

Final Report

Expanding the Technology Workforce
Higher Education's Role



Task Force on Development of the Technology Workforce
Texas Higher Education Coordinating Board
Higher Education Planning Paper
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Texas Higher Education Coordinating Board Task Force on the Development of the Technology Workforce

Joseph R. Krier (Chairman), President and CEO, Greater San Antonio Chamber of Commerce

Terri Alexander, Director of Corporate Diversity and Compliance, COMPAQ Computer Corporation, Houston

Greg Allemann, Vice President, Broadband Infrastructure and Services, SBC Technology Resources, Austin

Leonardo de la Garza, Chancellor, Tarrant County College District, Fort Worth

Kathleen Kelleher, Chief Operating Officer, Amarillo Biosciences, Amarillo

Tom Kowalski, President, Texas Health and Biosciences Institute, Austin

Gilbert Leal, President, Texas State Technical College - Harlingen

Adena Williams Loston, President, San Jacinto College, South Campus, Houston

George R. McAndrews, General Manager/Operations, Aerospace Support Center, The Boeing Company, San Antonio

Betty Otter-Nickerson, Vice President, BMC Software, Austin and Chair, Austin Software Council

Stephen Riter, Provost and Vice President for Academic Affairs, The University of Texas at El Paso

Juan M. Sanchez, Vice President for Research, The University of Texas at Austin

Jack E. Swindle, Senior Vice President, Texas Instruments, Inc., Dallas

Karan L. Watson, Associate Dean for Undergraduate and Graduate Studies, Look College of Engineering, Texas A&M University, College Station

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Executive Summary

Background

The Texas Higher Education Coordinating Board created a Higher Education Planning Committee to develop a plan for Texas higher education during the period 2000-2015. The Task Force on the Development of the Technology Workforce was created to support that activity.

The task force consists of eight corporate and six academic members. They met four times, in Dallas, Houston, San Antonio, and Austin during the period December 10, 1999 through March 31, 2000. They took testimony from over 30 people representing government, industry, and academia.

Findings

The task force has three primary findings:

1. The Texas economy has made a fundamental shift out of extractive industries, primarily agriculture and oil and gas production, into industries that are technology dependent. This shift is significant, continuing, and projected to occur at a faster pace if adequately supported.
2. The Governor and the Texas Legislature have established several regional and statewide bodies that are addressing immediate job training needs. Community and technical colleges have dramatically increased short-term job training for Texas companies.
3. The change in the economy is not reflected in degree production in the Texas higher education system. The essentially flat production of engineers and other key disciplines at the baccalaureate and associate degree levels limits the future growth of the Texas economy. In addition, Texas students are not being sufficiently informed nor prepared for some of the most interesting, challenging, and lucrative careers in the new economy.

Recommendation

The task force recommends that the Higher Education Coordinating Board provide leadership to make the output of the Texas higher education system more compatible with the current and future needs of high-technology industries.

Strategies

No single act or policy change will effect that transformation. It will only happen as the result of a better understanding of the problem and a series of sustained activities to address it. Appendix D contains a compendium of possible strategies for increasing degree production in high-technology disciplines. These strategies are variously addressed to legislators, the Coordinating Board, boards of regents and trustees, and institutions.

Six of those strategies are especially recommended for consideration at this time:

1. *Boards of trustees, boards of regents, and high-tech industry managers should provide incentives to make partnerships between industry and academic institutions a part of the culture of their organizations.*
2. *The Coordinating Board and the Legislature should require Texas public colleges and universities to develop and implement plans that will double the number of engineering, computer science, math, and physical science degrees awarded by 2012.*
3. *The Coordinating Board and the Legislature should require that the state's public community and technical colleges, with input from industry, develop common, fully transferable high-technology core courses.*
4. *The Legislature should create a fund that would competitively award funds that colleges and universities could use to match industry contributions for acquiring equipment, software, or maintenance for high-tech instructional laboratories.*
5. *Institutions and industry should cooperate to provide teachers, counselors, parents, and students more and better information regarding career opportunities in high-technology fields.*
6. *The Legislature should provide student aid programs to encourage students to pursue high-technology careers in Texas, as is done in Maryland, Pennsylvania, and Missouri. However, these programs should be designed to operate "on the margins" so that they bring additional students into high-technology programs, not simply subsidize students who would enter these programs in any event.*

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- B People providing testimony to the task force
- C A summary of high-tech certificate and degree production in Texas institutions of higher
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1 Background

In September 1999, the Texas Higher Education Coordinating Board embarked on a long-range planning effort to identify a small number of important goals that Texas higher education should pursue in the next 5 to 10 years, together with strategies for reaching these goals.

The chair of the Coordinating Board appointed a higher education planning committee consisting of 20 business, civic and higher education leaders from all areas of the state. The planning committee was chaired by Dr. Martin Basaldua, Vice Chair of the Board. Within the planning committee were four task forces addressing priority issues.

This document is the final report of the Task Force on the Development of the Technology Workforce. The task force was chaired by Mr. Joseph R. Krier, President and CEO of the Greater San Antonio Chamber of Commerce. Membership included eight corporate and six academic members. A roster of members is provided inside the front cover of this report.

The committee charge was:

1. Review information on the quality, accessibility, productivity, and cost of technology, science and engineering programs offered by Texas higher education institutions.
2. Review information and develop strategies regarding work force development needs for continued growth in existing technology-based sectors of the Texas economy and development of emerging new high-technology sectors.
3. Identify the best strategies by which higher education can prepare an adequate number of graduates from technology-related programs and assure that those graduates can successfully compete for jobs in the 21st century workplace.

The task force met four times between December 1999 and March 2000. Meetings were hosted by the chambers of commerce in Dallas, Houston, San Antonio, and Austin. Each meeting featured a presentation on local high-tech employment conditions and then focused on one of the three charges. The meeting agendas and a list of people who provided testimony to the task force are provided in Appendices A and B.

The task force believes there are few if any industries or jobs that are not impacted by technology. Restaurants use computerized ordering systems and cash registers. Secretaries typically work on computers. Farmers use sophisticated weather forecasting and access market data from on-line databases. Automobiles contain dozens of microprocessors, and auto mechanics routinely use digital diagnostic systems. In a sense, most American workers are technology workers.

. . . there are few if any industries or jobs that are not being impacted by technology.

Texas has seen a dramatic shift toward high-technology employment in the past 10 years. A report authored by Ross DeVol for the Milken Institute [*America's High-Tech Economy, 1999*] indicates that the Dallas-Fort Worth Metroplex ranks second in the nation in production of high-tech goods and services – ahead of every other U.S. metroplex except San Jose, California. Austin and Houston are both ranked in the top 25. Other metropolitan areas are growing rapidly, some that might not seem obvious. For example, DeVol's study indicates that the Lubbock metropolitan area is ranked 33rd in the nation in production of high-tech goods and services and is ranked fourth in the nation in the ratio of the value of high-tech goods and services produced to total goods and services produced.

. . . the Dallas-Fort Worth metroplex ranks second in the nation in production of high-tech goods and services. . .

The focus of this task force, however, was on a somewhat smaller group of industries that are commonly referred to as high-tech companies. One of the first things the task force found is that there is no commonly accepted definition of what companies *are* high-tech companies.

The Bureau of Labor Statistics uses one definition that is primarily related to electronics and communications; the American Electronics Association uses another. The Coordinating Board has defined a group of priority technologies for funding purposes, and several industry groups have still other definitions.

The task force decided to take a broad view and include virtually all disciplines that have as their foundations mathematics or science. This would include electronics, software, biotechnology, telecommunications, aerospace, and related fields.

The Governor and the Texas Legislature have established several statewide and regional bodies – based on coherent labor markets – to provide coordination, communications/outreach, single point of contact, and other services to employers, schools, college/universities, parents, students, and incumbent workers. These include the Texas Council on Workforce and Economic Development, local Workforce Development Boards, School-to-Career partnerships, and Tech Prep consortia. These bodies have thousands of prominent business, secondary/postsecondary education, and community leaders on their boards. They are actively engaged in workforce development activities with virtually all of the schools, colleges, and universities in the state, as well as thousands of employers. These entities receive state and federal funds to operate programs and implement initiatives.

These bodies have been successful in motivating schools and colleges to provide additional job training for Texas companies, including technology companies. However, fewer changes have been seen in college and university degree and certificate production, especially at the baccalaureate degree level and below.

While there has been a major shift in the Texas economy into industries that are technology dependent, there has not been a corresponding change in certificate and degree production.

Government and industry leaders are concerned that a technology economy cannot be sustained unless the state's higher education system makes changes to provide corresponding increases in the production of graduates prepared to work in these high-tech industries. These increases are not happening, and that is the primary motivation for this report.

. . . a technology economy cannot be sustained unless the state's higher education system makes changes . . .

2 Present and projected demand for college-trained and university-trained high-tech workers

A technology economy requires an educational support system that operates in multiple disciplines at many levels. While the need for engineers and computer scientists is apparent, a technology economy also requires managers, accountants, marketing experts, corporate training specialists, and numerous other persons from a variety of disciplines who are bright, creative and reliable. In these different disciplines, education and training at all levels is required, from short-term certificate programs for students immediately out of high school to doctoral programs. Education is required for students who can pursue degree programs full time and for those who wish to upgrade their skills while working full time.

In assessing the present and projected demand for college and university-trained high-tech workers, the committee took testimony from several sources. Some of the state's largest high-tech employers provided first-hand accounts of the efforts their personnel divisions are undertaking to recruit and train high-tech workers. Industry groups, especially the American Electronics Association and the Texas Healthcare and Biosciences Institute, provided valuable perspectives. The Texas Workforce Commission (TWC), the State Occupational Information Coordinating Committee (SOICC), and the Texas Council on Workforce and Economic Competitiveness (TCWEC) provided statistical data. Finally, the task force heard testimony from two high-level state advisory groups that had recently examined similar issues: the Texas Science and Technology Council and the State Economic Development Planning Commission.

All of these different groups - representing different parts of the state, different industries, and different constituencies - provided a compelling and consistent message. That message has five related themes.

1. *There is a substantial shortage of people to fill current high-tech job openings across a broad range of specializations.*

The task force was provided both qualitative and quantitative information that high-tech employers are faced with severe shortages of technically trained workers. In some high-tech companies, signing bonuses are routinely given to new employees. Stock options are now relatively common for engineers and other professional staff members in high-tech companies. Current employees of Texas Instruments who refer applicants for technical positions participate in drawings for new cars. Competing companies find that they need to use similar recruitment tools.

The American Electronics Association estimates that Texas led the nation in creating over 100,000 new jobs, a 37 percent increase, in electronics-related companies between 1990 and 1997. The Texas Healthcare and Biosciences Institute reported a 23 percent increase in employment during the same period.

. . . Texas led the nation in creating over 100,000 new jobs in electronics-related companies between 1990 and 1997.

Nationally, the U.S. is allowing 85,000 scientists and engineers to immigrate into the U.S. per year. Most of these are engineers or computer scientists who are taking some of the best jobs in the new economy.

This figure indicates that there is a major need for expansion of technical training programs, both to make the economy grow and to provide the best career opportunities for Texas students.

2. *The current shortage of technology workers appears to be a trend that will continue and may accelerate in selected areas.*

In his task force testimony, Dr. Richard Froeschle, Executive Director, State Occupational Information Coordinating Committee, mentioned four key indicators pointing to a general labor shortage that will not be quickly reversed:

- (1) declining unemployment rates as an indicator that most of those available for and actively seeking work are already employed
- (2) increases in the wage and salary employment (jobs) that have consistently over the past six years exceeded the rate of growth in the civilian labor force (workers)
- (3) the Texas employment to population ratio has increased to over 66 percent, which is the highest rate in Texas' history
- (4) the dispersion of unemployment rates and employment growth in other states has declined significantly over the past 20 years, indicating a decreased economic need for workers to leave high unemployment states to fill job vacancies in Texas.

He further pointed out that growth in employment rates in Bureau of Labor Statistics high-tech Texas industries has outpaced the growth rate for the state as a whole every quarter since the first quarter of 1993. Further, six of the seven projected fastest growing occupations in the state are in those high-tech industries.

The State Occupational Information Coordinating Committee collects data on high school student interest in different occupations. The list of top 20 occupations, as viewed by high school students, does not include engineering but does include medicine, law, nursing, teaching, artist, professional athlete, police officer, hair stylist, actor/actress, singer, accountant, and photographer. Only one occupation from the Bureau of Labor Statistics high-tech cluster – computer programmer – found its way into the top 20 list of desired occupations by Texas students.

A growing demand on the part of high-tech industry coupled with an apparent lack of interest in careers in this industry from students suggests a severe and long-term labor shortage in high-tech industries, unless changes are made to address this imbalance.

. . . suggests a severe and long-term labor shortage in high-tech industries . . .

3. *High-tech jobs pay dramatically more than the state average.*

Ms. Melissa Hendricks, Executive Director of the Texas Council of the American Electronics Association, provided dramatic evidence that in Texas, the average pay for workers in industries included in the American Electronics Association definition of high-technology was \$53,800 in 1997, compared to \$30,102 in other private sector jobs. The Healthcare and Biosciences Institute reports a similar disparity for biotechnology companies.

Employers provided testimony indicating that starting salaries for engineers in critical specialties exceed \$60,000 per year, and salaries for technicians in critical specialties exceed \$40,000 per year.

The Career Center at Texas A&M University indicated a \$43,047 average starting salary for engineering graduates in spring 1999. The Texas State Technical College Career Center reported an average starting salary of \$28,400 for persons with two-year technical degrees. National data from government, industry, and academic sources provides similar information.

4. *Industry believes there is a relationship between degrees produced and economic job growth.*

There is a considerable body of literature relating the quality and quantity of education to economic job growth. As the economy shifts from one based on extractive industries to an economy based on information and knowledge, the critical resource becomes trained people.

With the dramatic advances in communications and transportation, it is less important to be physically located near either markets or sources of materials. At the same time, it becomes critically important to be physically located near a source or sources of well-trained workers. Technology companies locate in areas in which they can hire and retain workers with the skills they need. If an area doesn't produce workers with those skills – or doesn't produce enough of those workers – that area is at a competitive disadvantage in attempting to retain those companies or attract additional technology companies.

Technology companies locate in areas in which they can hire and retain workers with the skills they need.

5. *To meet its needs for high-tech workers, industry needs flexibility, nimbleness, and quick response from institutions of higher education. Texas industry believes that higher education needs to restructure its academic offerings to meet this new economic reality.*

Testimony from industry representatives indicates considerable frustration with the time required by institutions of higher education to react to their needs for high-tech workers at all levels. Their perception is that higher education is not effective at predicting their needs for workers, reacts only after worker shortages are acute, and then reacts slowly. This is perceived to be less of a problem with community and technical colleges, which tend to respond more rapidly to the needs of business and industry.

Because of the time required to plan new degree programs, get approval for them, develop curricula, and then teach the students, the time from perception of the problem to actual production of graduates is measured in years as opposed to the weeks or months desired by industry.

As a result, there are currently some 1,600 corporate training centers created specifically to provide faster, targeted training needed by industry. A whole new class of private sector educational institutions are making inroads on traditional higher education institutions, training students that are largely ignored by them.

More importantly, when traditional institutions create new programs to meet new needs, they typically do so as additional programs with marginal funding rather than doing the major restructuring and redeployment of resources that has been the hallmark of U.S. industry in the past 15 years.

A whole new class of private sector educational institutions are making inroads on traditional higher education institutions . . .

3 Current production of high-tech degrees in Texas institutions of higher education

a. Certificate and degree production

To assess the current production of high-tech degrees, the task force took testimony from staff of the Texas Higher Education Coordinating Board on the numbers of different types of degrees currently being awarded, and trends in degree production.

Table 1 below summarizes current statewide high-tech degree production in Texas. Appendix C provides similar data by institution.

**Table 1
Degrees and Certificates Conferred by Texas Public Institutions of Higher Education - FY 1999**

	Computer Science and Information Systems	Physical Science and Math	Engineering	Life/Health Sciences and Technology	Other Technology	Total Science and Technology	Total Awards	Percent Science and Technology
Certificate	851	N/A	N/A	827	1,553	3,231	13,212	24.5%
Associate	1,308	N/A	N/A	1,108	2,044	4,460	22,855	19.5%
Bachelors	3,064	1,669	3,042	4,124	786	12,685	58,645	21.6%
Masters	1,173	443	1,383	913	46	3,958	17,962	22.0%
Doctoral	58	260	358	330	N/A	1,006	2,352	42.8%

Note: Computer science and information systems includes computer-related degrees that may be offered in several colleges, including Arts and Sciences, Business Administration, and Engineering, although no degrees with Engineering in their name are included. Life/health sciences and technology includes a variety of biological sciences degrees and some health-related degrees. In general, degree programs designed to prepare students to work directly with patients, such as nursing and physical therapy, are not included. Other technology is roughly equivalent to engineering technology and does not include all technology degrees.

Table 2 summarizes the statewide changes in high-tech degree production in community and technical colleges between FY 1993 and 1999.

Table 2
Percentage Changes in High-Tech Certificates and Degrees Conferred in Community and Technical Colleges: FY 1993 - FY 1999

	Computer Science and Information Systems	Life/Health Sciences and Health Technology	Other Technology	Total Science and Technology	Total Degrees
Certificate	+76.2%	-6.4%	+28.7%	+25.5%	+12.5%
Associate Degrees	+60.5%	+2.4%	+0.2%	+13.3%	+8.4%

Table 3 summarizes statewide changes in high-tech degree production in universities between FY 1989 and 1998.

Table 3
Percentage Changes in High-Tech Degrees and Certificates Conferred in Universities: FY 1989 - FY 1999

	Computer Science and Information Systems	Engineering	Technology	Physical Science and Math	Life/Health Science and Health Technology	Total Science and Technology	Total Degrees
Bachelors	+72.2%	+4.6%	-2.2%	+40.7%	+110.3%	+46.9%	+30.8%
Masters	+153.3%	+19.6%	-38.7%	-13.1%	+117.9%	+50.9%	+33.2%
Doctoral	+93.3%	+39.3%	0.0%	-6.1%	+83.3%	+6.2%	+27.2%

The committee also received testimony concerning the importance to workforce development of non-degree activity in two-year colleges and the extent of that activity. For example, in FY 1998, public two-year institutions provided contract training amounting to nearly 140,000 course enrollments for 2,110 different companies. This training typically involves courses ranging in length from a few hours to a few days on topics of immediate need to employers.

This input and other testimony led the task force to make the following observations:

1. *Total degree production has generally kept up with population growth. Increases in degree production are uneven, with the largest increases in the life and health sciences and health technology and small increases in engineering and technology. However, it is evident that degree production has not shifted to technical disciplines in numbers commensurate with shifts in the economy.*

In general, graduate degree production has increased significantly in most Science and Technology disciplines. Life and health sciences and technology degree and certificate production has increased dramatically at all levels. Information technology degrees have increased faster than the population. Engineering and technology degrees and certificates in areas not directly related to information technology have decreased relative to the population.

2. *The production of information technology degrees is incompatible with industry increases in the use of information technology.*

Information technology is so pervasive that it affects nearly all sectors of the economy. Many companies that in the past have had minimal or routine data processing requirements now find themselves competing for persons with information technology skills to support more-complex information processing, web activities, and a host of other activities. The disconnect between the supply of information technology personnel and the demand for these persons is causing major problems for Texas industry – as it is in most states.

3. *The quality of high-tech degrees being produced is not perceived to be a problem.*

While the task force has no quantitative data to make this assertion, all the testimony provided to the task force by industry representatives and by industry members of the task force indicated that the problem is more one of quantity than quality.

4. *The task force was unable to determine the extent to which underproduction of high-tech degrees is related to inadequate demand among students or inadequate capacity at institutions of higher education.*

It is generally true that the high-tech degree programs that are the subject of this report are some of the most selective programs on their campuses. The committee heard testimony indicating that the capacity of many of these programs was limited by the availability of faculty resources. These facts argue that the principal problem is one of inadequate capacity. On the other hand, the task force also heard testimony indicating that higher-than-average entrance requirements are necessary to ensure that students will be successful in rigorous academic programs and that the percentage of highly qualified students interested in careers in science and technology is lower than in previous years, arguing that inadequate demand is also an issue.

. . . the percentage of highly qualified students interested in careers in science and technology is lower than in previous years . . .

5. *Considering the large total enrollment in two-year colleges, production of certificates and associate degrees is low.*

Total enrollment in public two-year colleges exceeds 400,000, yet fewer than 36,000 degrees and certificates are awarded each year. Of these, about 6,000 are in high-technology fields. This relatively low production of certificates and degrees can be attributed to major allocations of resources to the large number of bachelor-degree bound students who transfer without receiving an associate degree, short-term workforce development activities, casual students who are not seeking either certificates or degrees, and the necessity of providing developmental education to large numbers of students.

Current transfer policies do not sufficiently incentivize students who enroll in two-year colleges to complete degrees prior to transferring to a university.

6. *Most of the increases in high-tech degrees have been in life sciences and in graduate degrees.*

Most of the increases in high-tech degrees has been in the life sciences, an area that is projected to be important to the economy but an area that has not, to date, been responsible for major employment growth. In addition, degree production in graduate degrees has increased at a rate significantly higher than undergraduate degree production.

b. The Houston Area Technical Advisory Council

Mr. Robert Mosbacher, Jr. and Mr. Charles Shomper of the Greater Houston Partnership gave the task force a description of the Houston Area Technical Advisory Council (HATAC) program.

This is an innovative, broad-based effort to provide a major increase in the number of information technology workers in the Houston area. It is a cooperative effort, involving the Houston business community and educational institutions at all levels.

It has an infrastructure component, which will create a high-speed data network encompassing a broad range of institutions and activities. Of most interest to the task force was a linkage of degree programs at multiple levels with industry certification programs from a number of corporations that sponsor training programs. Examples include Microsoft, Novell, Cisco, and other companies. Under the program, educational institutions will provide both academic training resulting in traditional degrees and training that will allow students to receive these proprietary certificates, often at the same time. This presentation led to the following observations.

1. *Innovative partnerships to provide proprietary information technology certificate programs as an “add on” to high school, two-year college, and four-year degrees may offer quick relief to current industry needs.*

These proprietary certificate programs have considerable credibility among employers. Different programs are appropriate to persons with different levels of educational backgrounds and, when combined with an academic degree, provide a marketable credential to students who receive these certificates.

. . . proprietary certificate programs have considerable credibility among employers.

These certificate programs are rigorous and require the attainment of specific, measurable skills. To offer them, institutions must make a significant, long-term commitment to staff and laboratory development.

2. *Meeting short-term needs with proprietary certificate programs is possible, but this strategy may have long-term adverse consequences.*

Concern was voiced that specialized certificate programs, while they may be successful in opening the door to a first job, may also limit the long-term career opportunities available to students. The value of good communication skills, computational skills, and problem-solving ability provided by more traditional degree programs cannot be overstated.

3. *Business, industry, and higher education need to jointly market and promote the advantages and benefits of high-tech degrees.*

Generating interest in technology-oriented academic programs is a major problem, especially as more students are drawn from populations that have not traditionally pursued technical careers. In an effort to enlarge the pool of students who are qualified and interested in technology careers, 500 Houston business executives visited every 8th grade class in the city during February 2000 to explain the economic and life-style consequences of academic decisions made while in high school. This kind of innovative partnership is a good example of the kinds of solutions required to address the problem in a meaningful way.

Generating interest in technology-oriented academic programs is a major problem . . .

c. Successful Workforce Development Efforts

In an effort to better understand the characteristics of successful workforce development programs and their potential for meeting workforce development needs, the task force took testimony from people involved in three different efforts: the Gulf Coast Process Technology Alliance at College of the Mainland, the North Harris Montgomery Community College Engineering Technician program, and the University of Houston-Clear Lake's Software Engineering program. Some lessons learned from those experiences include the following:

1. *It is important that workforce development efforts be true partnerships in which industry partners contribute to the curriculum and other aspects of the instructional program.*

Successful workforce development efforts are not based on partnerships in which academic institutions develop a curriculum and teach it while industry hires the graduates. The most successful programs involve shared curriculum development, shared instructional responsibilities with industry representatives in the classroom for at least some portion of the course work, internships, and other cooperative activities. Institutions need policies that allow for this level of interaction to happen.

2. *Successful workforce development programs involve long-term, stable commitments of both financial resources and staff time to the partnerships by industry without expectations of immediate return.*

None of the programs described to the task force involved an immediate financial pay-off. Most required significant levels of industry support over an extended period of time. Once established, however, these programs can be very profitable for the institution and the industry partner.

3. *Successful workforce development programs require a commitment on the part*

of academic institutions to rapid decision-making and implementation.

An inability to expeditiously make decisions and implement programs is a common complaint among industry persons testifying before the committee. Educational institutions are not perceived as “nimble” and able to pull together resources to implement workforce education programs quickly. Industry representatives typically believe that educational people charged with implementing workforce development programs are faced with an unacceptable level of bureaucracy.

Educational institutions are not perceived as “nimble” . . .

4. *The best workforce development programs incorporate accountability and course correction mechanisms in their design.*

All of the workforce development programs described to the task force included mechanisms for providing feedback to participating institutions on their performance and suggestions for improvement. Usually, these took the form of advisory committees made up of stakeholders that met regularly to evaluate the programs.

4 Strategies for increasing the production of high-tech degrees in Texas institutions of higher education

a. Overview

The task force received recommendations for increasing degree and certificate production from most of the persons who testified before it. A compilation of 25 strategies the panel considered to be meritorious is provided as Appendix D.

Many people pointed out the dependence of higher education on the experiences provided to students in their elementary and secondary schools and made recommendations for improving those schools. The task force is well aware of that relationship and strongly supports innovations for improving elementary and secondary schools. However, because K-12 education initiatives are the primary focus of another task force, most public school initiatives considered by the task force have been omitted from this report.

One of the primary conclusions of the panel is that there is no single strategy that will, by itself, result in a dramatic increase in high-technology certificates and degrees. There is no “magic bullet” that state policy-makers, governing boards, institutions, or industry can call on to produce an academic restructuring that will result in a significant increase in high-technology degrees and certificates. Instead, it requires an awareness of the problem, a commitment to solve it, and the persistent application of a number of complementary initiatives over an extended period of time.

There is no “magic bullet” that state policy-makers, governing boards, institutions, or industry can call on to produce an academic restructuring . . .

b. Strategies

To this end, the task force has identified six strategies that we believe are practical, workable, common-sense initiatives that will, if implemented, make a positive difference. They are:

1. *Boards of trustees, boards of regents, and high-tech industry managers should provide incentives to make partnerships between industry and academic institutions a part of the culture of their organizations.*

Most successful workforce development efforts involve true partnerships between academic institutions and industry. These partnerships take time to develop and typically involve many complex relationships.

They may involve industry engineers and scientists in teaching or team-teaching roles; industry support of faculty research or sabbaticals; shared laboratories or industry support of academic laboratories; industry involvement in curriculum decisions; novel class scheduling to accommodate working students; rapid administrative decision-making processes; and other innovations. Industry should be prepared to contribute to the cost of some of these innovations.

Governing boards should review their policies and incentives to ensure that colleges and universities encourage close collaboration with industry.

2. The Coordinating Board and the Legislature should require Texas public colleges and universities to develop and implement plans that will double the number of engineering, computer science, math, and physical science degrees awarded by 2012.

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Engineering deans have indicated that, given additional resources, they could increase engineering graduates by 10 percent per year in the near term by increasing retention rates. Long term, achievement of this goal will require the development of additional capacity in academic science and engineering programs, reallocation of resources, and additional emphasis on recruitment, especially among women and ethnic minorities.

Plans should include specific annual benchmarks that include both qualitative and quantitative measures. Plans may involve both creation of some new degree programs and expansion of some existing programs at rates faster or slower than others.

Achievement of this goal would put Texas institutions in a leadership role for solving a national shortage of graduates with technical degrees, provide home-grown graduates to fuel continued economic growth of Texas technology industries, and provide exceptional economic opportunities to thousands of Texas students.

3. The Coordinating Board and the Legislature should require that the state's public community and technical colleges, with input from industry, develop common, fully transferable high-technology core courses.

These core curricula should be developed in partnership with Texas' community and technical colleges, the Texas Skill Standards Board (TSSB), and Texas industry. The Texas Higher Education Coordinating Board should develop processes and guidelines to ensure that once an industry sector advanced technology core curriculum has been developed, it will be included in the Workforce Education Course Manual (WECM) to ensure common transferability.

There have been numerous proposals for a high-technology core curriculum that would specify a common core of mathematics, science, and general education courses that would be fully transferable and would form the basis for a wide range of high-technology certificate and associate degree programs. The Semiconductor Industry Association (SIA) and the Texas Science and Technology Council have similar proposals. Also, the Coordinating Board recently funded a curriculum development grant to address this issue.

While the complexities of such an effort cannot be overstated, it has great potential to increase certificate and degree production by allowing students to do much of their work on a campus that may not offer the complete program desired by the student, but then transfer that work to another institution to complete degree or certificate requirements.

4. The Legislature should create a fund that would competitively award funds that colleges and universities could use to match industry contributions for acquiring equipment, software, or maintenance for high-tech instructional laboratories.

High-technology education programs require state-of-the-art laboratories. The high cost of equipping and maintaining laboratories is a major impediment to operating high-technology degree programs at all levels, from community colleges through graduate schools.

Technology companies have demonstrated an interest in assuring that students who will eventually be employed by them learn on modern equipment and have on numerous occasions assisted institutions in equipping laboratories. A state fund to match industry contributions for equipping instructional laboratories would leverage state resources and increase the quality and relevance of new and existing technology programs.

5. Institutions and industry should cooperate to provide teachers, counselors, parents, and students more and better information regarding career opportunities in high-technology fields.

Students and their parents often have a poor understanding of the linkages that exist between courses selected in high school and college and career opportunities that are subsequently available to them. Lack of knowledge of the kinds of work done by professionals in different fields is a problem for all students, but lack of understanding of the world of work in high-technology fields is especially prevalent because much of it is undertaken in a non-public environment.

Few higher education institutions have effective career guidance programs, and most students do not learn about career opportunities in their chosen fields until they leave school and seek work.

Institutions and industry should cooperate to provide students with information regarding career opportunities early in their academic careers and at numerous points during their academic careers. Summer jobs and cooperative education programs are especially effective. Part-time faculty from industry provide students with insights into high-technology work. Numerous less intensive opportunities are possible, including plant tours, guest lectures, and automated career counseling systems. Properly implemented, this initiative could be of significant assistance in encouraging more minority students to participate in these areas of higher education.

Institutions and industry should cooperate to provide students with information regarding career opportunities early in their academic careers . . .

6. The Legislature should provide student aid programs to encourage students to pursue high-technology careers in Texas, as is done in Maryland, Pennsylvania, and Missouri. However, these programs should be designed to operate "on the margins" so that they bring additional students into high-technology programs, not simply subsidize students who would already enter these programs.

States have implemented programs that provide aid in the form of free or reduced tuition, tuition remission, loan forgiveness programs, or outright cash grants for students who receive degrees in information technology and work in the state. Texas has a similar loan forgiveness program for teachers who work in areas with critical teacher shortages.

Student aid programs that result in more qualified scientists, engineers, and technicians to work in high-technology industries can be an excellent investment for the state. Because these are key industries for Texas' future economy, investments that allow them to grow are warranted. Because jobs created by these companies pay substantially more than most other private sector jobs, the increased revenue to the state resulting from the economic activity they provide can offset the investment required for an incentive-based student aid program.

5 Conclusions and recommendations

Based on a broad range of testimony and statistical input, the task force has three primary conclusions:

- The Texas economy has made a fundamental shift out of extractive industries, primarily agriculture and oil and gas production, into industries that are technology dependent. This shift is significant, continuing, and projected to occur at a faster pace if adequately supported.
- The Governor and the Texas Legislature have established several regional and statewide bodies that are addressing immediate job training needs. Community and technical colleges have dramatically increased short-term job training for Texas companies.
- The change in the economy is not reflected in degree production in the Texas higher education system. The essentially flat production of engineers and other key disciplines at the baccalaureate and associate degree levels limits the future growth of the Texas economy. In addition, Texas students are not being sufficiently informed nor prepared for some of the most interesting, challenging, and lucrative careers in the new economy.

The task force recommends six strategies that are discussed in greater detail in Section 4 to address the imbalance between industry needs and higher education production. They are:

1. *Boards of trustees, boards of regents, and high-tech industry managers should provide incentives to make partnerships between industry and academic institutions a part of the culture of their organizations.*
2. *The Coordinating Board and the Legislature should require Texas public colleges and universities to develop and implement plans that will double the number of engineering, computer science, math, and physical science degrees awarded by 2012.*
3. *The Coordinating Board and the Legislature should require that the state's public community and technical colleges, with input from industry, develop common, fully transferable high-technology core courses.*
4. *The Legislature should create a fund that would competitively award funds that colleges and universities could use to match industry contributions for acquiring equipment, software, or maintenance for high-tech instructional laboratories.*
5. *Institutions and industry should cooperate to provide teachers, counselors, parents, and students more and better information regarding career opportunities in high-technology fields.*
6. *The Legislature should provide student aid programs to encourage students to pursue high-technology careers in Texas, as is done in Maryland, Pennsylvania, and Missouri. However,*

these programs should be designed to operate “on the margins” so that they bring additional students into high-technology programs, not simply subsidize students who would enter these programs in any event.

Appendix D contains additional recommended actions that may be undertaken by the Legislature, the Coordinating Board, regents and trustees, and institutions.

The task force applauds the efforts of state leaders and the Coordinating Board to make the demographics of Texas higher education reflect the demographics of the state. However, for that effort to be worthwhile, it is equally important that the output of our higher education system resembles and responds to the changing economy of our state. We believe this report helps chart a road map to achieve that ambitious goal.

Appendix

A Task Force Meeting Agendas

Agenda - December 10, 1999

Greater Dallas Chamber of Commerce
Renaissance Tower, 20th Floor
1201 Elm Street, Dallas

Noon

Working lunch

Introductions

Welcome

Ms. Patti Clapp, Vice President for Workforce Development
Greater Dallas Chamber of Commerce

Charge to the Committee

Martin Basaldua, M.D., Vice Chairman, Texas Higher Education
Coordinating Board

Discussion of Committee Activities

Perspectives on Local High-Tech Employment

Melendy Lovett, Vice President and Manager of Total Compensation and Human
Resources, Texas Instruments

Take Testimony Regarding Charge 2: "Review information ... regarding work
force development needs for continued growth in existing technology-based
sectors of the Texas economy and development of emerging new high-
technology sectors."

- Texas Workforce Commission (Labor Market Information and State Occupational Information Coordinating Committee), Richard Froeschle, Executive Director, SOICC
- Texas Science and Technology Council - Jack Swindle, Texas Instruments, Inc.
- American Electronics Association - Melissa J. Hendrick, Executive Director, Texas Council
- Texas Strategic Economic Development Commission and Texas Council on Workforce and Economic Competitiveness - David Sampson, Chair
- Texas Health and Biosciences Institute - Tom Kowalski, President

Discussion/planning for future meetings

3:30 p.m.

Adjourn

Agenda - January 21, 2000

Greater Houston Partnership
1200 Smith, Suite 700
Houston

Focus of the meeting: *Charge 1*: "Review information on the quality, accessibility, productivity, and cost of technology, science and engineering programs offered by Texas higher education institutions."

11:00 a.m. *Meeting convenes*

Introductions

Welcome

Nancy Rose, Manager, Education and Workforce, Houston Chamber of Commerce

11:15 a.m. *Perspectives on local high-tech employment*

Robert Mossbacher, Jr., Greater Houston Partnership Board of Directors and Chairman of the Education and Workforce Advisory Committee

Chuck Shomper, Chair of the Houston Area Technical Advisory Council (HATAC) and Vice Chancellor & Vice President for Information

Technology

University of Houston

Noon *Working lunch*

12:15 p.m. *Review draft of initial sections of final report*

12:45 p.m. *Testimony regarding high-tech degree production and accessibility in Texas institutions of higher education (public, proprietary, and independent)*

- Paul Meyer, Texas Higher Education Coordinating Board
- Lynette Heckman, Texas Higher Education Coordinating Board

Discussion

1:15 p.m. *Presentation of three exemplary technology workforce development programs*

- Petro-Chemical Technician Program, College of the Mainland (Bill Raley, Dean of Technology; Mike Kukuk, Plant Training Foreman, Sterling Chemicals)
- Engineering Technician Program, North Harris Montgomery Community College District, (Bonnie Longnion)

- Associate Vice Chancellor for Academic Programs and Services; (Jim Simpson, Associate Dean, Tomball College)
- Software Engineering Program, University of Houston - Clear Lake (Charles McKay, Dean of Natural and Applied Sciences)

Discussion

2:30 p.m. *Discussion/planning for future meetings*

2:45 p.m. *Adjourn*

Agenda - February 23, 2000

Greater San Antonio Chamber of Commerce
602 East Commerce Street
San Antonio

Focus of the meeting: Charge 3: *Strategies for increasing degree production in high-tech disciplines*

11:00 a.m. *Meeting convenes*

Introductions

Welcome

Joseph R. Krier, President and CEO, San Antonio Chamber

11:15 a.m. *Perspectives on Local High-Tech Employment*

Mario Hernandez, President and CEO, San Antonio Economic
Development Foundation

Discussion

11:45 a.m. *Working lunch*

noon *Discussion of working draft of completed portions of final report*

12:30 p.m. *Presentation of possible strategies for increasing degree production
in high-tech disciplines - Roger W. Elliott, Texas Higher
Education Coordinating Board*

Discussion

12:45 p.m. *University priorities for increasing degree production in high-tech
disciplines (Discussion)*

- Max Navarro, President and CEO, Operational Technologies, Inc.,
San Antonio
- Rick Scott, P.E., Director of Software Programs, Sematech, Austin
- Joseph H. Stafford, Associate Vice Chancellor for Academic Affairs,
The University of Texas System
- Jerome Supple, President, Southwest Texas State University

1:45 p.m. *Two-year college priorities for increasing degree production in high-tech
disciplines (Discussion)*

- Nadir Faris, Training Manager, Phillips Semiconductor, San Antonio
- Robert W. Ramsay, Chancellor, Alamo Community College District
- Bill Segura, Chancellor, Texas State Technical College
- J. William Wenrich, Chancellor, Dallas County Community College District
- Joseph A. Wilson, Training Manager, Lockheed Martin Kelly Aerospace
Center, San Antonio

2:45 p.m. *Task Force adopts strategies to be recommended to the Higher*

Education Planning Committee

3:15 p.m. *Discussion/planning for final meeting of the task force*

3:30 p.m. *Adjourn*

Attachment: Possible Strategies for Increasing High-Tech Degree Production

Agenda - March 31, 2000

Greater Austin Chamber of Commerce
111 Congress Avenue
Board Room, 8th Floor
Austin

11:00 a.m. *Meeting convenes*

Introductions

11:10 a.m. *Workforce Development Activities at The University of Texas at Austin*
 President Larry R. Faulkner

Discussion

11:40 a.m. *Welcome and Perspectives on Local High-Tech Employment*
 Mark Hazelwood, President and CEO, Greater Austin Chamber of
 Commerce

Discussion

Noon *Working lunch*

12:15 p.m. *State Policies and their Impact on High-Tech Degree Production in*
 Independent and Proprietary Institutions

- Mr. Norman Hood, Vice President for Research and Public Affairs,
 Independent Colleges and Universities of Texas
- Dr. William J. Pepicello, Vice President for Academic Affairs,
 University of Phoenix

1:15 p.m. *Detailed Review of Task Force Final Report*

3:00 p.m. *Discussion of Distribution of the Final Report*

3:15 p.m. *Adjourn*

Attachment: Draft Final Report

Appendix

B People providing testimony to the task force

The following people provided testimony to the task force, either in person or in writing:

- **Dr. Martin Basaldua**, Vice Chairman, Texas Higher Education Coordinating Board
- **Ms. Patti Clapp**, Vice President for Workforce Development, Greater Dallas Chamber of Commerce
- **Mr. Nadir Faris**, Training Manager, Phillips Semiconductor
- **Dr. Larry R. Faulkner**, President, The University of Texas at Austin
- **Dr. Richard Froeschle**, Executive Director, State Occupational Information Coordinating Committee
- **Mr. Mark Hazelwood**, President and CEO, Greater Austin Chamber of Commerce
- **Ms. Lynette Heckman**, Community and Technical Colleges, Texas Higher Education Coordinating Board
- **Ms. Melissa J. Hendrick**, Executive Director, Texas Council of the American Electronics Association
- **Mr. Mario Hernandez**, President and CEO, San Antonio Economic Development Foundation
- **Mr. Norman Hood**, Vice President, Independent Colleges and Universities of Texas
- **Dr. Tom Kowalski**, President, Texas Healthcare and Biosciences Institute
- **Mr. Mike Kukuk**, Plant Training Foreman, Sterling Chemicals
- **Ms. Bonnie Longnion**, Associate Vice Chancellor for Academic Programs and Services, Engineering Technician Program, North Harris Montgomery Community College District
- **Ms. Melendy Lovett**, Vice President and Manager of Total Compensation and Human Resources, Texas Instruments, Inc.
- **Dr. Charles McKay**, Dean of Natural And Applied Sciences, Software Engineering Program, University of Houston – Clear Lake
- **Dr. Paul Meyer**, Universities and Health-Related Institutions, Texas Higher Education Coordinating Board

- **Mr. Robert Mossbacher, Jr.**, Greater Houston Partnership Board of Directors and Chairman of the Education and Workforce Advisory Committee
- **Mr. Max Navarro**, President and CEO, Operational Technologies, Inc.
- **Dr. William J. Pepicello**, Vice President for Academic Affairs, University of Phoenix
- **Dr. Bill Railey**, Dean of Technology, Petro-Chemical Technician Program, College of the Mainland
- **Dr. Robert W. Ramsay**, Chancellor, Alamo Community College District
- **Ms. Nancy Rose**, Manager, Education and Workforce, Houston Chamber of Commerce
- **Dr. David Sampson**, Chairman, Texas Council on Workforce and Economic Development and Vice Chair, Texas Strategic Economic Development Commission
- **Mr. Gerhardt Schulle, Jr.**, Executive Director, Texas Society of Professional Engineers (written testimony)
- **Mr. Rick Scott, P.E.**, Director of Software Program, Semi/Sematech-SISA
- **Dr. William Segura**, Chancellor, Texas State Technical College
- **Mr. Charles Shomper**, Chair of the Houston Area Technical Advisory Council (HATAC) and Vice Chancellor & Vice President for Information Technology, University of Houston
- **Dr. Jim Simpson**, Associate Dean, Tomball College
- **Dr. Neal J. Smatresk**, Dean of Science, The University of Texas at Arlington (written testimony)
- **Dr. Joseph H. Stafford**, Associate Vice Chancellor for Academic Affairs, The University of Texas System
- **Dr. Jerome Supple**, President, Southwest Texas State University
- **Mr. Jack Swindle**, Senior Vice President, Texas Instruments, Inc.
- **Dr. J. William Wenrich**, Chancellor, Dallas County Community College District
- **Mr. Joseph A. Wilson**, Training Manager, Lockheed Martin Kelly Aerospace Center

Appendix

C A summary of high-tech certificate and degree production in Texas institutions of higher education

Certificate and Degree Production in Public Two-Year Colleges: Fiscal Year 1999 (Certificates/Associate Degrees)

Institution	Computer Science and Information Systems	Technology	Life/Health Science and Health Technology	Total Science and Technology	Total Certificates and Degrees
ALAMO COMMUNITY COLLEGE DISTRICT					
NW Vista College	0/0	0/11	0/0	0/11	1/12
Palo Alto College	23/5	7/2	0/0	30/7	72/185
San Antonio College	8/49	0/18	0/0	8/67	193/699
St. Philip's College	1/19	10/73	33/52	44/144	294/454
DALLAS COUNTY COMMUNITY COLLEGE DISTRICT					
Brookhaven College	2/13	0/0	0/0	2/13	29/257
Cedar Valley College	0/0	4/0	0/0	4/0	80/159
Eastfield College	14/38	28/66	5/14	47/118	107/437
El Centro College	4/6	0/0	59/51	63/57	170/401
Mountain View College	0/4	5/23	0/0	5/27	25/241
North Lake College	7/16	55/10	0/0	62/26	87/204
Richland College	8/37	3/12	0/0	11/49	83/373
HOWARD COUNTY JR COLLEGE DISTRICT					
Howard College	2/8	1/8	4/16	7/32	60/157
SW Col Institute for the Deaf	0/0	0/0	4/0	4/0	8/3
NORTH HARRIS MONTGOMERY COUNTY COLLEGE DISTRICT					
Kingwood College	3/5	10/17	0/21	13/43	131/116
Montgomery College	0/2	0/3	0/3	0/8	1/79
North Harris College	41/40	62/30	0/14	103/84	282/511
Tomball College	3/1	0/2	4/0	7/3	31/83
SAN JACINTO COLLEGE DISTRICT					
Central Campus	8/7	87/71	32/79	127/157	226/702
North Campus	11/19	37/11	15/1	63/31	221/134
South Campus	15/12	6/5	0/0	21/17	138/243
TARRANT COUNTY COLLEGE DISTRICT					
NE Campus	9/16	0/17	13/33	22/66	73/579
NW Campus	13/7	0/35	0/0	13/42	189/280
South Campus	20/34	34/57	0/0	54/91	91/538
SE Campus	9/7	10/10	0/0	19/17	27/328

Institution	Computer Science and Information Systems	Technology	Life/Health Science and Health Technology	Total Science and Technology	Total Certificates and Degrees
TEXAS STATE TECHNICAL COLLEGE DISTRICT					
Harlingen	4/55	26/118	43/5	73/178	313/287
Sweetwater	19/85	7/85	10/2	36/172	217/182
Waco	0/138	55/350	0/0	55/488	193/753
OTHER					
Alvin Community College	77/6	38/14	11/9	126/29	204/305
Amarillo College	63/20	31/46	19/71	113/137	327/511
Angelina College	1/9	25/34	47/34	73/77	177/238
Austin Comm. College	0/27	71/125	13/52	84/204	269/798
Blinn College	4/4	0/0	15/17	19/21	124/464
Brazosport College	7/15	15/33	0/0	22/48	173/164
Central Texas College	22/65	27/26	14/19	63/110	548/704
Cisco Junior College	8/2	14/6	4/1	26/9	138/137
Clarendon College	0/0	0/2	0/0	0/2	42/77
Coastal Bend College	35/20	19/11	0/0	54/31	347/203
College of the Mainland	0/8	11/30	21/1	32/39	123/188
Collin County Comm. CD	36/14	20/9	4/15	60/38	184/509
Del Mar College	13/34	11/39	27/41	51/114	267/621
El Paso Comm. CD	8/33	5/31	9/60	22/124	180/732
Frank Phillips College	5/6	2/0	0/0	7/6	75/63
Galveston College	3/7	0/0	28/8	31/15	80/94
Grayson County College	6/10	25/25	10/11	41/46	146/309
Hill College	6/7	18/6	0/0	24/13	150/116
Houston Comm. CD	12/15	52/51	73/45	137/111	719/935
Kilgore College	0/10	55/9	17/20	72/39	393/293
Lamar-Institute of Technology	0/19	29/183	0/55	29/257	108/322
Lamar State College-Orange	6/4	0/2	0/0	6/6	93/97
Lamar State College-Port Arthur	18/22	2/10	11/19	31/51	133/173
Laredo Comm. College	22/57	4/4	4/26	30/87	174/444
Lee College	90/26	282/87	4/5	376/118	874/380
McLennan Comm. College	5/24	0/0	16/39	21/63	194/386
Midland College	2/1	20/10	13/15	35/26	82/283
Navarro College	6/14	1/4	0/3	7/21	110/304
North Central Texas College	1/5	1/11	0/2	2/18	83/265
Northeast Texas Comm. College	6/2	0/0	4/1	10/3	93/156
Odessa College	0/10	6/17	14/42	20/69	191/283
Panola College	13/7	1/0	0/0	14/7	122/150
Paris Junior College	0/4	24/13	0/0	24/17	170/138
Ranger College	7/1	5/0	0/0	12/1	85/43
South Plains College	3/18	12/33	28/17	43/68	167/389
South Texas Comm. College	0/19	12/0	0/12	12/31	273/253
Southwest Texas Junior College	0/5	0/0	0/0	0/5	79/235
Temple College	7/40	2/16	14/27	23/83	79/237
Texarkana College	3/11	48/4	33/5	84/20	366/221
Texas Southmost College	0/12	2/6	12/41	14/59	152/408
Trinity Valley Comm. College	113/15	178/1	16/0	307/16	568/404

Institution	Computer Science and Information Systems	Technology	Life/Health Science and Health Technology	Total Science and Technology	Total Certificates and Degrees
Tyler Junior College	9/28	15/26	95/68	119/122	258/646
Vernon Regional Junior College	4/7	8/21	1/0	13/28	222/29
Victoria College, The	0/12	5/37	3/23	8/72	205/212
Weatherford College	6/6	4/6	25/1	35/13	121/162
Western Texas College	0/0	6/1	0/0	6/1	105/69
Wharton County Junior College	0/4	0/21	0/12	0/37	97/208
Statewide Total	851/1,308	1,553/2,044	827/1,108	3,231/4,460	13,212/22,855

Degree Production in Public Universities: Fiscal Year 1999
(Bachelors/Masters/Doctorates)

Institution	Computer Science and Information Systems	Engineering	Tech-nology	Physical Science and Math	Life/Health Science and Health Technology	Total Science and Technology	Total Degrees
TAMU SYSTEM							
Prairie View A&M	22/0/0	105/11/0	22/0/0	13/4/0	44/1/0	206/16/0	695/386/0
Tarleton State	53/0/0	0/0/0	23/0/0	36/1/0	19/8/0	131/9/0	953/239/0
TAMU International	10/20/0	0/0/0	0/0/0	11/0/0	12/0/0	33/20/0	414/207/0
TAMU	101/126/15	979/294/104	247/8/0	509/79/84	319/42/44	2155/549/247	6786/1325/488
TAMU-Galveston	0/0/0	24/0/0	0/0/0	0/0/0	104/0/0	128/0/0	187/0/0
TAMU-Commerce	56/45/0	0/0/0	34/11/0	41/9/0	20/7/0	151/72/0	1,039/588/38
TAMU-Corpus C.	64/17/0	0/0/0	1/0/0	26/4/0	53/22/0	144/43/0	884/412/8
TAMU-Kingsville	15/12/0	87/43/0	27/0/0	15/2/0	51/15/0	195/72/0	649/297/9
TAMU-TeXarkana	4/0/0	0/0/0	0/0/0	5/0/0	0/0/0	9/0/0	215/62/0
West Texas A&M	44/0/0	0/0/0	5/7/0	21/4/0	44/4/0	114/15/0	934/222/0
TEXAS STATE UNIVERSITY SYSTEM							
Angelo State Univ.	16/0/0	0/0/0	0/0/0	28/1/0	65/6/0	109/7/0	843/125/0
Lamar University	53/25/0	49/32/5	18/0/0	14/8/0	32/19/0	166/84/5	911/196/7
Sam Houston State	30/7/0	0/0/0	20/4/0	44/9/0	37/5/0	131/25/0	2,023/396/13
Southwest TX State	149/34/0	0/0/0	43/2/0	53/10/0	197/43/0	442/89/0	3,345/829/0
Sul Ross State	3/0/0	0/0/0	6/0/0	14/2/0	11/5/0	34/7/0	236/159/0
Sul Ross-Rio Grande	0/0/0	0/0/0	0/0/	1/0/0	0/0/0	1/0/0	153/62/0
UT SYSTEM							
UT-Arlington	309/168/2	224/157/22	0/0/0	53/18/14	169/7/5	755/350/43	2,892/1,071/84
UT-Austin	516/109/17	747/390/159	0/0/0	237/66/83	698/75/50	2,198/640/309	7,932/2,539/735
UT-Brownsville	4/0/0	0/0/0	0/0/0	29/0/0	32/0/0	65/0/0	494/167/0
UT-Dallas	156/234/3	82/75/6	0/0/0	38/14/15	137/106/16	413/456/40	1,217/937/60
UT-El Paso	122/6/0	119/50/12	0/0/0	40/21/6	86/27/0	367/104/18	1,740/442/18
UT-Pan American	40/5/0	39/0/0	0/0/0	31/3/0	108/26/0	218/34/0	1,330/293/2
UT-Permian Basin	5/0/0	0/0/0	0/0/0	15/4/0	26/0/0	46/4/0	342/86/0
UT-San Antonio	131/47/0	116/25/0	0/0/0	53/20/0	194/34/1	494/126/1	2,212/523/1
UT-Tyler	21/6/0	5/0/0	40/9/0	12/1/0	4/3/0	82/19/0	737/165/0
UH SYSTEM							
UH	441/75/8	261/175/29	142/3/0	104/21/27	254/50/11	1,202/324/75	4,726/1,465/218
UH – Clear Lake	53/85/0	0/29/0	0/0/0	24/14/0	32/12/0	109/140/0	943/780/0
UH – Downtown	127/0/0	0/0/0	35/0/0	9/0/0	35/0/0	206/0/0	1,074/0/0
UH – Victoria	20/0/0	0/0/0	0/0/0	6/0/0	0/0/0	26/0/0	200/147/0
NON-SYSTEM							
Midwestern State Univ.	42/16/0	0/0/0	19/0/0	12/0/0	84/6/0	157/22/0	753/142/0
S.F. Austin State Univ.	23/2/0	0/0/0	0/0/0	39/15/0	122/26/0	184/43/0	1,808/403/1
Texas Southern Univ.	19/0/0	0/0/0	40/0/0	14/5/0	68/9/2	141/14/2	612/189/24
Texas Tech Univ.	205/21/1	205/95/21	32/0/0	75/55/11	180/28/11	697/199/44	3,386/809/169
Texas Woman's Univ.	14/0/0	0/0/0	0/0/0	15/9/0	94/172/3	23/18/3	1,194/740/74
Univ. of N. Texas	196/113/12	0/0/0	32/2/0	32/16/15	197/62/10	457/193/37	3,331/1,121/168
HEALTH SCIENCE CENTERS							
TAMU HSC & Vet Med.	0/0/0	0/0/0	0/0/0	0/0/0	440/2/4	440/2/4	482/49/13
TTU HSC	0/0/0	0/0/0	0/0/0	0/0/0	51/17/2	51/17/2	91/80/3
UNT HSC	0/0/0	0/0/0	0/0/0	0/0/0	0/6/4	0/6/4	0/6/4
UTHSC – Houston	0/0/0	0/0/0	0/0/0	0/0/0	0/40/69	0/40/69	0/160/89
UTHSC – San Antonio	0/0/0	0/0/0	0/0/0	0/1/5	47/12/20	47/13/25	391/111/31
UTMB – Galveston	0/0/0	0/0/0	0/0/0	0/0/0	28/9/31	28/9/31	339/110/39
UTSW Medical Center	0/0/0	0/7/0	0/0/0	0/0/0	30/7/47	30/14/47	152/22/56
Total	3,064/1,173/58	3,042/1,383/358	786/46/0	1,669/443/260	4,124/913/330	12,685/3,958/1,006	58,645/17,962/2,352

Appendix

D Possible Workforce Development Strategies

Strategies that could be implemented primarily by the Coordinating Board

1. The Coordinating Board and the Legislature should require Texas public colleges and universities to develop and implement plans that will double the number of engineering, computer science, math, and physical science degrees awarded by 2012.

Engineering deans have indicated that, given additional resources, they could increase engineering graduates by 10 percent per year in the near term by increasing retention rates. Long term, achievement of this goal will require the development of additional capacity in academic science and engineering programs, reallocation of resources, and additional emphasis on recruitment, especially among women and ethnic minorities.

Plans should include specific annual benchmarks that include both quality and quantity measures. Plans may involve both the creation of some new degree programs and expansion of some existing programs.

Achievement of this goal would put Texas institutions in a leadership role in solving a national shortage of graduates with technical degrees, provide home-grown graduates to fuel continued economic growth of Texas technology industries, and provide exceptional economic opportunities to thousands of Texas students.

2. The Coordinating Board and the Legislature should require that the state's public community and technical colleges, with input from industry, develop common, fully transferable high-technology core courses.

These core curricula should be developed in partnership with Texas' community and technical colleges, the Texas Skill Standards Board (TSSB), and Texas industry. The Texas Higher Education Coordinating Board should develop processes and guidelines to ensure that once an industry sector advanced technology core curriculum has been developed, it will be included in the Workforce Education Course Manual (WECM) to ensure common transferability.

There are at least two proposals to implement a common "high-tech" core in two-year colleges, one by the Texas Science and Technology Council and one from the Semiconductor Manufacturer's Association. Both would provide for a common core of mathematics and science courses that would be fully transferable and would form the basis for a wide range of high-tech certificate and degree programs. As a third alternative, the Coordinating Board is currently funding a grant to develop a similar curriculum.

3. *The Coordinating Board and the Legislature should increase formula funding rates for study in high-technology disciplines.*

Institutions receive most of their appropriations through funding formulas that provide different amounts of funding for teaching courses in different disciplines and at different levels. Two-year college formulas currently include a 10 percent bonus for a limited number of high-tech programs. Higher formula rates provide incentives for institutions to recruit students into those programs. A shortcoming of this strategy is that the formulas are an appropriation mechanism and not a budgeting device, and institutions are not obligated to expend funds in the same categories in which they “earn” them, although there is a general tendency to do so. Raising formula rates for a discipline also tends to divert funds from institutions that have low involvement in that discipline to institutions that have high involvement in that discipline.

4. *The Coordinating Board should regularly report high-tech degree production and transfer success to the Legislature and the general public.*

No independent source of information on high-tech degree production or transfer success is currently available. The Texas Higher Education Coordinating Board should report this data regularly.

5. *The Coordinating Board should adopt policies that will improve the ability of students in two-year college technical degree programs to transfer credits to baccalaureate degree programs.*

Students who complete technical associate degrees or certificate programs are typically able to transfer few of those credits to baccalaureate degree programs. This makes it difficult for these graduates, who have demonstrated an interest and capability in technology fields, to advance in their careers.

6. *The Coordinating Board and boards of regents and trustees should designate some institutions as “rapid deployment institutions” with authority to implement a range of workforce development programs without prior approval of the Coordinating Board or board of regents or trustees.*

Industry often voices a complaint that institutions are not sufficiently “nimble” in responding to their needs for new and specialized programs because they must seek approval at multiple levels.

Under this strategy, institutions would apply for authority to implement a range of programs in an area in which they had a demonstrated competence, and boards would delegate to institutions authority to implement needed workforce development programs in that area without further approval.

Strategies that could be implemented primarily by the Legislature

7. *The Legislature should create a fund that would competitively award funds that colleges and universities could use to match industry contributions for acquiring equipment, software, or maintenance for high-tech instructional laboratories.*

Start-up costs for equipping teaching laboratories are a major problem for institutions at all levels. The Legislature should provide an incentive for industry to help institutions address

these problems.

8. The Legislature should provide student aid programs to encourage students to pursue degrees in high-tech fields, as is done in Maryland, Missouri, and Pennsylvania. However, these programs should be designed to operate “on the margins” so that they bring additional students into high-technology programs, not simply subsidize students who would enter these programs in any event.

These states have implemented programs that provide aid in the form of free tuition for information technology students, loan forgiveness programs for students who work in the state, or outright cash grants. Texas currently has a loan forgiveness program for teachers who work in areas with critical teacher shortages.

9. The Legislature should provide funding incentives for producing graduates from high-technology disciplines.

Current funding formulas provide funding for teaching courses but do not reward institutions for producing graduates. Some would argue that this promotes overly long degree programs, inadequate attention to advising, and low degree production. It has been suggested that at least some portion of institutional appropriations should be based on the number of graduates produced. Others argue that this would motivate institutions to graduate unqualified students.

10. The Legislature should designate some institutions as centers of excellence, charge them with the responsibility to take a leadership role in specific high-tech disciplines, and provide those institutions supplementary funding.

Several states have designated specific institutions as “centers of excellence” in specific areas. Legislatures typically provide additional funding for those program areas. The institutions, in turn, are expected to produce a significant number of graduates in the area and provide statewide leadership in developing academic and research programs in the area.

11. In allocating capital funds, the Legislature and boards of trustees and regents should give a priority to projects that enhance facilities supporting workforce development.

The Legislature and governing boards allocate over \$500 million each year for capital construction projects. Sources of funds include Higher Education Assistance Funds (HEAF), Permanent University Fund (PUF), tuition revenue bond authorizations, and local taxing district funds. In making these allocations, a priority should be given to facilities that support high-tech workforce development programs.

12. The Legislature should include high-tech degree production among performance measures included in the General Appropriation Act.

The General Appropriations Act currently includes a number of performance indicators. High-tech degree production should be added to those performance indicators.

Strategies that could be implemented primarily by trustees and regents

13. Boards of trustees, board of regents, and high-tech industry managers should provide incentives to make partnerships between industry and academic institutions a part of the culture of their organization.

Most successful workforce development efforts involve true partnerships between academic institutions and industry. These partnerships take time to develop and typically involve many complex relationships.

14. Boards of trustees and regents should re-allocate resources from other disciplines to high-technology disciplines where student demand exceeds capacity.

There is evidence that student demand significantly exceeds capacity in at least some high-tech disciplines at a number of institutions. Where this is the case, boards of regents and trustees should take steps to meet that demand by diverting resources from other less-critical disciplines.

15. Boards of trustees and regents of institutions of higher education and technology corporations should adopt policies that encourage teaching by industry scientists and engineers in two-year college and university high-tech academic programs.

Partnerships in which industry scientists and engineers bring their experiences to the classroom provide benefits to both industry and academic institutions. Employment policies in both academic institutions and industry often discourage these partnerships.

Strategies that could be implemented primarily by institutions

16. Institutions and industry should cooperate to provide teachers, counselors, parents, and students more and better information regarding career opportunities in high-technology fields.

In an effort to “develop a market” for high-tech degree programs, institutions should provide students in elementary and secondary schools as well as currently enrolled students and their parents with more and better information regarding career opportunities in high-tech fields.

17. Institutions should make curriculum modifications to introduce more representative experiences earlier in high-tech academic programs.

There is some evidence to indicate that high drop-out rates in science and engineering programs are related to the fact that students seldom are exposed to experiences similar to those of a typical high-tech worker until the last year of their undergraduate programs. Some institutions have had success in lowering drop-out/transfer rates by bringing those experiences into freshman and sophomore course work.

18. Institutions should increase the incorporation of proprietary information technology certificate programs into relevant academic programs.

Proprietary information technology certificate programs, such as certifications provided by Microsoft, Novell, and Cisco, provide a valuable credential for students and employers. Several Texas two-year colleges offer these certification programs. Widespread incorporation of these

programs into relevant academic programs, where appropriate, would help meet a critical need for information technology workers with specific skills.

19. Both two-year and four-year institutions should provide training resulting in proprietary information technology certification programs as part of their continuing education programs. See above.

20. Institutions should give a priority to professional development of faculty in high-tech disciplines.

A number of institutions indicated that few resources are available for professional development of faculty teaching in high-tech programs, especially in community and technical colleges. Because the knowledge base for these programs changes rapidly, institutions should give a priority to faculty in these disciplines when allocating professional development resources, including sabbaticals, travel funds, and related items.

21. Institutions should place more emphasis on short-term training programs to meet industry needs that may or may not result in certificates or degrees.

Industry needs people with specific skills. Institutions can help industry and job-seekers by providing training programs that make students employable.

22. Cooperative education programs should be strengthened and expanded.

These programs provide students with work experience, usually in alternate semesters during their academic programs. While they do lengthen time-to-degree slightly, they provide financial aid to students, create more productive graduates, and give students a better understanding of the work for which they are preparing.

Strategies that could be implemented primarily by technology companies

23. Industry should provide more opportunities for faculty members to work in industry during summers or during sabbaticals.

These opportunities make faculty members' teaching and research more relevant, update faculty skills, and assist in faculty retention.

24. Industry should sponsor public service announcements and engage in other activities designed to generate interest in high-tech careers.

Industry should be proactive in supporting activities that encourage elementary and secondary students to consider careers in high-tech fields and otherwise promote a better understanding of high-tech career opportunities.

25. Industry should link degree or certificate completion to recruiting, employment, and salary policies.

Companies that hire students prior to completion of their academic programs provide a disincentive for students to complete those programs and limit their opportunities for future advancement. The policies of the Houston technology initiative are a good model.

Some additional sources of information on technology workforce development in Texas

American Electronics Association. *Cyberstates*, v. 3.0, 1999. Available from American Electronics Association, 601 Pennsylvania Avenue, NW, Suite 600, North Building, Washington, D.C. 20004 or on the web site www.aeanet.org

Texas State Occupational Information Coordinating Committee. Emerging and Evolving Occupations in Texas, 1999. Available from the Texas Workforce Commission

Texas Healthcare and Biosciences Institute. *Index of the 1998 Texas Healthcare Technology Industry, 1998*. Available from the Institute, 815 Brazos Street, Suite 310, Austin, TX 78701

Texas Comptroller of Public Accounts. "Help Wanted – Everywhere!," *Fiscal Notes*, February 2000.

Texas Strategic Economic Development Planning Commission. *Texas Strategic Economic Development Plan 1998-2008*. Available from the Texas Council on Workforce and Economic Development

Texas Science and Technology Council. *Developing Texas' Technology-Based Economy: Report of the Texas Science and Technology Council*, April 1998. Available from the Office of the Governor

U. S. Department of Labor Bureau of Labor Statistics. Employment data available on the web site www.stats.bls.gov



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