well-accepted, two-part definition to describe technology in Texas' economy:

Industries that create high-tech goods and services. This category includes companies in electronics manufacturing, software development, computer-related services, and telecommunications. The American Electronics Association's recent "Cyberstates" report, which focuses on this category, concludes that Texas is the nation's fastest growing state in these core technology industries.

Industries that apply technology to create other goods and services. This category includes companies that apply technology in industries such as oil exploration, chemicals, and agricultural processing. These industries all rely heavily on technology-driven research and development activities to create new goods and services.

CREATING NEW INDUSTRIES—CHANGING EXISTING ONES

The diversity of Texas' economy gives our state's technology sector a unique character. Texas' energy sector remains the state's chief technology industry. The state's computer and semiconductor manufacturing industries have achieved new levels of pre-eminence during the last 10 years. Texas is becoming increasingly specialized in software development and high-tech services, which represent the state's next growth opportunity. This section reviews five of the state's key technology sectors.

Energy

As our natural endowments of oil and gas decline, technology has been the key reason for the state's growth in the energy and chemicals industry and why Texas maintains world-class status in oil and gas exploration and production.

Horizontal drilling, 3-D seismic imaging technology, global positioning satellites, and high-powered workstations have combined to provide energy producers with a new arsenal of oil-finding tools. These technologies have increased the industry's proven reserves, lowered finding costs, and raised exploration success rates, allowing companies to thrive even at today's lower prices.

Electronics Manufacturing

Texas was the birthplace of the integrated circuit, the invention that triggered the computer revolution. From this strong beginning, Texas has become a world leader in electronics manufacturing. The state is home to two top computer manufacturers, Compaq and Dell, and to top semiconductor companies including Texas Instruments and Cyrix. Texas hosts facilities for many leading semiconductor companies, such as AMD, Motorola, National Semiconductor and Samsung, and for telecommunications manufacturers, such as AT&T, Nokia, Nortel, and Siemens. All of these companies and their spin-offs and suppliers add to the strength of this sector.

Texas' Dynamic High-Tech Manufacturing Sector

A recent Texas Department of Commerce study shows Texas' pre-eminence in high-tech manufacturing:

- Texas accounts for 1 in every 10 microelectronics manufacturing jobs in the U.S.
- Texas is a leading producer of semiconductors and other microelectronics.
- Texas is a world leader in major semiconductor plant expansions and construction.
- Texas is the second-largest U.S. employer in telecommunications equipment manufacturing, employing over 22,500 workers.

Software and Services

The software and services sector has grown the fastest of all Texas' technology sectors. It will also make the biggest future contribution to the state's economic well being. Texas is home to pioneers in computer services, such as Electronic Data Systems, and in telecommunications, such as Southwestern Bell, GTE, and PCS Prime Co.

Texas is also a hotbed for developing small entrepreneurial software and multimedia companies. I2, SMART Technologies, Tivoli, Trilogy and pcOrder.com are at the leading edge of the Internet and electronic commerce revolution.

Biotechnology

Biomedical research from academic institutions and technology firms will make biotechnology a strong Texas-based industry in the 21st century.

Texas already has a significant biotechnology presence. With 55 medical research institutions and over 100 young biotechnology companies, Texas is poised to take advantage of the opportunities that will arise through the rapid advancements in biological research. These opportunities will lead to better treatments for patients and to new agricultural and environmental applications that will improve our quality of life.

Agriculture

Texas farms increasingly rely on technology to produce crops and to improve farm life. Global Positioning Systems now allow crop dusters to more efficiently spray pesticides. These systems also have revolutionized the survey process by helping farmers to level fields and build levees. Tractors now use radar to measure their speed and help ensure that chemicals are applied evenly.

TEXAS' REGIONAL TECHNOLOGY CLUSTERS

Texas has many regional technology clusters. These clusters are groups of companies that depend on one another to compete effectively in national and global markets.

Technology clusters, primarily in major metropolitan areas, consist of buyers and suppliers who constantly help each other expand, competitors who seek common financial and infrastructure support, and a local infrastructure—such as a chamber of commerce—that facilitates communications among companies and strives to develop common solutions to problems.

Clustering generates many benefits by allowing regions to identify and help industries excel. It allows economic development organizations facing intensive resource and personnel demands to target key industries.

These clusters exist all over the state. Richardson's Telecommunications Corridor is home to over 550 software and telecommunications companies. Austin has developed strong clusters in software, multimedia, and semiconductors. Houston has energy and biotechnology clusters. Ft. Worth has defense and aerospace industries. The South Texas border has telecommunications and electronics manufacturing. San Antonio is developing telecommunications and biotechnology clusters.

TEXAS' TECHNOLOGY EMPLOYMENT AND GROWTH

Texas' exploding technology employment growth is making Texas as important a technology state as California and Massachusetts—states traditionally viewed as technology leaders.

Technology employment has risen from 696,000 in 1990 to more than 772,000. The relative size of Texas' technology workforce, over 11 percent, is now comparable to California's 12.7 percent.

According to the American Electronics Association (AEA), Texas is the nation's second largest employer in computer manufacturing, semiconductors, software, and telecommunications. The AEA calculates that more than 340,000 of the state's 772,000 technology workers are employed by such companies.

Texas Leads the Nation in Technology Employment Growth

Texas has led the nation in technology employment growth for the last decade. Technology-based industries added over 76,000 net new jobs to the Texas payroll between 1990 and 1996, more than a 9 percent increase. During this same time period, California, New York, and Massachusetts lost a combined total of over 233,000 high-tech jobs.

Furthermore, Texas' high-tech employment growth appears to be accelerating. In 1996 alone, Texas added almost 39,000 new high-tech jobs. This is more than the total number of high-tech jobs created in the five years between 1991 and 1995. Texas technology employment growth in 1996 also exceeded the one-year totals in California, Massachusetts, and New York, continuing Texas' lead over the other major high-tech states in producing new technology jobs.

Shifts in Texas' Technology Employment

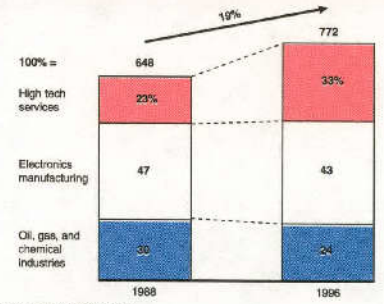
The composition of Texas' technology-based workforce is changing. While the energy industry remains the base for Texas' technology employment, electronics manufacturing and services account for all of the growth. While the oil, gas, and chemical industries still account for about 24 percent of Texas' high-tech jobs, employment in these industries has fallen from 194,000 in 1988 to 185,000 in 1996.

The growth of high-tech manufacturing and services jobs in Texas indicates the increasing importance of these sectors to the future of the state's economy. Employment in electronics manufacturing increased 8.9 percent from 303,000 in 1988 to 332,000 in 1996. Texas' high-tech services sector has undergone tremendous growth, adding over 100,000 new jobs during the same time period, a 68 percent increase (Exhibit 1).

This explosive growth has significantly altered the distribution of jobs in Texas' high-tech economy. In 1996, electronics manufacturing constituted 43 percent of Texas' high-tech employment, down from 47 percent in 1988, while high-tech services grew from 23 to 33 percent.

Exhibit 1

GROWTH AND SHIFTS IN TEXAS' TECHNOLOGY EMPLOYMENT
Thousands of workers



Source: Department of Labor ES-202 data

PART 2: COUNCIL FINDINGS

The Council's review of Texas' technology industry has demonstrated its economic importance to the state. Technology has transformed and revitalized our economy. Our economic future is now tied to continued technology industry growth.

"The high-tech manufacturing industry has realized that the Texas workforce is not adequately educated."

—Jack Swindle
Senior Vice President,
Texas Instruments

Texas faces a growing workforce shortage and skill gap which threaten to undermine continued high-tech growth and economic prosperity. A survey conducted for the Council demonstrates that industry demand for skilled, high-tech workers is growing faster than supply. The Council believes that we must take steps today to address these issues.

TEXAS' HIGH-TECH WORKFORCE SHORTAGE

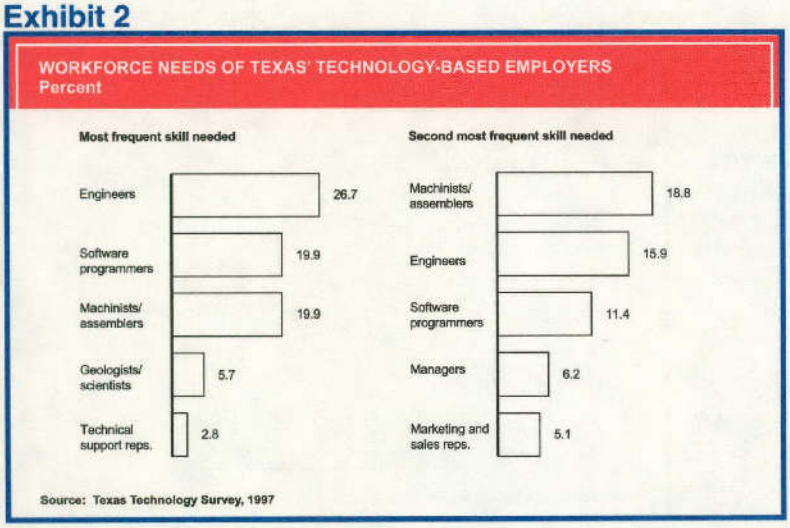
The supply of technology workers in Texas does not satisfy the current demand. In addition, the demand for workers will continue to increase as the global markets for high-tech products and services expand.

Demand for Technology Workers

The tremendous growth in Texas' technology-based economy is driving the increasing demand for technology workers. According to Texas Workforce Commission statistics, Texas' technology workforce will grow from 772,000 to over 900,000 by the year 2000, meaning that the state is projected to add about 130,000 new workers to the technology workforce, a 16 percent increase.

The demand for workers with key technology skills, such as computer scientists and engineers, systems analysts, and computer programmers, will increase rapidly. Recent national studies have projected that the U.S. will need more than one million of these workers by the year 2005. According to Texas Workforce Commission statistics, Texas will need an additional 104,000 of these professionals by the year 2005.

Exhibit 2



Scope of the Problem: The Texas Technology Survey

Industry demand for high-tech employees is already growing faster than the supply of qualified workers.

Recent national studies have shown that employers are having difficulties obtaining qualified technology workers. A study by the Information Technology Association of America found that there are now 346,000 unfilled high-tech jobs in the United States due to a shortage of qualified workers.

The Texas Technology Survey, a study of Texas companies performed by the George Bush School of Government and Public Service at Texas A&M, identified two major problems in Texas' technology workforce:

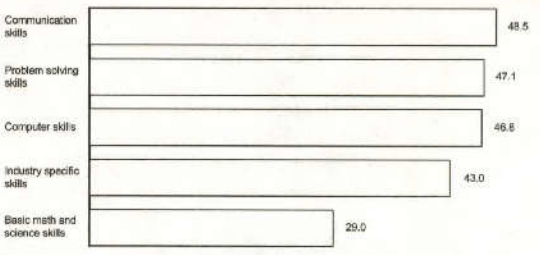
1. Texas faces a growing technology worker shortage.

2. Most companies believe that current employees have skill deficiencies.

The Texas Technology Survey found a growing workforce shortage. Over 60 percent of the companies surveyed had unfilled high-tech jobs. Seventy-three percent lacked 25 or fewer workers, and 6 percent said they lacked more than 100 workers. Based on the Survey, the Council believes that Texas currently has between 26,000 and 34,000 unfilled technology jobs on any given day. The surveyed companies identified engineers, software programmers and machinists/ assemblers as their largest employment needs (Exhibit 2).

Exhibit 3

SKILLS GAPS IN THE HIGH-TECH WORKFORCE
Percent

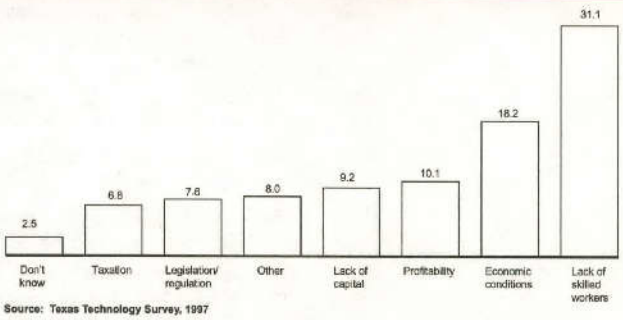


Source: Texas Technology Survey, 1997

The survey also found that Texas workers have significant skill gaps. Over 90 percent of the companies surveyed identified some skill gap in their current workforce. Of those indicating a gap, nearly half stated that their employees lack adequate computer skills, industry-specific skills, problem-solving skills, or communication skills (Exhibit 3).

Exhibit 4

BARRIERS TO GROWTH OVER NEXT 12 MONTHS
Percent



Source: Texas Technology Survey, 1997

TECHNOLOGY WORKFORCE SHORTAGES: A BARRIER TO TEXAS' ECONOMIC GROWTH

The technology workforce shortage is becoming an increasing threat to the state's economic future. The Texas Technology Survey found that the surveyed companies identified a lack of skilled workers as the most significant barrier to future growth. The survey also showed that almost one-third of these companies felt that the workforce shortage negatively impacted the state's economic attractiveness (Exhibit 4).

ROOT OF THE PROBLEM: GAPS IN EDUCATION AND TRAINING OF TEXAS' TECHNOLOGY WORKFORCE

The Council has identified two gaps in the state's education and training system which are contributing to the growing technology workforce shortage:

1. The state is not producing sufficient numbers of high school graduates with adequate science, math, and communication or problem-solving skills. The lack of trained high school graduates decreases the number of students interested in pursuing college-level technology-related degrees or in entering the technology workforce.

2. Texas universities and colleges are not graduating sufficient numbers of students in technology-related fields.

Low K-12 Achievement Levels

Many Texas high school graduates lack the basic skills required to succeed in higher education or in the technology workforce. The National Assessment of Educational Progress (NAEP), a national test of educational performance and student achievement, shows that Texas ranks under the national averages for math, with 41 percent of Texas 8th graders scoring below basic achievement levels and only 21 percent at or above the proficient level.

The NAEP scores also show that Texas ranks below national averages for science. Forty-five percent of Texas 8th graders score below basic achievement levels and only 24 percent are at or above the proficient level.

The results from the Texas Assessment of Academic Skills (TAAS) test confirm these national results. The TAAS mathematics pass rates decline significantly from 5th to 10th grade: 79 percent of Texas' 5th graders pass the TAAS math test, but only 66.5 percent of 10th graders pass the TAAS math exam.

These statistics indicate that Texas students lose interest and underperform in math and science during junior and senior high school. Surveys have shown that only 20 percent of high school sophomores are interested in science and math and only 8 percent are still interested as college freshmen. The less interested high school students become in math and science, the less likely they are to pursue work or college degrees in technology-related fields.

Flat University Graduation Rates In Technology-Related Fields

While Texas' high-tech industry requires an expanded pool of technology-trained graduates, these demands are not being met by Texas universities. While the total number of engineering degrees awarded by Texas colleges and universities rose from 2,891 in 1992 to 3,315 in 1996, the number of bachelor's degrees in electrical engineering and computer science remained flat. Texas universities awarded 1,046 bachelor's degrees in electrical engineering and computer science in 1992 and 1,031 degrees in 1996.

This condition is a result of multiple problems, including student recruitment, retention, and capacity limitations in our schools.

Based on job growth predictions, the Council encourages Texas colleges and universities to triple the number of electrical engineering and computer science graduates over the next decade in order to meet industry demand.

PART 3: RECOMMENDATIONS

"We must meet high-tech industry's workforce needs in order to maintain our position as a world technology leader."

—Governor George W. Bush

The Science and Technology Council recommends that the state create and expand programs that improve education and training in Texas. The Council's recommendations seek to increase the pool of qualified high school students interested in math and science and the number of Texas' qualified technical associate and bachelor degree workers. While there are many avenues to addressing the state's workforce challenge, the Council recommends statewide implementation of two existing, highly successful programs:

- An incentive-based Advanced Placement program will increase the number of high school graduates with strong math and science skills.
- A community college-based, technology training program that uses an industry-created curriculum will increase the number of qualified workers.

Additionally, the Council makes other recommendations aimed at keeping Texas' technology growth strong:

- Increase funding to the state's Advanced Research Program/Advanced Technology Program (ARP/ATP).
- Create the Texas Institute of Science and Technology to continue to track and foster these efforts.
- Adopt a research and development franchise tax credit.
- Develop a statewide technology/workforce information and marketing campaign.

RECOMMENDATION #1: ADVANCED PLACEMENT—CREATING THE MATH- AND SCIENCE-LITERATE STUDENTS NEEDED FOR THE HIGH-TECH WORKFORCE

The Council recommends that the State expand its successful AP Incentive Program Advanced Placement (AP) which consists of voluntary, college-level courses taught in high school. The College Board in New York, which administers AP, offers teacher training and curriculum guides for 31 AP courses, ranging from history and languages to math and the arts. The AP curriculum is local; the AP exam is national, pegged to high academic standards with measurable results. Students scoring at least a 3 out of a possible 5 on national AP exams receive credit at more than 2,900 universities in the United States.

Texas currently has a modest, though very successful, AP Incentive Program in place. During the 1993-94 school year, the number of Texas 11th and 12th grade students taking AP exams lagged behind the U.S. average by 33 percent. Since the inception of the AP Incentive Program in 1994-95, Texas has completely closed the gap. During the 1996-97 year, the number of Texas African-American and Hispanic juniors and seniors taking AP exams was almost double the national number.

Advanced Placement and AP Incentive Programs

The goal of an AP Incentive Program is to increase dramatically the number of students taking and passing AP exams by offering monetary incentives at three levels: the teacher, the student, and the school. The essential elements of a successful AP Incentive Program are:

"A recent analysis by the U.S. Department of Education indicates that high school students who take algebra, geometry, and other rigorous mathematics courses are more likely to go on to college. . . .The key to understanding mathematics is taking algebra or courses covering algebraic concepts by the end of the 8th grade. Achievement at that stage gives students an important advantage in taking rigorous high school mathematics and science courses."

—Richard W. Riley, U.S. Secretary of Education

- Training, support, and incentives for teachers
- A system of incentives for students to take and pass AP exams
- Pre-AP courses starting in the 7th grade to assure that students will be ready for the more demanding high school courses
- Support and incentives for schools to build strong AP programs

The AP Incentive Program increases the number of teachers with advanced skills. Texas currently has a critical shortage of specialized teachers, particularly in science and math. The AP Incentive Program combines the College Board's outstanding teacher training program with monetary incentives for teachers to participate in training. This teacher training program improves the level of instruction in an entire school since AP teachers also teach non-AP classes.

The program establishes "vertical" teaching teams that work together to link courses from 7th to 12th grade. These teams create a curriculum that helps students continually build skills. National studies confirm that many students enter high school without solid basic skills, closing doors very early for further education and better careers.

The Council believes that Texas public schools should begin in the 7th grade to prepare students to graduate from high school with good math, science, and English skills. This will not only benefit the high-tech sector; it will also benefit the state and the economy.

Dallas Public Schools: A Successful Program Model

An AP Incentive Program that has been successfully deployed in the Dallas Independent School District (DISD) provides a model for enhancing the state's existing AP program. The country's eighth largest school district with an 88 percent minority enrollment, the DISD offers AP courses in English, Calculus, Statistics, Computer Science, Biology, Chemistry, and Physics. The DISD program provides an integrated package of incentives for teachers, students, and the school.

Lead Teachers

Lead teachers provide the academic leadership for the DISD's AP Incentive Program. They build the skills and confidence of AP and vertical team teachers; mentor new AP teachers; prepare students for AP exams; and improve the quality of instruction. The Dallas Public Schools recruited outstanding AP teachers in math, science and English as lead teachers. To help the schools compete for the very best, private sources pay each lead teacher an annual stipend of $10,000.

Linking Middle Schools to AP Standards and Expectations: Vertical Teams

Vertical Team Teachers are an essential part of the program if students are to get the early training they need to take the more difficult high school courses. Vertical teams link middle schools to high schools. In math, for example, teachers in grades 7 to 12 work as a team. The team is headed by the AP calculus teacher. Teams create a vertical math curriculum so that in each grade, students are taught the concepts they must master to take AP calculus and pass.

Through Vertical Teams, the high standards of AP are driving curriculum reform down to the lower grades in the Dallas Public Schools. Vertical Teams increase the AP pipeline by giving 7th grade students a clear goal: AP in high school.

"Almost 90 percent of our students are from low-income or Hispanic or African-American families. For years, many had no expectation of going to college. The AP Incentive Program is changing that. Today our students not only have college as a goal, they are taking AP courses to help them do better when they get there."

—John Washington, AP Principal of the Year, H. Grady Spruce High School, Dallas

Program Results

The DISD program costs only $600 per student and yields dramatic results. In nine of the district's high schools, the AP Incentive Program reached 17 percent of all juniors and seniors, quadrupled passing scores, and dramatically raised the number of women, African-American, and Hispanic students taking and passing AP tests. While Texas' existing statewide AP program has brought the state in line with national averages for passed AP exams, the DISD program dramatically improved on those results:

- The program increased the number of students taking AP courses and AP exams; the number of math, science and English AP exams taken increased from 312 in 1995 to 1,750 in 1997. The number of students with passing scores during that time increased from 139 to 559.
- The program increased the number of women taking math, science, and English AP exams from 94 in 1995 to 452 in 1997. The number of female DISD students passing AP exams is 50 percent greater than the national average.
- Minorities benefit from the DISD program. The number of African-American and Hispanic AP students increased from 64 to 734 in the program's second year.

According to Dr. Herbert Walberg, professor at the University of Illinois at Chicago, "[AP] incentives work. More specifically, they work 1) in different kinds of schools, urban, suburban, and rural, 2) in a variety of disciplines, and 3) for different types of students."

The High Cost of Remediation

In the current biennium, Texas appropriated $172 million to pay for remedial courses for students in community colleges and four-year universities. Up to 50 percent of first-time freshmen cannot pass the entrance exam which tests for English and math skills necessary to do college-level work. A statewide AP Incentive Program offers the best solution to this problem. It prepares students to do college-level work and saves the state money by reducing the need to fund expensive remedial courses.

RECOMMENDATIONS FOR TEXAS' AP PROGRAM

The Council proposes to increase AP participation on three levels: the student, the faculty, and the high schools:

- The Council's proposed AP Incentive Program seeks to triple the number of AP exams in math, science or English with passing scores in five years. In 1997, Texas high school students passed 34,000 AP exams.The Council recommends that the state establish a goal for 2002 of increasing the number to 100,000.

- In support of this goal, the Council also proposes to increase the number of AP math and science teachers from 2,500 to 10,000 by the year 2002.
- The number of school districts offering AP courses must be increased from the current level of approximately 50 percent to 100 percent, to include all districts and all high schools.

In 1993, the Texas Legislature adopted an AP program, called the Texas AP Incentive Program, containing many of these features, but to date, it has not been funded. The Council strongly recommends that the state fund that program now. According to the office of the Comptroller of Public Accounts, the AP program as envisioned in prior legislation would result in a net cost savings to the state of Texas.

"The AP and pre-AP programs provide a means to give kids exposure to a quality curriculum that is recognized by higher education all across the nation. We have worked hard to tie the pre-AP years to the AP experience, and now even sixth graders are getting specific instruction that will help them take advantage of the challenging AP classes in their junior and senior years."

—Daniel Coward, Principal, Amarillo High School

Policies

To further strengthen AP in Texas, the Council recommends that the state enact the following policies:

- Require high schools to publish AP results each year. This provides accountability for state funds as well as academic results.
- Require state colleges and universities to give students credit and placement for test scores of 3, 4, and 5.
- Require that community colleges give advanced placement credit toward the associate's degree rather than just elective credit. This permits students to complete an associate's degree in fewer hours and enter the workforce sooner.

RECOMMENDATION #2: COMMUNITY COLLEGE HIGH-TECH TRAINING PROGRAMS

Texas' community colleges are at the cutting edge of an emerging education model, in which businesses and educators work together to meet industry needs for technology workers. Community colleges are well-suited to technology training programs because they provide:

- Easy Access: 95 percent of the state's population is in a community college service area.
- Large Target Population: Community colleges enroll about 45 percent of the state's higher education students. Over 70 percent of Texas freshmen and sophomores are enrolled in a community college.
- Ethnic Diversity: Enrollment at community colleges almost matches Texas' ethnic composition with a high percentage of Hispanic and African-American students. Community colleges enroll 55 percent of all minority students in Texas.
- Workforce Training Focus: Community colleges account for 92 percent of all technical and vocational education in Texas public higher education.

"A growing number of our employees will be graduates of the community college technical education system. These programs will give Texas the edge in continued growth of its high-tech economy."

—Jack Swindle, Senior Vice President, Texas Instruments

Successful Community College Workforce Development Programs

Models for effective technology workforce development programs already exist in the following Texas community colleges:

- Dallas and Collin County Community Colleges: These schools partnered with the North Texas Telecom Corridor Business Council and received a $2 million grant to develop an electronics technology training program. The colleges have enrolled over 600 students since 1996. The program emphasizes cooperation between colleges by allowing cross registration.
- Tarrant County: A partnership between Intel and National Semiconductor jointly developed a program with an enrollment of over 1,200.
- Austin County Community College: ACC increased its technology program enrollment from 18 to 530 and enjoys a 100 percent job placement rate for graduates.

Developing and Implementing High-Technology Training Programs at Community Colleges

Experience implementing such programs in Texas colleges has shown that to develop a successful program, six fundamental areas must be addressed:

1. Curriculum. In order to effect a real technology workforce development initiative in the state, it is essential to impact the curriculum in the college. Successful core curricula have already been developed by the programs described above. In these, 80 percent of the courses are common across disciplines. These include communications, interpersonal skills, math, and technical topics. The remaining 20 percent are specialty curricula/degree programs developed by each community college according to the industries prevalent in that region of the state. Specialty disciplines include medical, aerospace, computer languages, electronics, energy-petroleum, agri-business, telecommunications, and semiconductors.

2. Faculty. Faculty training and development is a critical element of a successful program. Faculty—the backbone of any educational program—are technically competent but rarely have direct experience in the industries they teach. Industry needs to take a major role in giving teachers the needed hands-on experience, including providing internships.

3. Laboratories. An equally important part of the program is specialized training labs. To become productive members of the high-technology workforce, students need hands-on training as part of their education. Two types of labs are needed: 1) computer and virtual training labs to be used by all high-technology students, and 2) specialized, hands-on labs—such as semiconductor or telecom labs—with tools of the industry.

4. Enrollment. While high-tech employment is growing in the state, enrollment in high-tech community college training programs has declined. Enrollment marketing plans—done either on a regional or a statewide basis—have been a crucial element in the success of existing programs.

5. Retention. In existing programs, student dropout rates are high. High school AP programs are critical if students are to enter community colleges with the math and science skills needed to succeed.

6. Job Placement. Currently, industry and the community colleges are not well connected. Representatives from each need to work together to ensure that there is a place in the local workforce for graduates.

COMMUNITY COLLEGE RECOMMENDATIONS

The Science and Technology Council recommends that Texas community colleges statewide adopt the Texas High-Technology Curriculum, with 80 percent of the courses being common across colleges and disciplines, and 20 percent being regionally adapted to meet local needs. Courses in the Texas High-Technology Curriculum should be transferable among all community colleges in the state.

The Council recommends that our community college systems play a greater role in developing our technology workforce. In order to ensure community colleges will be able to meet industry needs for technology workforce, the Legislature should review and determine whether the state should:

- Consider incentives that will ensure that the Texas High-Technology Curriculum is taught in every community college in the state.

- Determine if an adjustment needs to be made to the technical-vocational funding formula.

- Explore the development of an incentive-based program for both teachers and community colleges to increase their number of graduates in these programs.

To accomplish the goals set forth for the community colleges will require intense cooperation and endorsement from the Texas Higher Education Coordinating Board.

ADVANCED RESEARCH PROGRAM: GENERATING HIGH-TECH KNOWLEDGE IN TEXAS UNIVERSITIES

The ATP/ARP program was initiated in 1985 as a state investment seeking to develop both a technologically competent workforce and an effective research base by focusing on peer-reviewed proposals for frontier research and technology development. The value of the ATP/ARP program to the people of Texas is clear. From its inception in 1985, the growth in Texas' share of federally sponsored research has been significantly greater than the growth of all such programs.

The Council recommends that the state increase funding for ARP/ATP. Inflation has seriously eroded the contribution that the ARP/ATP plan can make to the future of Texas. The state must invest $90,000,000 to restore the program to its original level of effective-

ness. As is true of the current program, the establishment of an appropriate funding level for the ARP/ATP program should be independent of core funding for higher education. Furthermore, Texas institutions of higher education are losing in national competitive grant proposals because the current ARP/ATP program does not permit matching funds. Improving our state's competitive position requires that institutions be permitted to provide matching funds for innovative grant proposals. Current institutional funding rules, such as allocation of peer-reviewed monies once every two years, make the allocation of matching funds for sponsored research difficult, if not impossible.

The Council recommends that 2/3 of the new funding increase be allocated to institutions for matching money to encourage participation in research sponsored by the private sector and the federal government. The remaining 1/3 would be used to increase the dollars in the APR/ATP programs for basic research. The matching funds would be allocated to the university in proportion to the awards made through the existing APR/ATP program. Any matching money not allocated to successful projects would revert to the parent fund for reallocation in succeeding companies.

The ARP/ATP program has been very successful for the state of Texas. The Council recommends that the state not allow another 12-year period to pass without adjusting funding.

ESTABLISH THE TEXAS INSTITUTE OF SCIENCE AND TECHNOLOGY

Texas has been well served by both public and private universities developing new knowledge in science and technology, as well as agencies promoting economic development around the state. The state has also been fortunate to have individuals from business, academia, and government ready to voluntarily serve on councils and task forces typically formed by political leaders focused on increasing technology-based industry in Texas.

Unfortunately, these efforts are usually short-lived—one to four years—and rarely provide continuity from one council to the next. Texas should not have to continually reorganize its public and private efforts to support science and technology needs and opportunities. Texas must fill the gap between technology development and technology commercialization, as well as provide for continuity in our rapidly changing world.

Therefore, the Science and Technology Council recommends that the state create a private sector-driven and -supported entity—possibly called the Texas Science and Technology Institute—to lead in the identification and promotion of science and technology-based opportunities for Texas. The Legislature should formally endorse and support this entity as the vehicle for providing this leadership in Texas.

Public and private cooperation, collaboration, and endorsement should be an organizing theme in creating such an entity. The agenda for the Institute should be based on input from key technology industry sectors and economic sub-regions in the state. Further, any statewide technology initiative needs to address all of the various stages of the technology life cycle, from research to commercialization. The experience of other states suggests that the most effective organizational structure is that of a non-profit corporation with strong ties to industry, government, and academia.

Here are a few of the many issues that the Institute could address: 1) education and training; 2) university-industry technology transfer; and 3) fostering technology-based entrepreneurs. The Institute, as a state-endorsed, private technology organization, could also effectively perform the following tasks: 1) broker partnerships across sectors, organizations, and regions, 2) conduct policy analysis, 3) benchmark performance and "best practices," 4) function as an information clearinghouse, and 5) conduct pilot programs.

Reflecting its natural constituencies, financial support for a state technology organization should primarily come from the private sector and foundations, but state or federal money would be accepted for specific projects. The work of a state technology organization would be transacted via projects, conducted by a permanent staff and contractors. Ideally, the state technology organization would be highly integrated into state economic development strategy.

As it pursues its various projects and initiatives, the organization should exercise due diligence by incorporating an ongoing methodologically-robust impact evaluation of everything that it does.

Here are specific steps recommended to create and sustain the Texas Institute of Science and Technology:

- In cooperation with the Governor's office, establish and refine the charter, short- and long-term goals, and benchmarks for the Institute.
- Determine an appropriate legal structure for the Institute to serve the purposes of the charter.
- Evaluate funding requirements for the initial implementation of the Institute and ongoing support of Institute efforts, and develop a program for obtaining necessary funds.
- Draft resolution/legislation for recognition and endorsement by the Texas Legislature, thereby allowing the Institute to contract with the State for studies and services.

ADOPT A FRANCHISE TAX CREDIT FOR RESEARCH AND DEVELOPMENT ACTIVITIES

The Texas Legislature should adopt a franchise tax credit for companies involved in research and development activities in Texas. Texas' competitiveness in attracting and retaining advanced technology-based industries would be enhanced by the offering of such a credit.

Texas is one of only a handful of states with no direct tax inducement of any kind for research and development activities. Most states offer exemptions or credits for sales taxes, property taxes, or more frequently—for corporate taxes—for activities related to research and development.

The following steps are needed to ensure the Legislature passes an R&D tax credit:

- Develop regional and cluster support for the adoption of a credit.
- Work with the Governor's Office and legislative offices to ensure a firm understanding of the benefits of this tax credit.
- Identify regional proponents of the credit.
- Work with the Texas Department of Economic Development and other regional economic development agencies to identify the potential benefits to their region.

MARKETING CAMPAIGN

This report makes the case for new programs that will help facilitate Texas' preeminence in high-tech industries. However, these programs will fail unless there is a qualified stream of students to enter high-tech professions. Students must start early, in the 7th grade, and maintain a proficiency in math and science courses; this takes awareness and encouragement. In order to fill the job pipeline, the Council recommends that Texas develop and adopt a statewide marketing campaign. The Council recommends the successful "Don't Mess with Texas" program as a model: a simple campaign carried to all parts of the state.

GETTING TEXANS INVOLVED: DEVELOPING A REGIONAL APPROACH

Regional efforts have been shown as the most effective method to address local workforce needs. Accordingly, regional groups must play a significant role in implementing the Council's recommendations. These groups can help in assessing workforce needs, education and industry resources; providing regional verification of statewide initiatives; and soliciting regional sponsorship and implementation of recommendations and initiatives.

The Council recommends that the state implement education and training programs on a regional level through partnerships between government agencies, businesses, educational institutions, and private foundations. We recommend that major urban areas—Houston, Dallas, San Antonio, Austin and El Paso—start regional partnerships that become models and expand to other regions of the state. These regional organizations will become the backbone for implementing the Council's recommendations. We challenge industry to take the lead and establish the regional partnerships.

CONCLUSION

This report has demonstrated that technology has transformed Texas' economy during the last decade. Technology-based industry is the economic growth engine driving the state's wealth and job creation. Texas is the fastest growing major state in technology-based employment. Our state's economic well being is now clearly tied to continued growth of technology-based business.

The Council has shown that the state must address a growing workforce shortage and skills gaps that threaten our continued economic prosperity. The Texas Technology Survey and Texas Workforce Commission statistics confirm that Texas must address these workforce issues in order to continue to meet industry's demand for workers.

The Council has concluded that gaps in our present education and training systems impede our future. The state must increase the pool of students interested in high-tech careers and must improve our performance in graduating students prepared to enter the technology-based workforce.

The Council's recommendations are the first step in addressing the state's workforce and training issues. We can begin to solve the problem by enhancing the AP Incentive Program and by implementing a technology curriculum at Texas' community colleges. The Council also recognizes that these programs are only part of the solution and urges that the state adopt a range of programs to address the problem.

The Council also urges educators, industry leaders, and state and local government officials to become involved in building our state's technology-based future by taking responsibility for implementing the Council's recommendations.

This Report constitutes the Science and Technology Council's first set of recommendations. The Council will continue to study issues affecting Texas' high-technology future, and further recommendations may be forthcoming.

For more information, call the Governor's State Policy Office, at (512)-463-2198.

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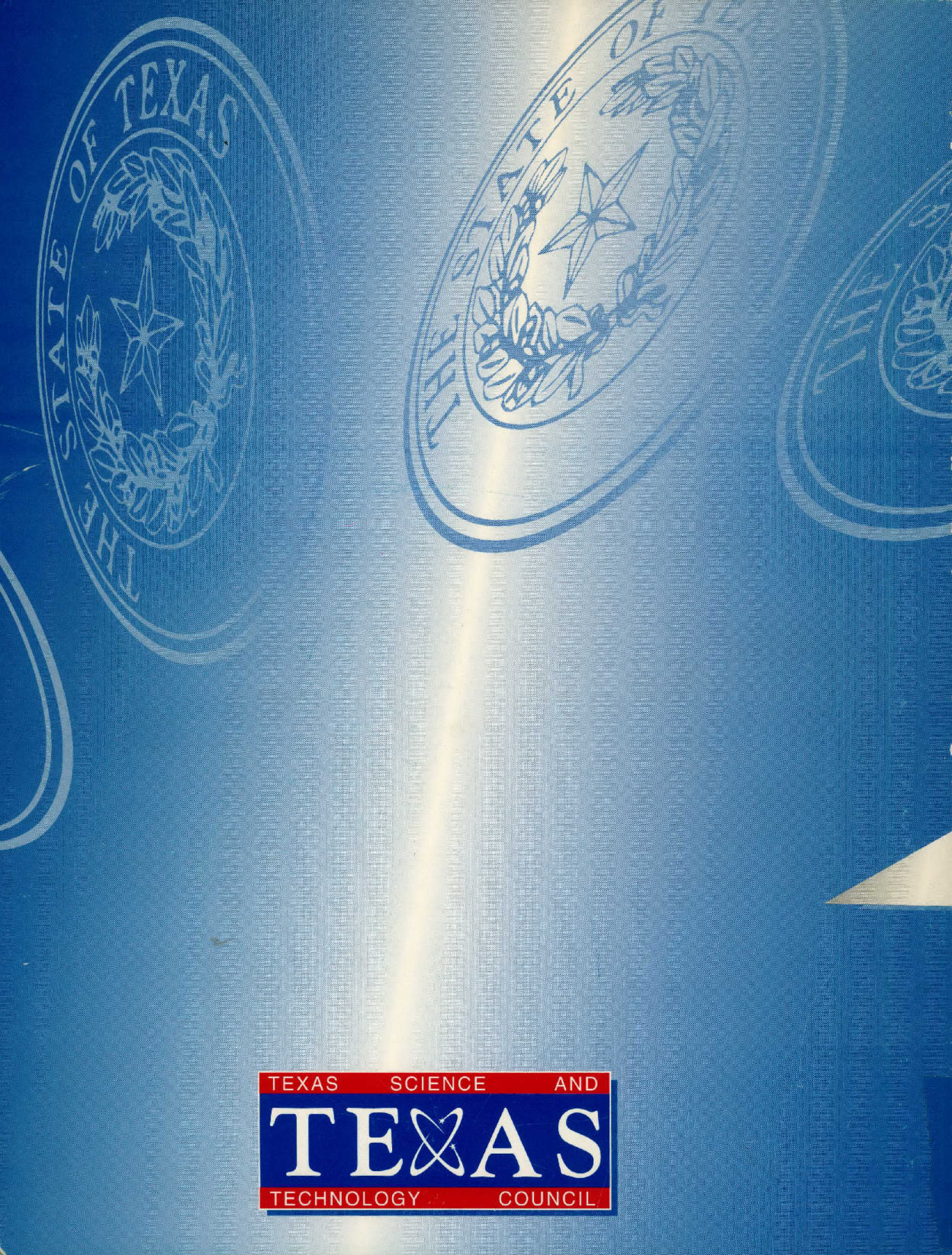
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