

The Austin/San Antonio Corridor: The Dynamics of a Developing Technopolis

By: **Raymond W. Smilor, George Kozmetsky and David V. Gibson**

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Abstract:

Examination of the factors contributing to the development of the Austin/San Antonio corridor as a high-technology center in the years 1945-1986. The paper uses a conceptual framework called the Technopolis Wheel, which identifies seven segments as fundamental in regional high-tech growth: university, large and small technology companies, state-local-and federal government, and support groups (e.g., chambers of commerce). The major contribution of the paper is its emphasis on using multiple data sources to measure the relative importance of these segments. It concludes with case studies of Microelectronics and Computer Technology Corporation (MCC) in Austin and the biotechnology sector in San Antonio.

Keywords:

Austin, Texas; San Antonio, Texas; economic development; technopolis; Microelectronics and Computer Technology Corporation (MCC)

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THE AUSTIN/SAN ANTONIO
CORRIDOR: THE DYNAMICS
OF A DEVELOPING TECHNOLIS

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THE AUSTIN/SAN ANTONIO CORRIDOR:

The Dynamics of a Developing Technopolis

INTRODUCTION

The Austin/San Antonio Corridor is a strip of land approximately 100 miles long in the heart of Texas. Interstate Highway 35 connects Austin on the north end of the Corridor to San Antonio on the south end. To the east side of the highway lies the Blackland Prairies, some of the richest farmland in the United States. To the west of the highway lies the famous Hill Country of Central Texas.* (See Appendix A).

By the 1980s the Austin/San Antonio Corridor began to attract national and international attention as a high-technology center. In 1983 with the location of the Microelectronics and Computer Technology Corporation (MCC), Austin made headlines in the New York Times, the Wall Street Journal and the world press as the next great "Silicon Valley." Nicknamed "Silicon Prairie," "Silicon Gulch" and "Silicon Hills," the area experienced a unprecedented wave of enthusiasm because of the perception that it had suddenly become a major technology center. Between 1984-1987, the corridor began to experience a series of problems revolving around a general economic recession in the state, cut backs in higher education funding, changes in local governmental attitudes, a speculative development cycle that ended in a plethora of foreclosures and a loss of direction for this technopolis.

*There are two other developing technopoleis in Texas: The Dallas-Fort Worth Metroplex and the Houston area north to the Woodlands.

What accounts for the development of the Austin/San Antonio Corridor as a technopolis? How deep are the institutional roots? How wide are the implications? What is required to continue the momentum for this developing technopolis?

This paper looks at a number of critical components in the development of this technopolis. The research traces the most important events in a number of sectors from 1945 through the end of 1986. During this period of time, the Austin/San Antonio Corridor moved from being an essentially small university town within a state capital on the north and a military dependent town on the south to a developing technopolis within a region of relative general economic slowdown. This research seeks to describe the most important environmental forces, organizational issues, key individuals, and public-private sector relationships which contributed to the growth of this technopolis.

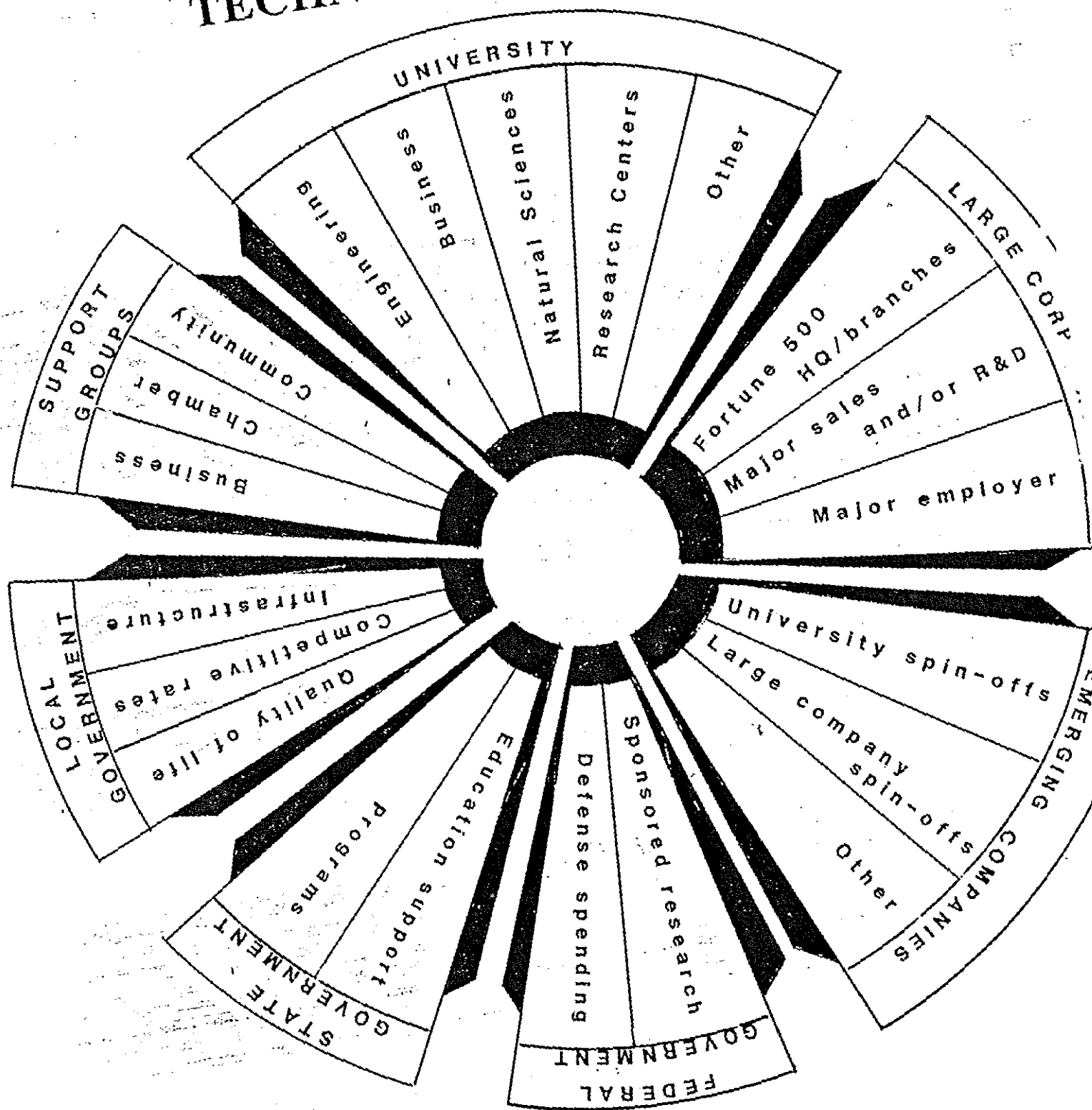
This paper develops a conceptual framework, which we call the Technopolis Wheel, to describe the process of technology development and economic growth in the Austin/San Antonio Corridor. We believe this concept of the Technopolis Wheel has important implications for the development of other technopoleis. In the U. S., the Wheel reflects the interaction of major segments in the institutional make-up of a technopolis. It seeks to assess the impact among and between seven segments of the technopolis, all of which contribute to or inhibit the development of the technopolis. These seven segments include: the university, large technology companies, small technology com-

panies, state government, local government, federal government and support groups. This paper also considers as most important key individuals, whom we label influencers, who link the seven segments of the Wheel. See Figure 1.

New kinds of institutional developments between business, government and academia have been emerging to promote economic development and technology diversification. Several studies have begun to analyze these new relationships and organizational structures. (See General Selected Bibliography.) They have sought to evaluate the impacts and ramifications of new kinds of relationships between business, government, and universities, particularly as they pertain to technology development and diversification.

A fascinating paradox has emerged--the paradox of competition and cooperation in the development of a technopolis. On the one hand, a great deal of competition takes place between universities, companies, and public and private-sector entities. On the other hand, cooperation is essential for a technopolis to develop. Segments within the technopolis must find new ways to cooperate while competing at the same time. This study looks at some of the dynamics of this paradox of competition and cooperation and the new kinds of institutional developments that have emerged to deal with it. Our own conceptual framework of the Technopolis Wheel seeks to explain some of the components of these new relationships for competition and cooperation. It focuses on the concept of networking, that is, the ability to link

FIGURE 1 TECHNOPOLIS WHEEL



Source: The Authors

public and private sector entities, some of which had previously been adversarial, to effect change.

The methodology for this study utilized several research approaches. It focused on extensive data collection, primarily analysis of archival material, surveys and interviews to identify and understand the dynamics of this technopolis.

DEFINING AND MEASURING THE TECHNOLIS

Technopolis comes from the Greek term of "techno," meaning technology, and "polis," meaning city-state. In the U. S., the modern technopolis is one that interactively links technology development with the public and private sectors to spur economic development and promote technology diversification. Three factors are especially important in the development of a technopolis and provide a way to measure the dynamics of a modern technology city-state. These are:

1. The achievement of scientific preeminence.

A technopolis must earn national and international recognition for the quality of its scientific capabilities and technological prowess. This may be determined by a variety of factors including R&D contracts and grants; chairs professors

and fellowships in universities; membership of faculty and researchers in eminent organizations such as the National

Academy of Sciences and the National Academy of Engineering;

the number of Nobel Laureates; and the quality of students as

measured by the number of national merit scholars. In addition, scientific and technological preeminence may be measured through newer institutional relationships such as industrial R&D consortia, academic and business collaboration, and research and engineering centers of excellence.

2. The development and maintenance of new technologies for emerging industries.

A technopolis must promote the development of new industries based on advancing cutting-edge technology. These industries provide the basis for competitive companies in a global economy and the foundation for economic growth. They may be in the areas of biotechnology, artificial intelligence, new materials and advanced information and communication technologies. This factor may be measured through the development of R&D consortia, the commercialization of university intellectual property, and new types of academic-business-government collaboration.

3. The attraction of major technology companies and the creation of home-grown technology companies.

A technopolis must impact economic development and technological diversification. This may be determined by the range and type of major technology-based companies attracted to the area, by the ability of the area to encourage and promote the

development of home-grown technology-based companies, and by the creation of jobs related to technologically based enterprises.

The rest of this paper covers the following topics:

1. Background of the Corridor
2. Austin/San Antonio Technopolis Segments:
 - A. The University
 - B. Large corporations
 - C. Emerging Companies
 - D. Federal Government
 - E. State Government
 - F. Local Government
 - G. Support groups
 - H. Influencers
 - I. Summary
3. Case Studies demonstrating the dynamics of the Technopolis Wheel:
 - A. MCC
 - B. Biotechnology
4. Conclusion

BACKGROUND OF THE CORRIDOR

The seeds of the Austin/San Antonio Corridor's development go back at least to World War II. During the early and mid-1940s, the military expanded their presence in both San Antonio and Austin. That presence began to contribute to the early stages of economic growth.

In 1950, the string of seven dams creating the Highland Lakes in Central Texas was completed. This completion provided a major improvement in the quality of life, particularly in recreation, and helped reshape the geography and perception of the area. Throughout the 1950's and early 1960's infrastructure improvements, such as the development of new airports and highways, were undertaken. When Lyndon Baines Johnson became president in 1963, increasing national and international attention was focused on the area of Texas where he was raised: the Hill Country of Central Texas.

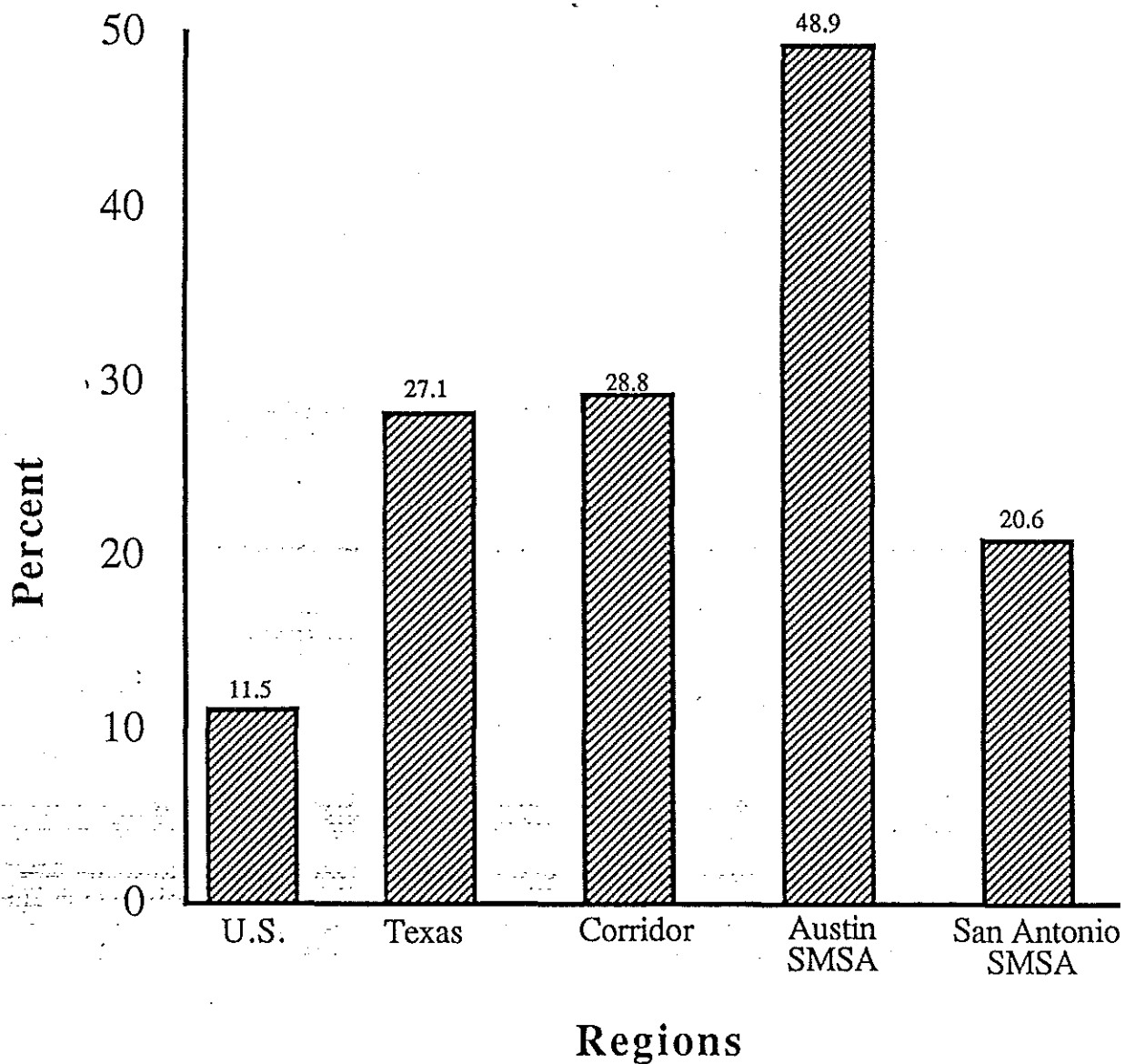
In the 1970's rising oil prices benefited all of Texas including the Corridor and allowed an expansion of state appropriations for higher education which in turn advanced the development of the technopolis. By 1980, as shown in Chart 1, the rate of population growth in the Corridor was 2.5 times that of the U.S. By the mid-1970s, the increasing growth in the Austin and San Antonio SMSAs began to raise questions about growth management and the benefits of growth in general.

The early 1980's were special years for Texans because of the state's approaching sesquicentennial in 1986, and centennial celebrations at the State's two flagship universities. The University of Texas at Austin, for example, made significant gains in new endowed faculty chairs, professorships, lectureships and fellowships.

These endowed positions were designed to help UT-Austin become a world class, research and teaching university. The national press focused

CHART 1

POPULATION GROWTH IN CORRIDOR 1970-1980



Source: The Emerging Economic Base and Local Government
Policy Issues in the Austin-San Antonio Corridor,
LBJ School of Public Affairs, UT-Austin, 1985

on UT-Austin as a major university of the future that could challenge the traditional standards set by Harvard and Stanford. Appendix B dramatically demonstrates the emerging perception of UT as U.C. Berkeley worried that "The Eyes of Texas are Upon Us," when UT-Austin created 32 \$1 million chairs for scientific preeminence. The development of the Austin/San Antonio technopolis reached a crescendo in 1983 when MCC chose Austin as its headquarters after a major and very public site selection process among some of the most visible high tech centers in the U.S.

In 1984, the dramatic and unexpected plunge in oil prices coupled with declining farm and beef prices caused a general economic decline: a state which previously enjoyed a budget surplus and no corporate or personal income taxes now faced budget deficits. The Austin/San Antonio Corridor in terms of the development of the technopolis began to loose its momentum.

AUSTIN/SAN ANTONIO TECHNOLIS SEGMENTS

This study uses the conceptual framework of the Technopolis Wheel to describe the development of the Austin/San Antonio Corridor. It considers each of the seven segments of the Wheel and shows their role in and impact on scientific preeminence, the development of new technologies and technology company formation.

THE UNIVERSITY SEGMENT

The nucleus in the development of the Austin/San Antonio Corridor as a technopolis is the university segment. In Austin, at the north

end of the corridor; The University of Texas at Austin has played the key role. In San Antonio, at the south end, The University of Texas Health Science Center and The University of Texas at San Antonio have played the key role.

An important point needs to be made about higher education in general in the Corridor. Other universities have also provided research, teaching, and training that contributed to the development of the Technopolis. Some of these include: Southwestern University in Georgetown (20 miles north of Austin); in Austin, St. Edward's University, Austin Community College, and Concordia College; Southwest Texas State University in San Marcus (20 miles south of Austin); in San Antonio, Trinity University, St. Mary's University, and Our Lady of the Lake College among others. These universities have over 139,000 students.

These universities, and especially UT-Austin, UT-Health Science Center and UTSA, have been pivotal in several ways:

- the fostering of research and development activities;
- perceptions of the region as a technopolis;
- the attraction of key scholars and talented graduate students;
- the spinoffs of new companies;
- the attraction of major technology based firms;
- a large talent pool of students and faculty from a variety of disciplines;
- a magnet for federal and private sector funding; and

- a source of ideas, employees and consultants for high technology as well as infrastructure companies, large and small, in the area.

Indeed, the fundamental point can be made that if the major research universities were not in place, and had not attained an acceptable level of overall excellence, then the Corridor could not have developed as a technopolis. See Figure 1. There would be little or no research and development funding; no magnet for the attraction and retention of large technology based companies; and no base for the development of small technology companies.

Interestingly, the only other flagship university in the state, Texas A&M University in College Station, 100 miles northeast of Austin, also impacted the Corridor through its major research activities. In fact, there is some speculation that the Technopolis of the Corridor may in fact eventually form a crescent by looping from Austin to College Station.

A number of factors are important in measuring the scientific and technological preeminence of the region, all of which center on the role of the research university. In this paper, we will focus on the University of Texas at Austin (UT) and the University of Texas Health Science Center in San Antonio (HSC) as examples of the critical role that a research university can play in the developing technopolis.

The University of Texas at Austin now claims two Nobel Laureats in physics and 38 faculty members who belong to the National Academies

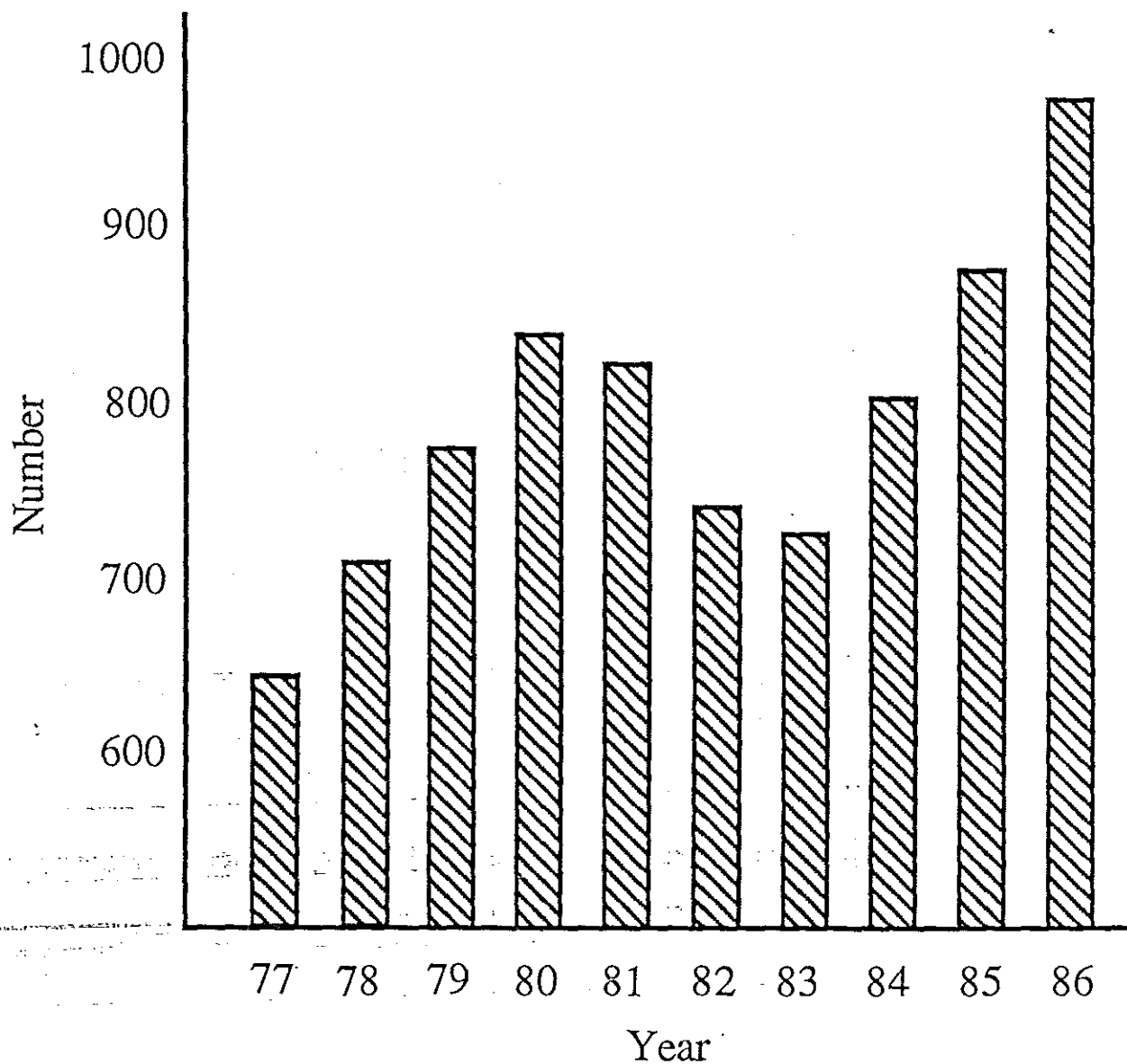
of Science and Engineering. In addition, the number of national merit scholar students has continued to rise from 361 in 1981 to 916 in 1986. In 1986, UT was second in total national scholarship graduates with only 87 fewer than Harvard.

Chart 2 shows the total number of contracts and grants awarded to UT-Austin by year from 1977 to 1986. Chart 3 shows the total dollar amount of contracts and grants awarded to UT by year from 1977-1986. These include both federal and non-federal sources of support. The number of contracts and grants declined in 1982-83 due to changes in federal funding policies and then increased steadily since 1983. A lot of the increase can be attributed to the UT Endowed Centennial program for chairs, professorships and fellowships. At the same time, the total amount has increased every year. In other words, centennial endowments have made a significant difference in attracting researchers who in turn attract additional research funds.

Non-federal funding to the university has also increased. Non-federal includes industrial, foundation and state sources of support. As shown in Chart 4, the number of non-federal contracts and grants from 1977 to 1986 has grown from 181 to 485. The dollar amount of these contracts and grants has grown from over \$7 million in 1977 to nearly \$25 million in 1986, as shown in Chart 5.

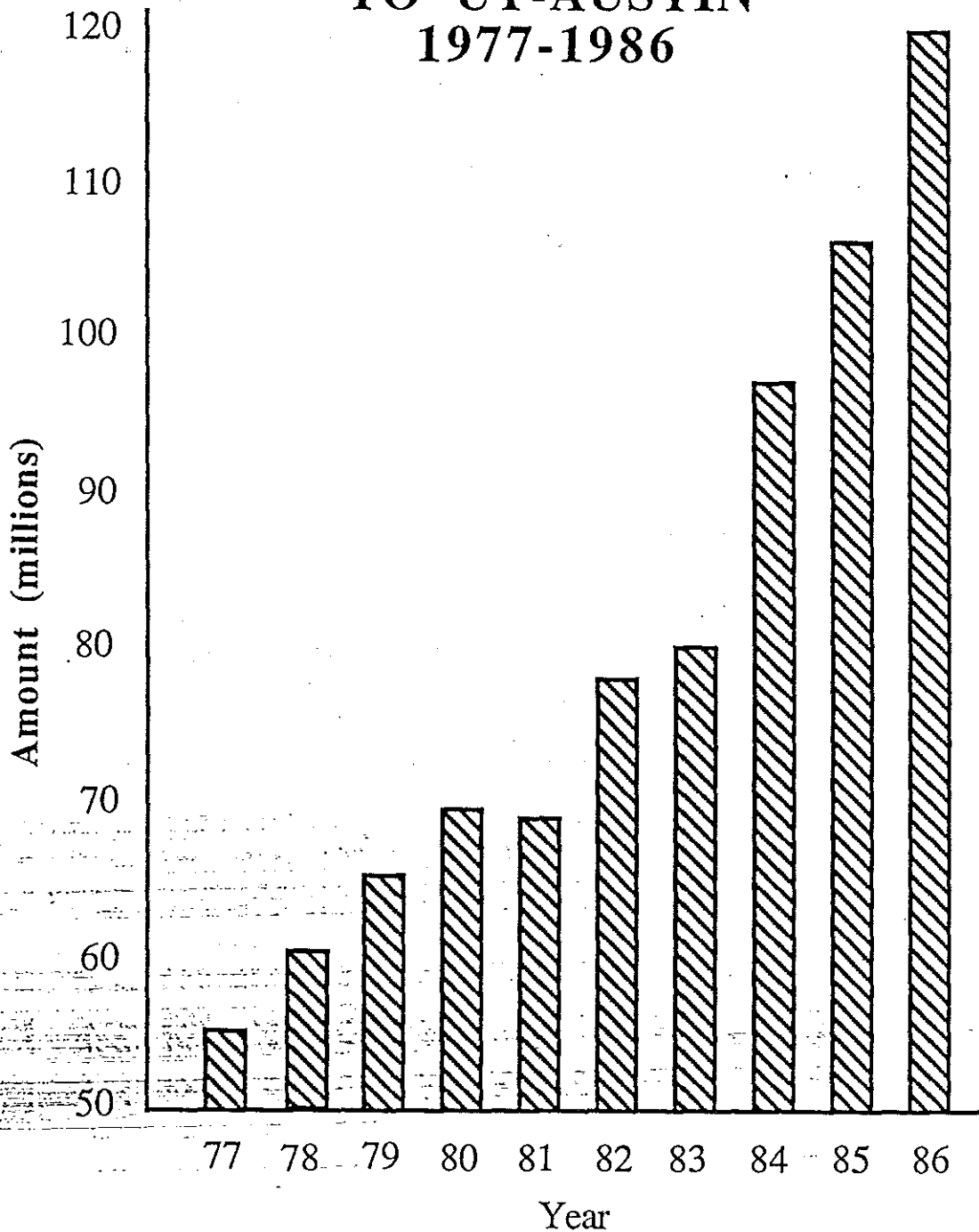
In addition, the university has established major organized research units in the College of Engineering and College of Natural Sciences. Table 1 shows 18 research centers in the College of

CHART 2
ANNUAL TOTAL NUMBER OF
CONTRACTS AND GRANTS
TO UT-AUSTIN
1977-1986



Source: Office of Sponsored Projects, UT-Austin,
September 14, 1978 though September 15, 1987

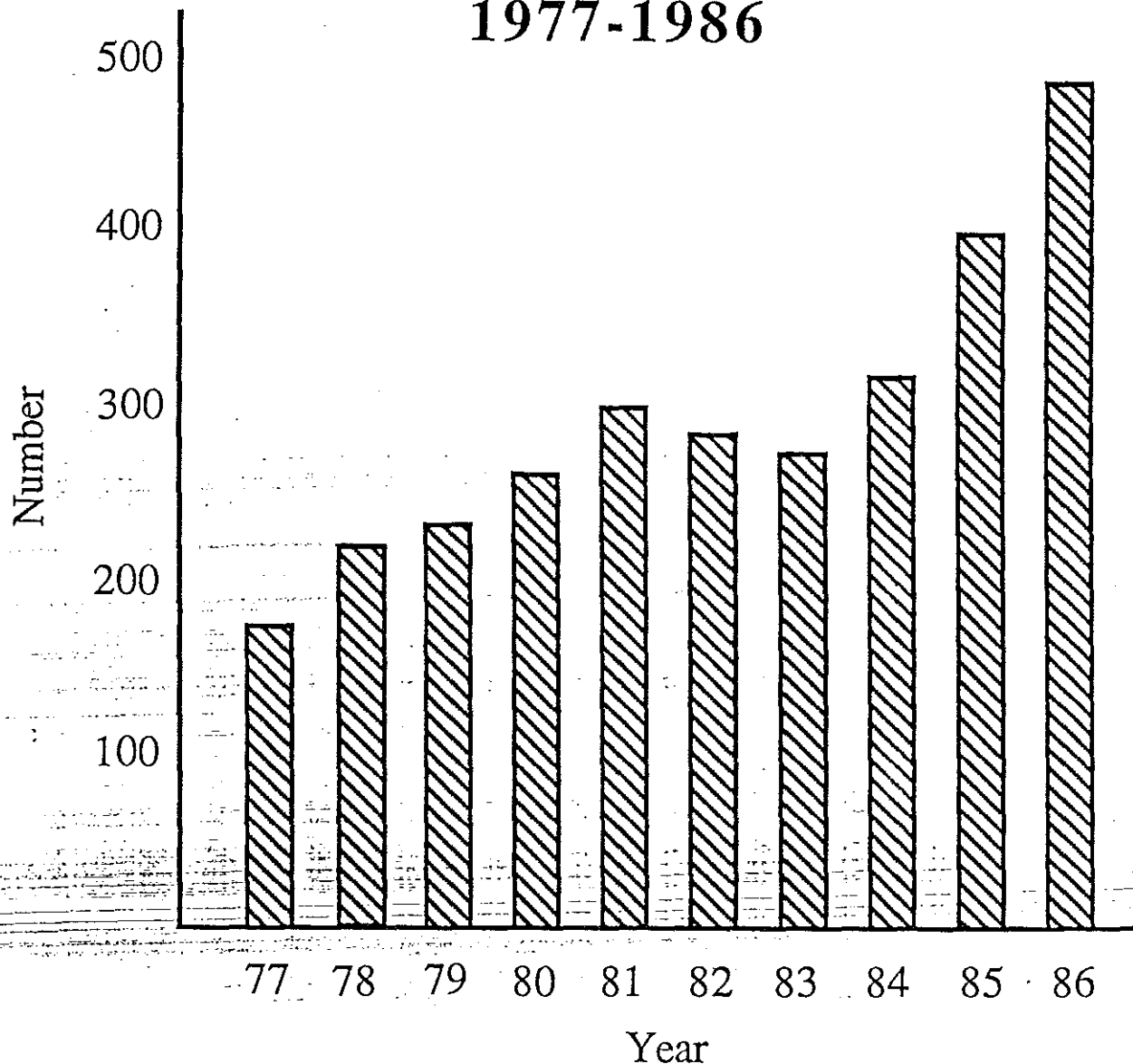
CHART 3
ANNUAL TOTAL AMOUNT OF
CONTRACTS AND GRANTS
TO UT-AUSTIN
1977-1986



Source: Office of Sponsored Projects, UT-Austin,
September 14, 1978 through September 15, 1986

CHART 4

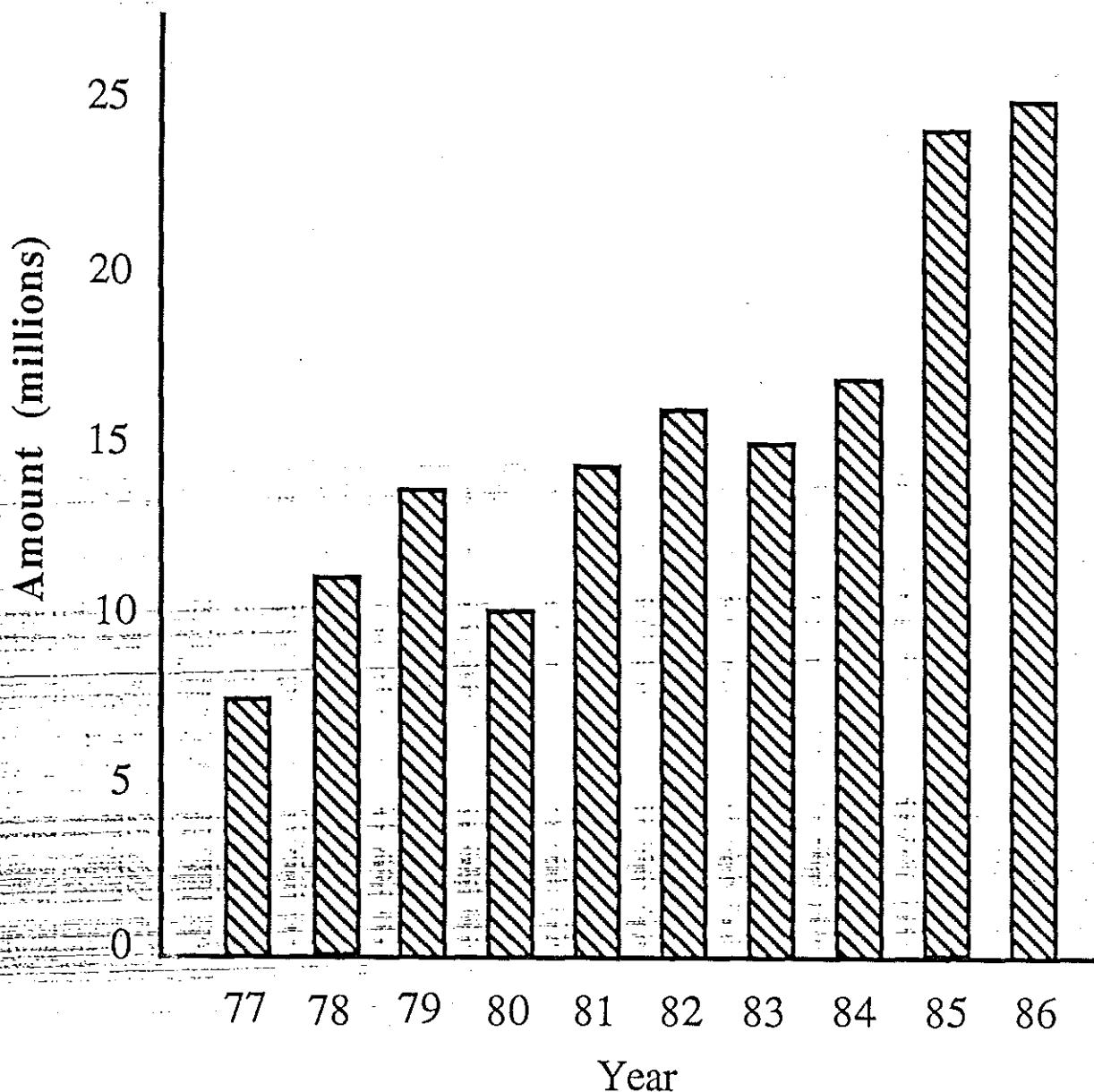
**ANNUAL TOTAL NUMBER OF
NON-FEDERAL CONTRACTS
AND GRANTS
AT UT-AUSTIN
1977-1986**



Source: Office of Sponsored Projects, UT-Austin,
September 14, 1978 through September 15, 1987

CHART 5

**ANNUAL TOTAL AMOUNT OF
NON-FEDERAL CONTRACTS
AND GRANTS
TO UT-AUSTIN
1977-1986**



Source: Office of Sponsored Projects, UT-Austin,
September 14, 1978 through September 15, 1986

TABLE 1
ORGANIZED RESEARCH UNITS IN ENGINEERING AT UT/AUSTIN
January 1987

	<u>Funding Levels</u>
Aeronautical Resarch Center	\$ 415,491
Texas Institute for Computational Mechanics	415,018
Computer and Vision Research Center	399,487
Construction Industry Institute	1,425,519
Center for Earth Sciences & Engineering	253,266
Electrical Engineering Research Lab	941,150
Center for Electromechanics	11,096,384
Electronics Research Center	699,255
Center for Fusion Engineering	460,081
Geotechnical Engineering Center	461,975
Center for Materials Science & Engineering	1,709,255
Microelectronics Research Center	2,041,240
Center for Enhanced Oil & Gas Recovery Res.	691,355
Center for Polymer Research	1,356,817
Center for Space Research & Applications	1,558,102
Phil M. Ferguson Structural Engineering Lab.	859,081
Center for Transportation Research	3,224,539
Center for Research in Water Resources	908,084
TOTAL: 18	<hr/> \$28,916,099

Engineering with a total funding in 1986 of \$28,916,099. Table 2 shows 32 research centers in the College of Natural Sciences with a total funding in 1986 of \$21,354,719. Many of these research units are in emerging, cutting-edge technological areas.

The number of endowed fellowships, lectureships, professorships and chairs in the University of Texas at Austin has increased significantly since 1981. Chart 6 indicates the cumulative total of endowed fellowships and lectureships in business, engineering and natural sciences from 1981 through 1986. Fellowships and lectureships in business have increased from 2 to 68. Fellowships and lectureships in engineering have increased from 0 to 67. Fellowships and lectureships in natural sciences have increased from 2 to 50.

Chart 7 indicates the cumulative total of endowed professorships in business, engineering and natural sciences from 1981 through 1986. Professorships in business have increased from 20 to 71. Thirty-two of the 71 professorships were filled by the end of 1986.

Professorships in engineering have increased from 30 to 59. Fifty-one of the 59 professorships were filled by the end of 1986.

Professorships in natural sciences increased from 12 to 75. Forty-three of the 75 professorships were filled by the end of 1986.

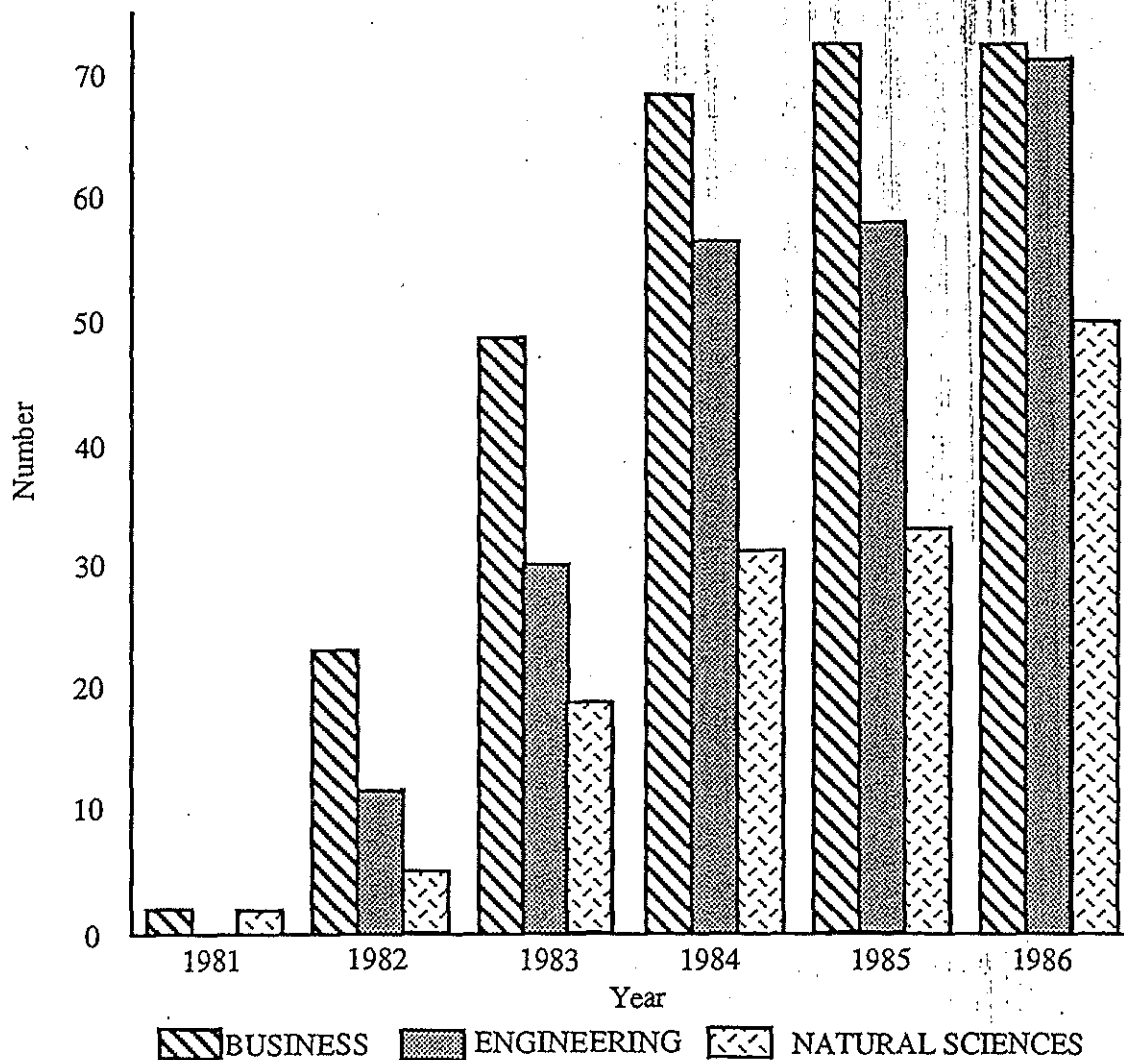
Chart 8 indicates the cumulative total of endowed chairs in business, engineering and natural sciences from 1981 through 1986.

Chairs in business increased from 3 to 20. Twelve of the 20 chairs were filled by the end of 1986. Chairs in engineering increased from

TABLE 2
ORGANIZED RESEARCH UNITS IN NATURAL SCIENCES AT UT/AUSTIN
January 1987

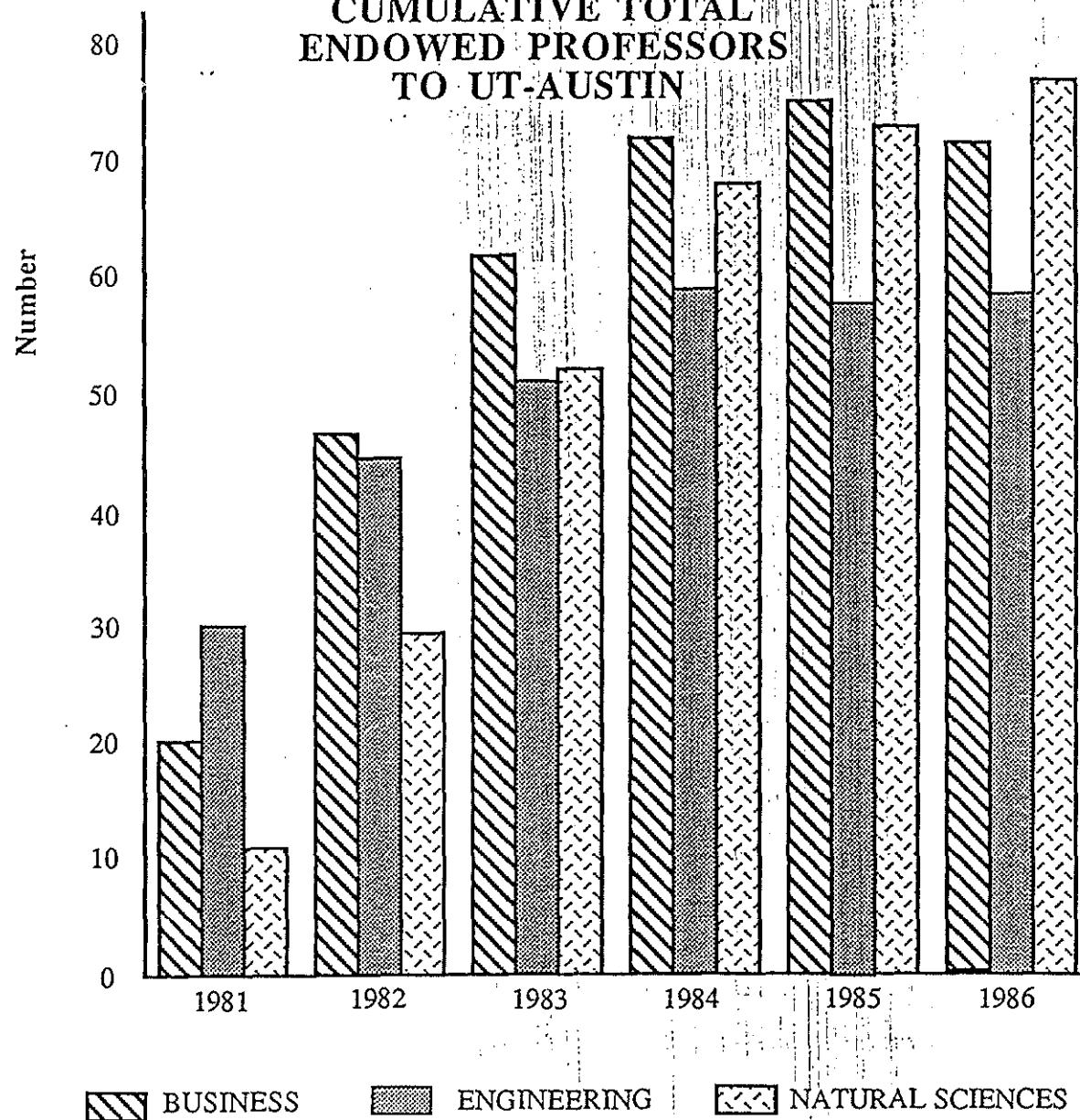
	<u>Funding Level</u>
Applied Microbiology, Center for	751,158
Artificial Intelligence Laboratory	1,422,556
Biomedical Research, Institute for	515,489
Brackenridge Field Laboratory	204,422
The Field Station	
Cell Research Institute	422,686
Central Hybridoma Facility	
Clayton Foundation Biochemical Institute	1,154,731
Institute for Computing Sci. & Computer Appl.	1,637,166
Culture Collection of Algae	153,005
Developmental Biology, Center for	520,446
Electrochemistry, Laboratory of	551,852
Fast Kinetics Research, center for	727,458
Fusion Research Center	5,507,251
Fusion Studies, Institute for	2,500,287
Genetics Institute	1,293,788
Ilya Prigogine Ctr for Stud in Stat Mech	400,311
Materials Chemistry, Center for	
Nonlinear Dynamics, Center for	424,378
Numerical Analysis, Center for	186,719
Particle Theory, Center for	225,094
Plant Resources Center	53,681
Protein Sequencing Facility	
Radiocarbon Laboratory	86,896
Reproductive Biology, Institute for	520,323
Relativity, Center for	279,081
Research Institute-Weinberg	
Research Instruments Laboratory	75,277
Statistical Sciences, Center for	149,281
Structural Studies, Center for	300,297
Theoretical Chemistry, Institute for	863,617
Theoretical Physics	252,603
Vertebrate Paleontology Laboratory	174,866
TOTAL: 32	\$21,354,719

CHART 6
CUMULATIVE TOTAL ENDOWED
FELLOWSHIPS/LECTURESHIPS
TO UT-AUSTIN



Source: Vice President for Development and University Relations, UT-Austin, September 1981 through February 1987

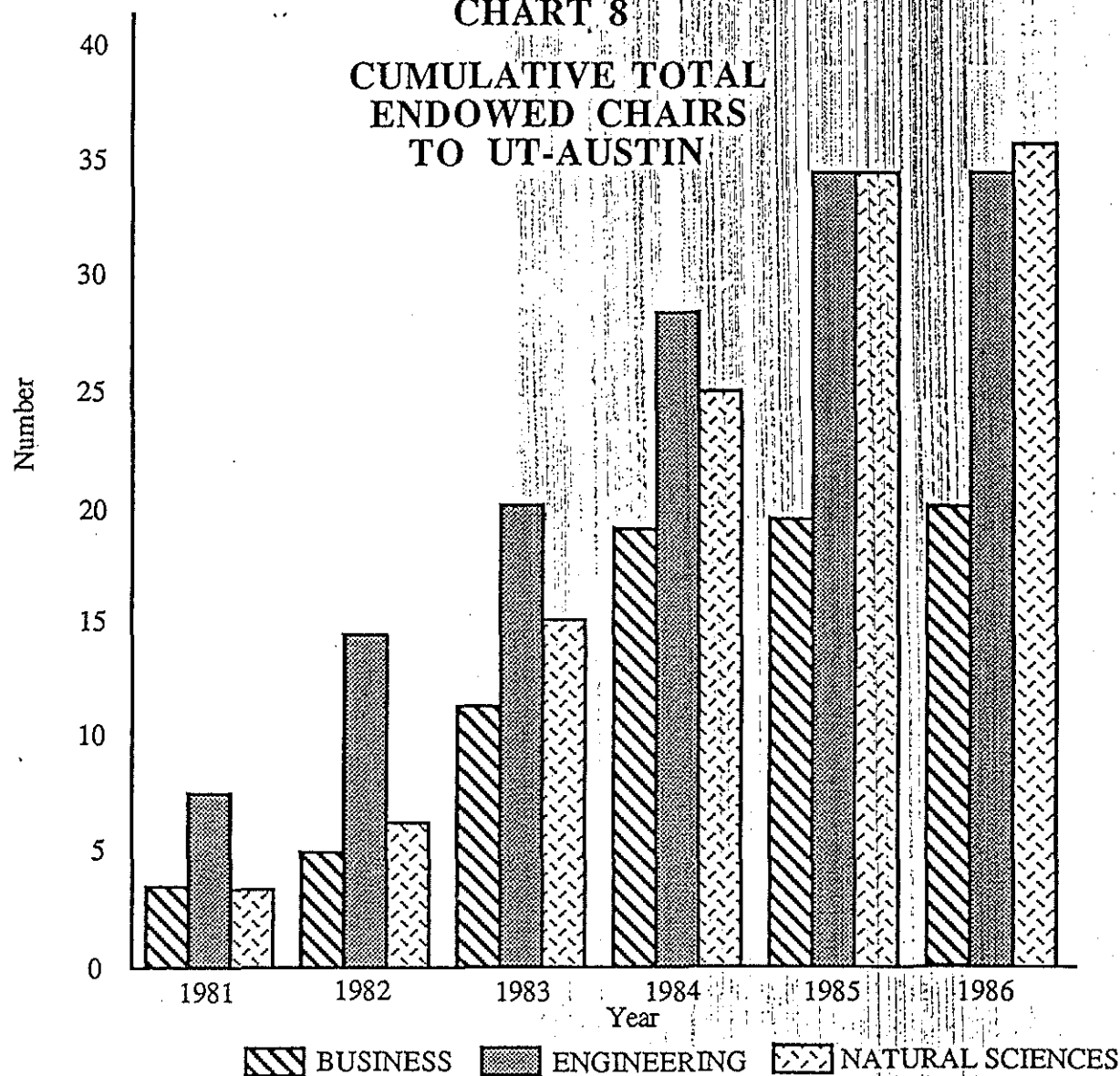
CHART 7
CUMULATIVE TOTAL
ENDOWED PROFESSORS
TO UT-AUSTIN



Source: Vice President for Development and University Relations, UT-Austin, September 1981 through February 1987

CHART 8

CUMULATIVE TOTAL
ENDOWED CHAIRS
TO UT-AUSTIN



Source: Vice President for Development and University Relations, UT-Austin, September 1981 through February 1987

7 to 34. Twenty of the 34 chairs were filled by the end of 1986.

Chairs in natural sciences increased from 3 to 36. Thirteen of the 36 were filled by the end of 1986.

The University of Texas Health Science Center at San Antonio is a health professions university and a leading biomedical education and research institute in the Austin/San Antonio corridor. The university has 700 full time faculty members, 3,400 employees and 2,200 students.

The university offers degrees in 5 schools: medical, dental, nursing, allied health sciences and the graduate school of biomedical sciences.

A cooperative Ph.D degree is offered with The University of Texas at Austin's College of Pharmacy.

Since 1975, the Health Science Center has more than quadrupled its grants of research funds. It had more than \$40 million in 1986 in

sponsored research projects. These major research areas include,

cancer, cardio-vascular disease, pulmonary and kidney disease, immunology, reproductive biology, aging, genetics, arthritis, nutrition and psychiatry. The HSC has three centers that are nationally funded.

These are the Multipurpose Arthritis Center, the Center for Research and Training in Reproductive Biology, and the Center for Development Genetics. In addition it has received a five-year grant from NSF to develop an Industry-University Cooperative Center for Bioscience and Technology.

In Texas, the state government is responsible for the major portion of funding for the budgets of public universities. The

University of Texas component institutions have also benefited tremendously from a Permanent University Fund (PUF), with a current book value at \$2.6 billion. The fund has been crucial to the development of the teaching and research excellence at UT, as well as in permitting the acquisition of modern facilities and laboratories. The PUF alone, however, is insufficient for the development of a technopolis.

Let this example drive the point home. In 1984 while oil prices were still about \$30 a barrel and state revenues increased by \$5.4 billion or 17 percent over the previous year, Texas was the only State in the nation to decrease appropriations for higher education, a decrease of 3 percent. In that same year, California increased its state appropriation for higher education by 31 percent over the previous year. It was at this point that UT's momentum toward teaching and research excellence, e.g. being able to fill endowed positions, began to slow down.

Consequently, despite UT's recent phenomenal growth in endowed chairs, professorships, lectureships and fellowships; despite the location of MCC in Austin; and despite national and international press claiming Austin/San Antonio a new center of excellence in education, the lack of sustained state support for higher education sent a mixed message to the best scholars and researchers whom the University was trying to attract.

In summary, as state allocations for higher education increased through the late 1970s and the early 1980s, the perception of the

development of the Austin/San Antonio Corridor as a technopolis outside the state increased proportionately as well. On the other hand, as the State of Texas began to cut back on its funding to higher education in 1983, the perception of the Corridor as a developing technopolis declined and the perception of retrenchment in the university began to emerge.

THE PRIVATE SECTOR

One way to measure the growth of high technology company development in the Austin/San Antonio Corridor is to track employment and high technology incorporations by SIC code over time. Table 3 shows employment in high technology industries in Austin and San Antonio as well as other Texas cities as of 1985 by SIC code. Chart 9 shows the incorporation of high technology companies in Austin from 1945 to 1985. Chart 10 shows the incorporation of high technology companies in San Antonio from 1945 to 1985. It is interesting to note that in 1984 and 1983, respectively, growth of these firms leveled off. These are manufacturing related technology firms. They do not include service related technology firms.

There are two other ways that we have tracked high technology company development in Austin. One is the founding or relocation of major technology-based companies. The other is an evaluation of a selected list of emerging technology-based companies.

The location and home-grown development of major technology based companies began in 1955. By "major" technology-based companies, we

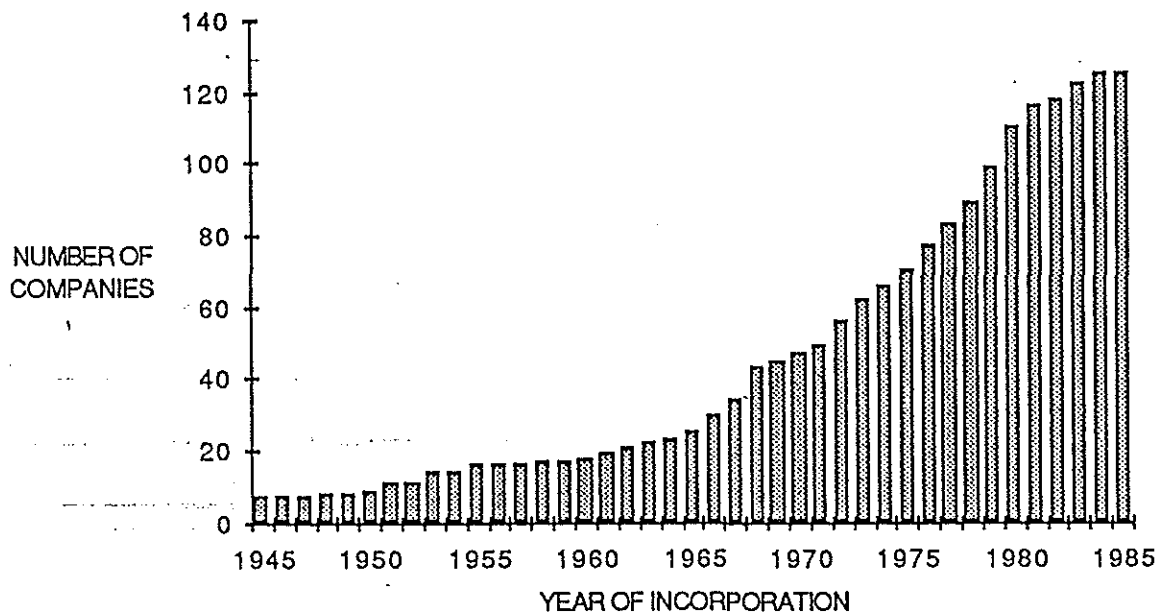
TABLE 3
EMPLOYMENT IN HIGH TECH INDUSTRIES IN TEXAS
1985

SIC Code	SMSA Industry	Austin	DFW	El Paso	Houston	San Antonio	Total
283	Drugs	962	1,413	0	435	303	3,113
348	Ordnance & Accessories (except vehicles and guided missiles)	0	1,437	0	79	4	1,520
357	Office computing and accounting machines	4,334	12,610	391	3,979	3,441	24,755
361	Electronic transmitting and distribution equipment	175	1,478	0	1,996	16	3,665
362	Electronic industrial apparatus	1,094	4,947	449	3,330	99	9,919
364	Electric lighting and wiring equipment	104	5,277	0	1,734	189	7,304
365	Radio & TV receiving equipment	36	416	0	411	32	895
366	Communication equipment	605	21,348	537	3,396	282	26,168
367	Electronic component and accessories	4,929	13,941	4,768	896	482	25,016
369	Misc. electronic machines, equipment and supplies	487	2,792	404	380	3,395	7,458
376	Guided missiles and space vehicles, parts	0	5,282	0	75	750	6,107
379	Misc. transportation equipment	122	2,096	4	524	227	2,973
381	Engineering, laboratory, science and research instruments and associated equipment	406	1,021	250	1,675	115	3,467
382	Measuring and controlling instruments	862	3,499	629	13,842	398	19,230
383	Optical instruments and lenses	79	1,194	16	144	0	1,433
384	Surgical, medical and dental instruments and supplies	523	1,489	391	1,439	213	4,055
385	Ophthalmic goods	0	1,026	4	259	0	1,289
386	Photographic equipment and supplies	24	837	75	340	37	1,313
387	Watches, clocks, clockwork operating devices and parts	32	1,048	0	0	83	1,163
TOTAL		14,774	83,151	7,918	34,934	10,066	150,843

Source: 1986 Directory of Texas Manufacturers, Bureau of Business Research, Graduate School of Business, The University of Texas at Austin

CHART 9

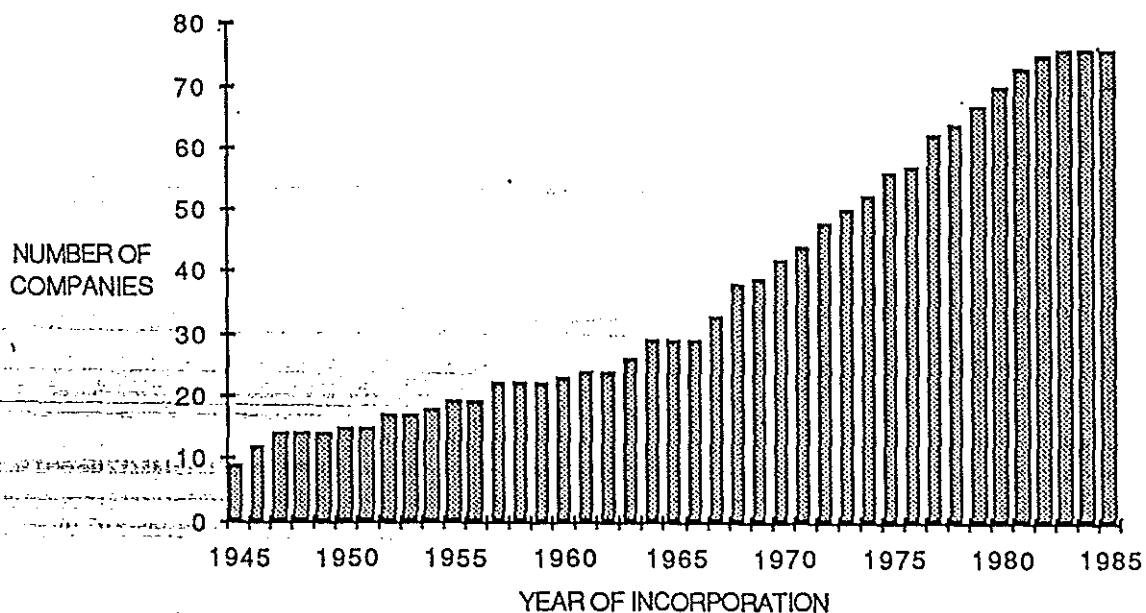
Cumulative Total of High Technology Manufacturing Companies in Austin by SIC Code



Source: 1986 Directory of Texas Manufacturers, Bureau of Business Research, Graduate School of Business, The University of Texas at Austin.

CHART 10

Cumulative Total of High Technology Manufacturing Companies in San Antonio by SIC Code



Source: 1986 Directory of Texas Manufacturers, Bureau of Business Research, Graduate School of Business, The University of Texas at Austin.

mean headquarters (of which Austin has one) and branches of Fortune 500 companies, and/or those companies with annual revenues or annual R&D budgets of over \$50 million, and/or those companies with over 450 employees in Austin. See Figure 1. As shown in the timeline in Figure 2, Austin currently has 32 such major firms.

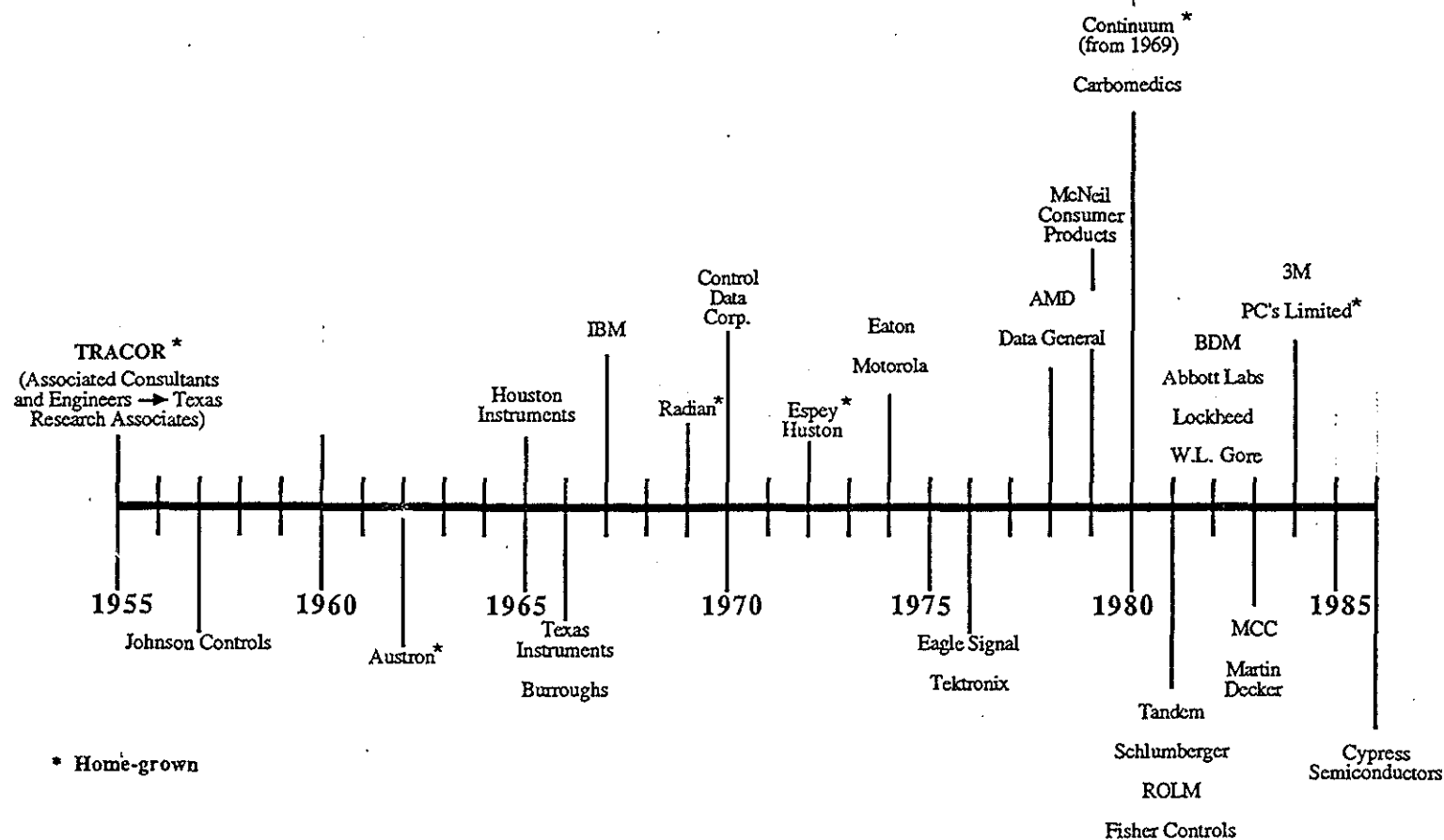
Six of the companies are home-grown, and all six have had direct or indirect ties to The University of Texas at Austin. In addition, the location of the other major firms in the area was dependent on two critical elements: the presence of The University of Texas at Austin, and the perception of an affordable high quality of life--that is, a place with high quality of life factors where a company could also make a profit. In addition, two four-year clusters are interesting to note: 1965-1969 and 1980-1984. Major events took place in each of these clusters. During the first, IBM located in Austin, and during the second, MCC located in Austin.

In addition to these major firms, a second tier of small and emerging companies has been steadily increasing. See Figure 1. We have been able to specifically identify 218 large and small high-technology related firms in existence in Austin in 1986.* Chart 11 shows their establishment in five year intervals from 1945-1985. Chart 12 shows the establishment of small and emerging technology related firms in existence in Austin in 1985 in five year intervals from 1945-1985. (These charts are non-cumulative. That is, they show the number of new firms established during each five-year period.)

*This list was developed from the Austin Chamber of Commerce database and the IC² Institute database.

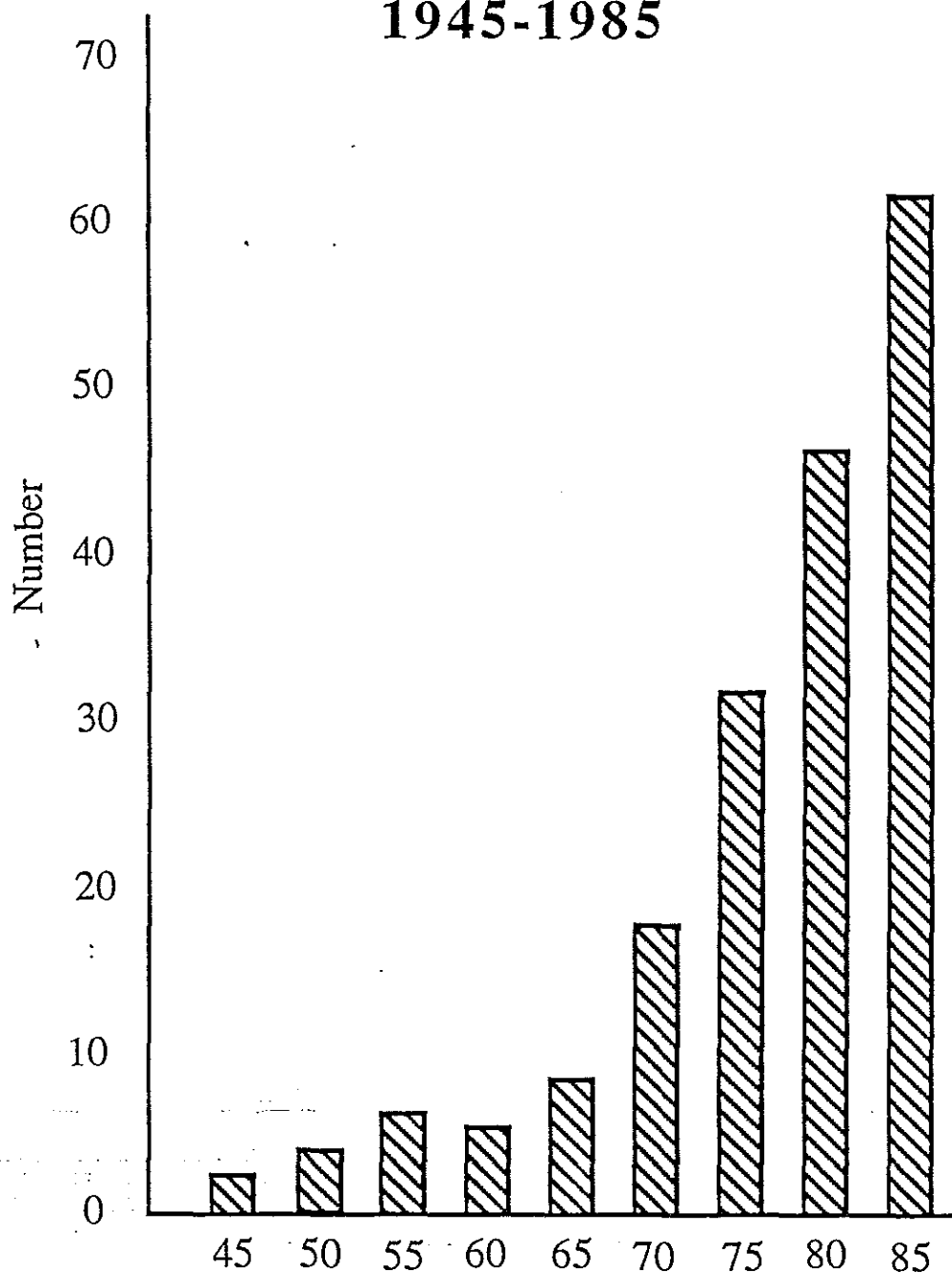
FIGURE 2

MAJOR COMPANY RELOCATION OR FOUNDING IN AUSTIN 1955-1986



Source: The Authors

CHART 11
ESTABLISHMENT OF HIGH
TECHNOLOGY
RELATED FIRMS OR BRANCHES
1945-1985

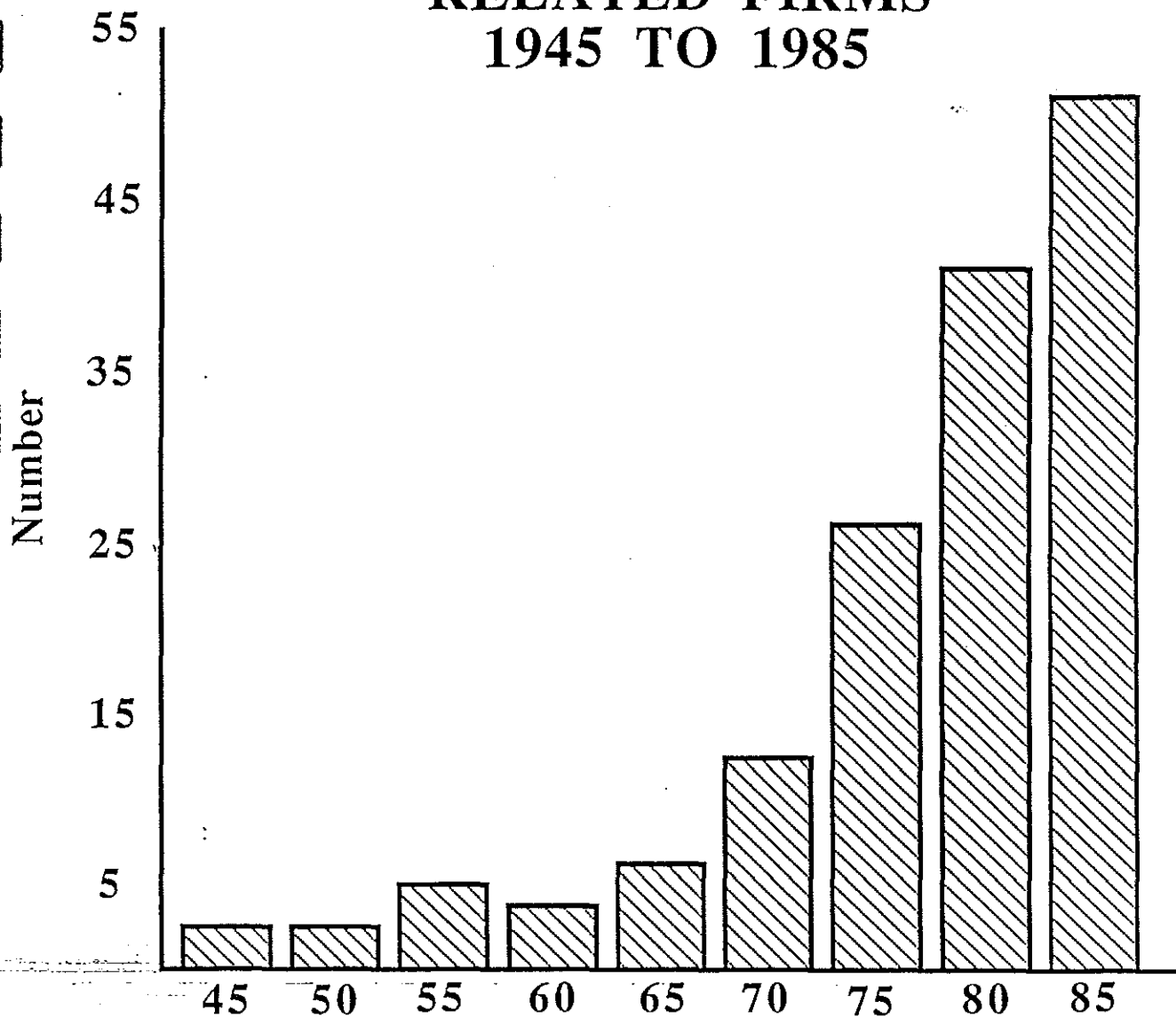


Five-year non-cumulative intervals - 1945-1985

Source: Directory of Austin Area High-Technology Firms, 1986-1987
Austin Chamber of Commerce, 1986.

CHART 12

**FOUNDINGS OF SMALL AND
MEDIUM-SIZED TECHNOLOGY
RELATED FIRMS
1945 TO 1985**



Five-year non-cumulative intervals 1945-1985

Source: Directory of Austin Area High Technology Firms, 1986, Austin Chamber of Commerce, 1986

Of 103 small and medium sized technology based companies in existence in 1986 for which IC² conducted a survey, 53 or 52% indicated a direct or indirect tie to The University of Texas at Austin. See Chart 13. These companies' founders were UT students, graduates, faculty members or employees. They demonstrate an important requirement for a technopolis -- the ability to generate home-grown, technology-based companies. These companies in turn have had a direct impact on job creation and economic diversification. Their tie to The University also enabled many of the companies to start their businesses with a contract that originated while they were involved in University research activities. In addition, the ability to continue their relationship in some capacity with The University was an influential factor in their staying in the area, along with their perception of an affordable high quality of life.

Another way to look at the tie to the University of Texas at Austin is to consider spin-out companies from selected departments and centers in the various Colleges. Table 4 shows the type of diversity of new company development from research activities. Companies have spun out of computer sciences, physics, applied research, engineering, structural mechanics, and business.

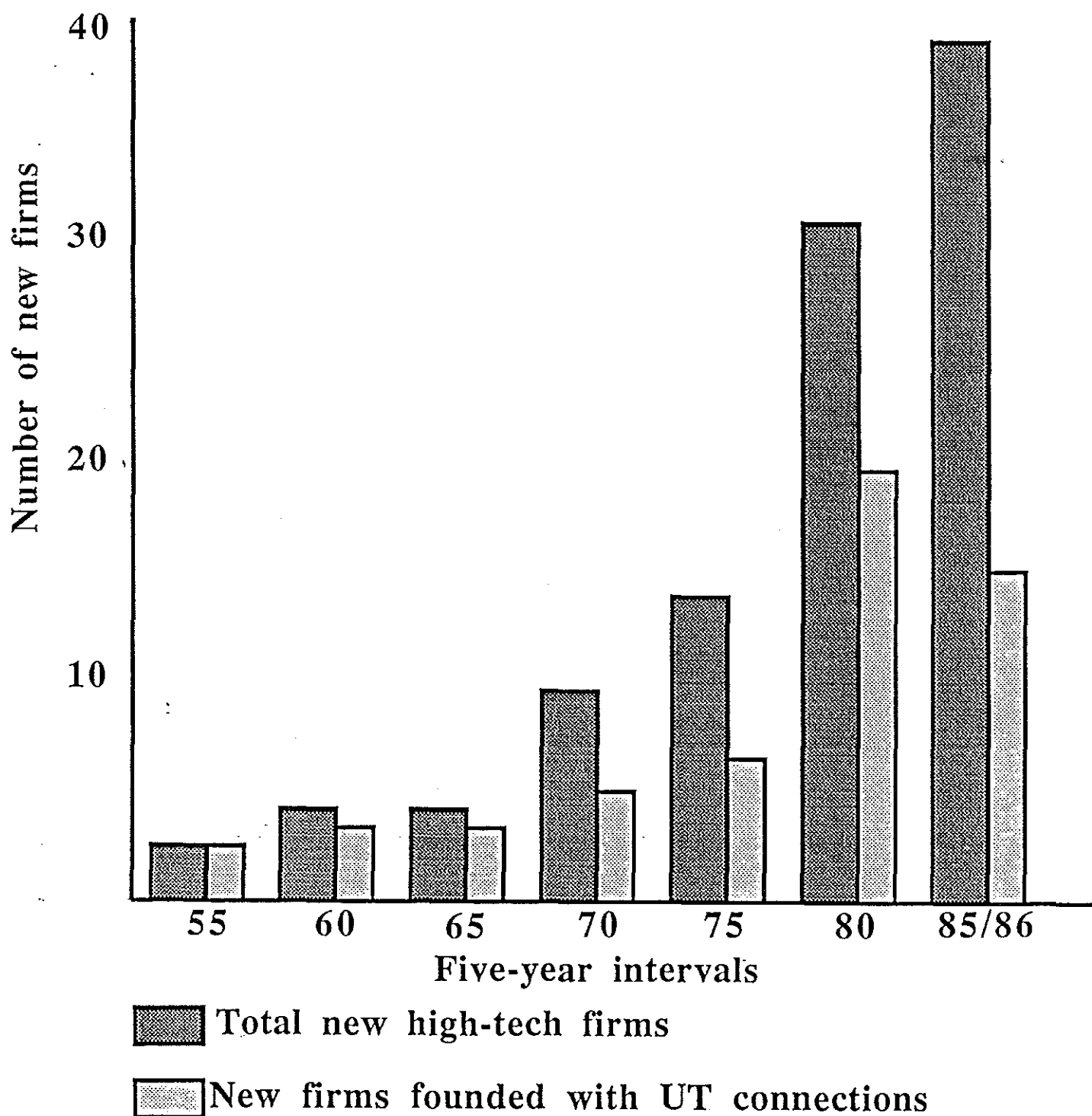
These factors can be effectively demonstrated through a case study of TRACOR, Inc.; a home-grown company that is also the only Fortune 500 company headquartered in Austin.

TRACOR CASE

Frank McBee, the founder of Tracor, earned both bachelor's (1947)

CHART 13

SMALL HIGH TECH FIRMS FOUNDED WITH UT CONNECTIONS



Source: The Authors

TABLE 4

SELECTED UT SPIN-OUTS
by DEPARTMENT.

Computer Sciences Department

Information Research Associates

MRI (since became a division
of INTEL)

Statcom

Knowledge Engineering

Cole & Vansickle

Computation Center

Balcones Computing Co.

Physics Department

Lacoste & Romberg

Astro Mechanics

Texas Nuclear

Columbia Scientific Ltd.

Scientific Measurement Systems

Eaton Corp.

Texion

Applied Research Laboratory

Modular Power Systems

Electro-Mechanics

National Instruments

Tracor

Engineering Department

Mesa Instruments

Geotronics Corp.

White Instruments

Wight Engineering

Structural Mechanics

Tekcon

College of Business

Execucom

ARC

Source: Kirk Ladendorf, Austin American-Statesman,
September 13, 1982.

and master's (1950) degrees in mechanical engineering at UT after serving as an Army Air Corps engineer from 1943-1946. After graduating, McBee decided to remain in the Austin area where he was raised. After his travels in the Army, he felt that Austin had the affordable quality of life that he wanted for himself and his family. He first worked as an instructor and then as an Assistant Professor in the UT Department of Mechanical Engineering. In 1950 he became the supervisor of the Mechanical Department of UT's Defense Research Laboratory (now called the Applied Research Laboratory).

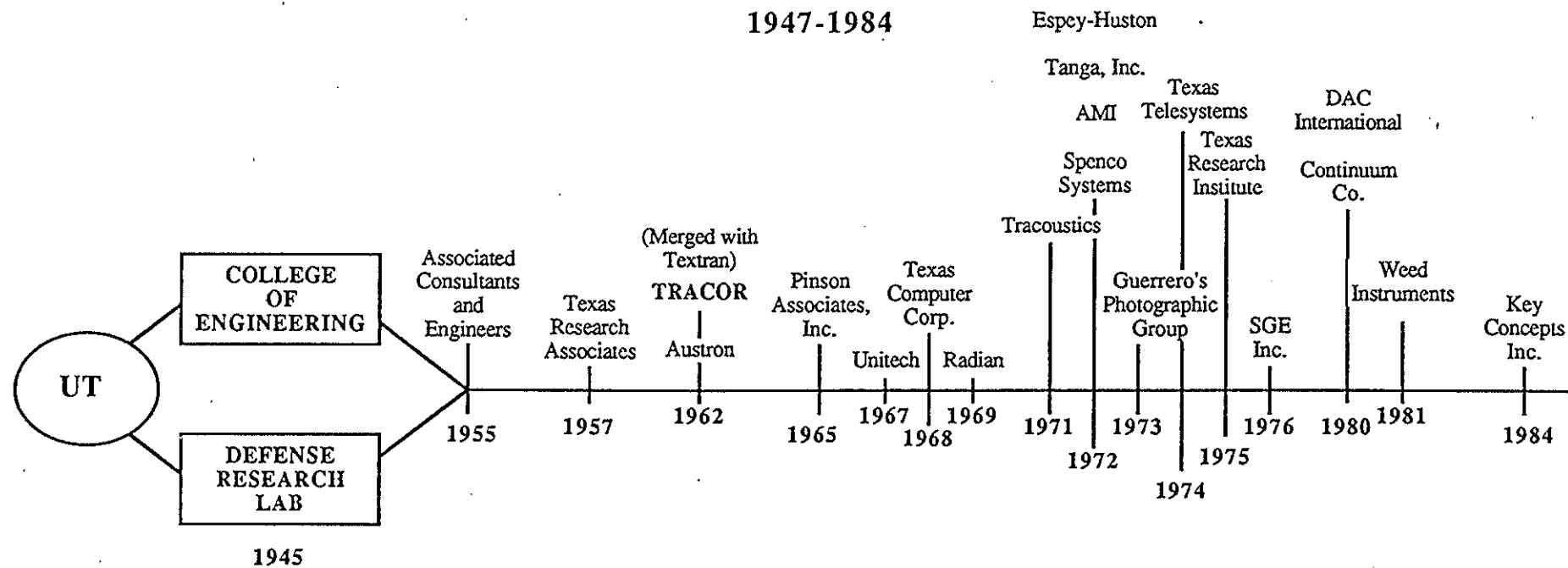
In 1955, with funding of \$10,000, McBee joined forces with three UT physicists and a UT-trained lawyer to form Associated Consultants and Engineers, Inc., an engineering and consulting firm. Drawing on their UT training and work experience, the four scientists focused their efforts on acoustics research. They were awarded a \$5,000 contract for an industrial noise reduction project. The company's name was changed to Texas Research Associates (TRA) in 1957. During the late 1950s, the four scientists taught and did research at UT while working on developing TRA.

In 1962, the firm merged with a company called Textran and adopted its present name of Tracor, Inc. By this time McBee had left the University of Texas to devote full time to building the company.

Figure 3 clearly shows that from the College of Engineering and the Defense Research Lab at the University of Texas at Austin came the educated talent to form the entrepreneurial venture of Associated

FIGURE 3

DEVELOPMENT OF TRACOR AND ITS SPIN-OUTS



Source: The Authors

Consultants and Engineers in 1955 which led to the establishment of Tracor in 1962. However, even more impressive is the constant stream of entrepreneurial talent that came from Tracor itself. At least 16 companies have spun-out of Tracor since 1962 and located in Austin.

Figure 4 and Chart 14 dramatically show the job creation impact of Tracor and its spin-outs on the Austin area. A total of 5,467 employees were employed in these companies as of 1985.

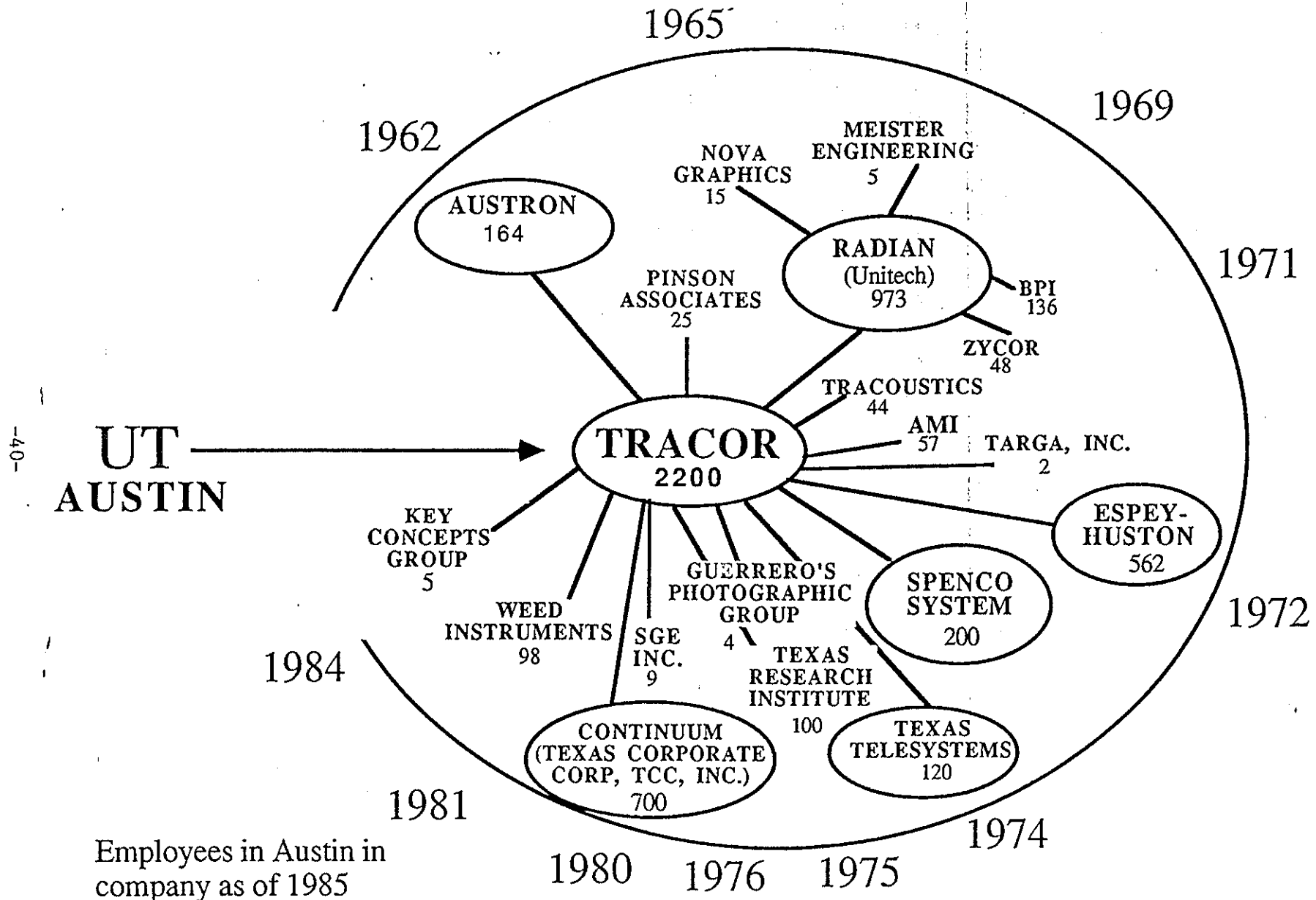
Perhaps most impressive is that some of these spin-outs have the potential of becoming Fortune 500 companies as their parent Tracor did. All are also capable of creating spin-outs of their own. Radian Corporation, as one example, has spun-out four companies. Most importantly, it must be remembered that neither Tracor and its spin-outs nor the jobs they created would exist without the University of Texas at Austin.

In summary, the private sector association with and effect on the technopolis can be summarized as follows:

- Companies have spun-out of The University system.
- Major firms have been attracted and chosen to locate here for two primary reasons: access to University resources, particularly the talent pool; and desire to participate in an affordable quality of life environment.
- Employment has grown around technologically based companies.

Figure 4

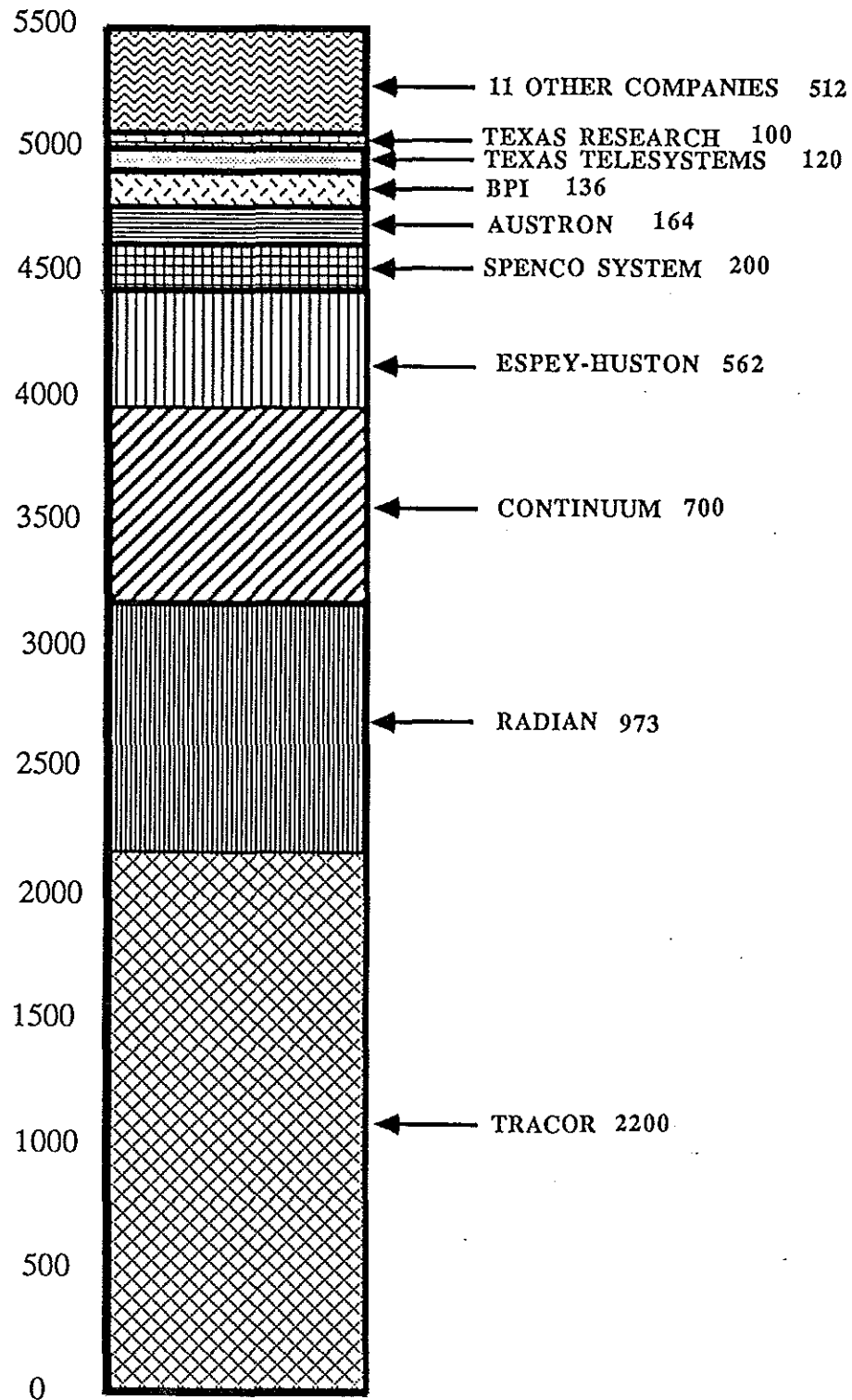
JOB CREATION IMPACT OF TRACOR AND ITS SPIN-OUTS



Total -- 5,467

Source: The Authors

CHART 14 JOB CREATION IMPACT TRACOR AND ITS SPIN OUTS



Source: The Authors

GOVERNMENT SEGMENTS

Federal, state and local government have also played a vital role in the development of the Austin/San Antonio Corridor as a technopolis. However, each level of government has impacted the respective areas' economic development in different ways.

The federal government has impacted the region in two key ways: through military involvement in the development and operation of U. S. military bases; and through federal funding for research and development activities onsite and at major universities in both cities. See Figure 1. Table 5 shows the impact of military bases in the Corridor. All the bases provide a general economic stimulation to the region through their employment of civilian and military personnel. For example, a San Antonio chamber of commerce study determined that the bases provide a \$2.6 billion impact annually on the city's economy.

As noted, state government in Texas is the primary source of support for public universities, including The University of Texas at Austin, The University of Texas at San Antonio and The University of Texas Health Science Center in San Antonio. See Figure 1. State funding for higher education had been increasing until 1983 when Texas cut back on appropriations for higher education, just when every other state was increasing funding for education. The result was that in 1984 and 1985 the image of Texas being committed to achieving excellence in education was questioned.

TABLE 5

DATA ON MILITARY BASES IN AUSTIN/SAN ANTONIO CORRIDOR

<u>Austin</u>	<u>Founded</u>	<u>Personnel</u>	<u>Annual Payroll</u>
Bergstrom	1942	1,000 C* 6,000 M**	\$167 million
<u>San Antonio</u>			
Fort Sam Houston	1876	6,000 C 12,000 M	42 million
Kelly AFB	1917	15,000 C 6,000 M	
Brooks AFB	1918	600 C 2,000 M	72 million
Lackland AFB	1941	8,000 C 11,000 M	
Randolph AFB	1930	2,500 C 5,500	

Medical Centers, Medical Training & Research Programs

Brooke Army Medical Center - 692 beds

- 200 on Gary Research Partners

The Institute of Surgical Research - \$1.3 Million Research Budget

Academy of Health Sciences - 32,000 resident students

- 42,000 correspondence course students

Wilford Hall USAF Medical Center - 1,000 beds

- 300 active clinical investigators

Aerospace Medical Division - \$120 Million Research Budget

C * Civilian

M** Military

Source: San Antonio Chamber of Commerce
and Military Bases Publications

Spurred by general economic slowdown and a desire to promote economic development, the 1987 state legislative session took a more proactive role. A series of new legislative proposals were presented to spur economic development and technological diversification. These include bills for business incubator support, state venture capital funding, a growth fund to spur product development and other programs designed to assist new company development.

While state government's primary role has been in relation to education, local government's primary role in Austin and San Antonio has focused on quality of life, competitive rate structures for such items as utilities, and infrastructure requirements. See Figure 1.

"Quality of life" carries different meanings given one's perspective and given the subjective attributes of the issues involved. In Austin, over the past years, quality of life has remained relatively high and relatively good in comparison to other technology centers. Perhaps the most dramatic statement in support of this view is the fact that MCC, which listed an affordable quality of life as one of its four main site selection criteria, decided to locate in Austin. A quality of life survey done at the time rated Austin as exceptional (when compared to San Diego, California; Atlanta, Georgia; and Raleigh-Durham, North Carolina) in terms of quality of primary and secondary schools, quality of parks and play grounds, outdoor recreational opportunities, community cleanliness, and as a place to live.

A more important point is that perceptions vary within any region undergoing rapid economic growth associated with a developing

technopolis. There is always the possibility that such growth will diminish the very qualities that caused the area to be so attractive to high technology companies in the first place.

This fine balance between a sustained quality of life and sustained economic development has been most visible throughout the development of the Austin/San Antonio Corridor. One of the main reasons Tracor located and grew in Austin and one of the main reasons Tracor spin-outs were able and wanted to locate in Austin was the affordable quality of life. Nevertheless, with each new economic development activity there was likely to be some community group which felt the loss of some, from their view central, aspect of Austin which made the city unique, desirable and affordable. Such a list of "losses" might include more days when Barton Springs Pool, the city's best swimming location, is closed down because the spring-fed pool is too full of silt from run-off at construction sites; the loss of landmarks, such as the Armadillo World Headquarters where music greats and yet-to-be greats performed in a casual, intimate setting; and the loss of affordable land and housing. The list could go on and would vary in intensity depending on one's point of view.

Over the history of the economic development of the Austin/San Antonio Corridor, local government has tended to favor the "developers" or the "environmentalists" depending on one's point of view. The issue becomes more complex because many "developers" are Austinites who also want to preserve Austin's quality of life. An

inspection of many of Austin's development projects supports the view. On the other hand, many "environmentalists" also favor economic development. Indeed, quality of life and economic development are two sides of the same coin: each has a vital impact on the other.

Nevertheless, local government has gone through cycles of support for or opposition to perceived quality of life in the city. When local government supports the perception of quality of life, then the development of the technopolis increases, that is, company relocation seems to be facilitated and obstacles to development seem to diminish. When local government believes quality of life is diminishing, then the development of the technopolis decreases, that is, company locations go to outlying cities, obstacles for development increase (such as high utility rates or slower permitting procedures), and the ability to work with diverse segments of the community declines.

One final point needs to be made concerning the quality of life issue. While "environmentalists" and "developers" may disagree on what makes for sensible environmental/development policy, most would agree that overall quality of life suffers most when the people who inhabit the Corridor are out of work and cannot afford to pay the costs associated with further development, such as infrastructure or housing, or improved quality of life, such as expanded park land or recreational opportunities.

SUPPORT GROUPS SEGMENT

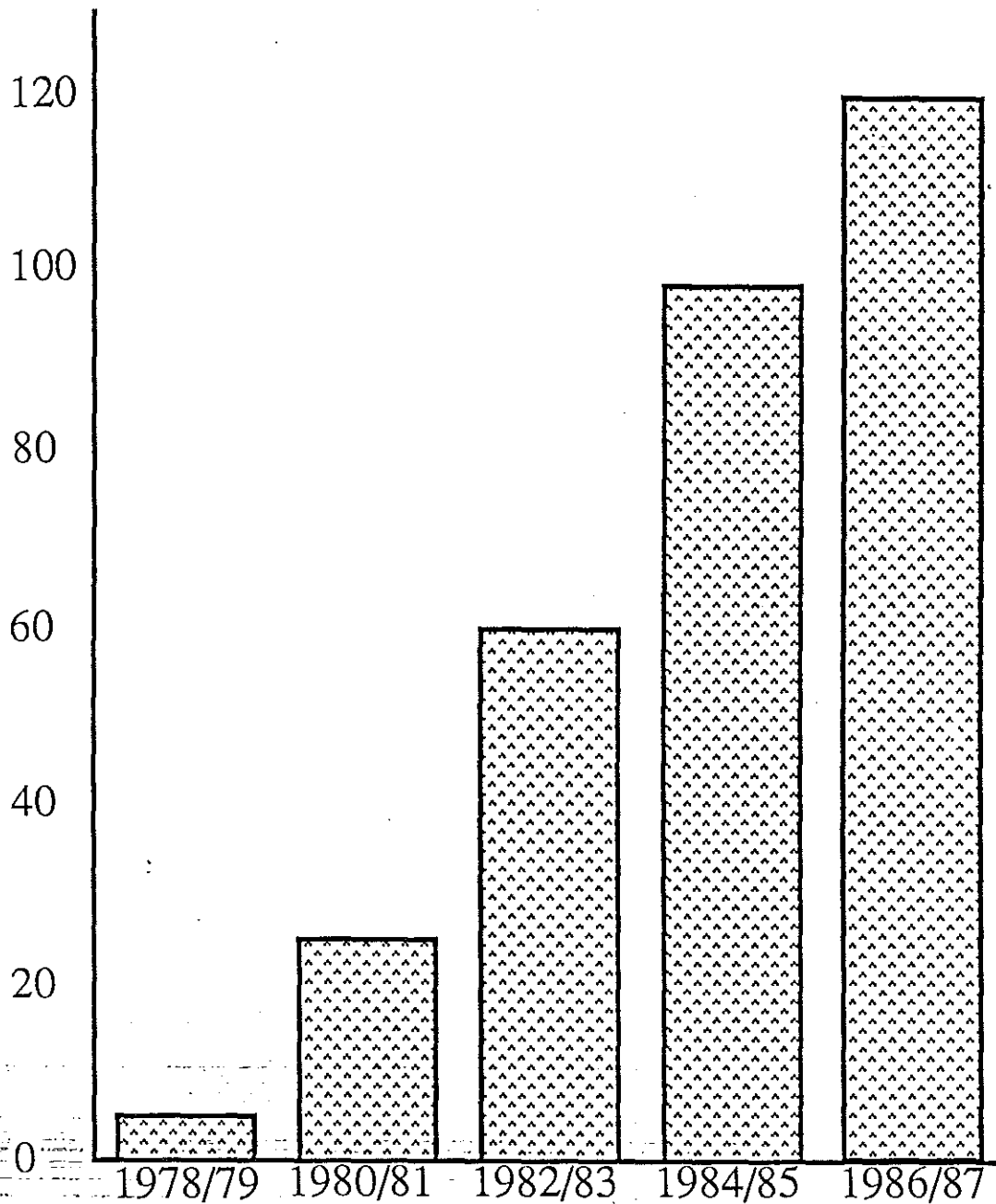
Support groups have provided an important networking mechanism for the development of the technopolis. See Figure 1. These groups take a variety of forms. Business-based groups in the Corridor relate to the emergence of specific components for high technology support in the practices of big-8 accounting firms, key law firms, major banks and other companies. These components provide a source of expertise, even when embryonic, and a reference source for those founding and/or running technology-based enterprises.

The growth of venture capital in the Corridor provides a good example. Chart 15 shows that venture capital increased significantly in the 1980s. The growth was due primarily to two factors, one external and the other internal. Externally, changes in federal tax laws in 1979 and 1986 pertaining to capital gains encouraged investments in venture capital pools. Internally, the perception of the Corridor as an emerging technology center encouraged the development of home-grown pools. The sources of the venture capital were a few individuals knowledgeable about the venture capital process as well as the major commercial banks in the area. While funds in these pools increased, most venture capital investments continued to be made outside the Corridor and the state of Texas. Venture capitalists in the Corridor, while wanting a local window on technology and company development, still do not see enough good deals, i.e. fast-growth company potentials, in the region.

The Chamber of Commerce is another important support group. It can provide a focal point for information about and support of

CHART 15

GROWTH OF VENTURE CAPITAL IN CORRIDOR (in millions)



NOTE: Incubators Venture Capital and SBICs.

Source: Selected Venture Capital Firms

technology-based companies. The Austin Chamber, for example, played a key role in attracting IBM in 1967. It has also helped to establish other efforts to further expand the high technology network in the city. Such efforts included a highly publicized major study by SRI in 1983 that focused on Austin's potential as an "idea" city and one with real opportunities in specific high technology industries; expanded programs to attract and retain Japanese companies; and new organizations to broaden networks among and between technology-based organizations.

In San Antonio, the Chamber, in conjunction with the Mayor and City Council, has proven to be a catalyst for cooperative activities to expand the south end of the technopolis. They have, for example, conducted annual economic development conferences to bring together various components of the city. They were instrumental in attracting the UT Health Science Center and UT San Antonio, and they raised the necessary private funds to insure the creation of an engineering school.

Community groups have emerged to broaden the links and facilitate the communication process among and between technology-based organizations. The most notable development in the area was the organization of the Greater Austin/San Antonio Corridor Council in 1983. The Council has provided a high level mechanism to link key individuals and organizations from both cities. It has significantly contributed to the growing perception of the area as one region with mutually ben-

official opportunities and similar problems. Other community groups have served to try to bring together sometimes diverse and even opposing viewpoints to find common ground to address problems of mutual interest. Such groups include breakfast groups, policy-oriented groups and special high technology groups, such as The Greater Austin Technology Business Network, which was established in late 1986, and a risk capital network system that was established at UT San Antonio in early 1987.

INFLUENCERS

While each of the institutional segments in the Technopolis Wheel are important to the development of a technopolis, the ability to link the segments is most critical. Indeed, unless the segments are linked in a synergistic way, then the development of the technopolis slows or stops. In the Austin/San Antonio Corridor, these segments have been linked first by "influencers"--key individuals who make things happen. As shown in Figure 5, the influencers are at the top of the inner rim of each segment. They are able to link themselves with other influencers in each of the other segments as well as within each segment.

First level influencers, have a number of criteria in common:

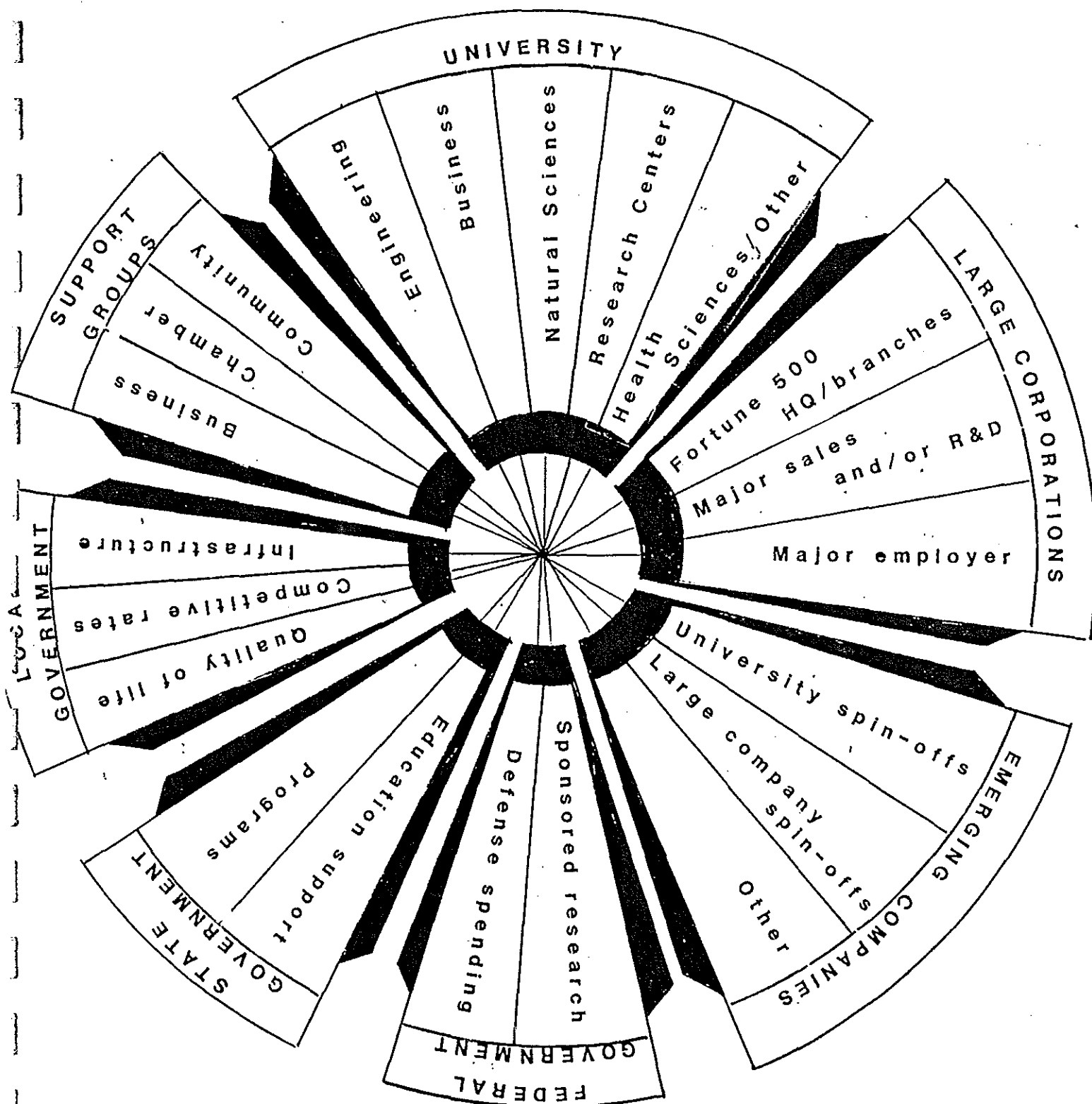
- They provide leadership in their specific segment because of their recognized success in that segment.
- They maintain extensive personal and professional links to all or almost all the other segments.

- They are highly educated.
- The move in and out of the other segments with ease, i.e., they are accepted and consequently help in establishing requirements for success.
- They are perceived to have credibility by others in the other segments.

The second linkage is by second level influencers within each segment. The second level influencer interacts and generally has the confidence of the first level influencer. The role and scope of the second level influencers is to act as gatekeepers in terms of their abilities to increase or decrease flows of information to first level influencers. They also have their own linkages to other second level influencers in the other institutional segments. In many cases, the first level and second level influencers initiate new organizational arrangements to institutionalize the linkage between business, government, and academia.

Influencers seem to coalesce around key events or activities. They then play a crucial role in conception, initiation, implementation, and coordination of these events or activities. Interestingly, once an event or action is successfully managed or achieved, they help institutionalize the process so that it can function effectively without them. Consequently, an important characteristic of a technopolis is to be able to develop first level influencers and nurture second level influencers in all segments of the Technopolis Wheel.

FIGURE 5
TECHNOPOLIS WHEEL:
ROLE OF INFLUENCERS



Source: The Authors

Both first and second level influencers build extensive networks. The larger the number of influencers, the more extensive their networks, and the more they are able to interact effectively (i.e. be persuasive) with all the other segments, the more rapidly the technopolis develops. Interestingly, influencers play a particularly important networking role through the support groups because these groups can provide convenient opportunities to interact across all segments of the Wheel.

San Antonio can be used as an example of the role of influencers. In 1947 the San Antonio Medical Foundation was chartered by a few prominent physicians. They realized that a large amount of land was critical to the long-term success of a Medical Center. Consequently, they acquired over 620 acres of land in the then uninhabited western area of San Antonio. Later the acreage was increased to almost 1000 acres. Today San Antonio has the largest medical center in the U.S. in terms of acreage.

Situated on this acreage as of 1987 are 8 major hospitals totaling 2893 beds, over six allied research services and several specialized rehabilitation centers. The hub of this complex is The University of Texas Health Science Center. With more than 15,300 employees in the medical center, and it is one of San Antonio's largest employers. The combined annual budget of the centers facilities is over \$500 million.

Another example is the Southwest Research Institute in San Antonio. It was founded in 1947 as a not-for-profit research and development

organization. The Institute works at any given time on more than 1,000 engineering and physical science projects including biotechnology programs. There are currently more than 2,000 employees. Their gross revenues are just under \$149 million. A Southwest Research Consortium has been formed by the Southwest Research Institute, The University of Texas Health Science Center at San Antonio, The University of Texas at San Antonio, and the Southwest Foundation for Biomedical Research. These institutions participate in cooperative projects.

SUMMARY

While the current general economic situation in Texas has impacted all the segments that make up the Austin/San Antonio Technopolis Wheel, it is possible to examine the reality of this developing technopolis based on the data and analysis in this study.

The following series of tables compare Austin and San Antonio along the three dimensions for measuring the dynamics of a modern technopolis; namely, the achievement of scientific preeminence; the development and maintenance of new technologies for emerging industries; and the attraction of major technology companies and the creation of home-grown technology companies.

These tables confirm that the two ends of the corridor complement and extend the resources of the other city on many dimensions. Table 6 shows the achievement of scientific preeminence in Austin and San Antonio. The segments that stand out in San Antonio are the federal

TABLE 6

ACHIEVEMENT OF SCIENTIFIC PREMINENCE

Criteria	Austin	San Antonio
1. R&D Contracts & Grants		
• University Segment	\$120 million	\$40 million
• Non Profit Research Inst.		150 million
• Federal Agency Research		124 million
2. Chairs, Professorships & Fellowships	470	108
3. Membership in National Organizations -		
• Nobel Prize Holders	2	
• Membership in Natl Academies of Science & Engineering	38	
4. Number of Students in	87,000	52,100
• Higher Education -		
• Public & Private		
• Universities & Colleges		
5. Merit Scholars	916	
6. Newer Institutional Relationships:		
• Industrial R&D Consortia	MCC	
• Academic/Business Collab.	\$25 million	
• Research & Engineering Centers of Excellence		7
7. University Research & Engineering Centers	50	5

p

government and private sectors in terms of R&D contracts and grants. In Austin, the university segment is predominant. Both cities have major higher education student populations. Over half the student population in San Antonio is involved with technical training and education. In addition, San Antonio is providing unique curriculums in secondary education in health and high technology.

Table 7 confirms that the Corridor has been developing and maintaining new technology for emerging industries. Both cities have provided environments and acquired a variety of resources for advanced cutting-edge technologies. These technological areas have been developed and improved through university, federal government and other research institutions. In addition, the private sector in both cities has been conducting industrial R&D activities in leading technological areas. New institutional relationships are emerging but need to be aggressively pursued to maintain momentum in linking new technology developments to become a mature technopolis.

Table 8 confirms that both cities have succeeded in attracting major technology companies and creating home-grown technology manufacturing companies. Both cities have achieved significant percentages, i.e. over 5%, of the State's employment in high technology manufacturing, according to SIC code data. These numbers do not include additional company creation and employment in high technology services, software and other areas. San Antonio, for example, has significant service employment in the biotechnology and health related areas.

TABLE 7
DEVELOPMENT AND MAINTENANCE OF
NEW TECHNOLOGIES FOR EMERGING INDUSTRIES

Criteria	Austin	San Antonio
1. Advanced Cutting Edge Technologies-Universities, Federal Agencies & Research Institutes	Biotechnology- plant genetics molecular Semiconductor Fusion Electrochemistry New Materials Theoretical Physics Theoretical Chemistry Aeronautical Earth Sciences Computer Science Artificial Intelligence Computerized Integrated Mfg. Vision Research	-Medical Instrumentation New Technology Products Products for use in rehabilitation & home health Biomedicine Cancer Infectious & virus related disease Aging Burns Premature births Biotechnology genetics molecular Human centered research applications to weapons system design and operations
Industrial R&D	AI - Expert systems Electronics Semiconductors Advanced Computer Res. Software Biotechnology	Biotechnology Computer Research Semiconductor
2. New Institutional Relations		
• Industrial R&D Consortia	MCC	
• Academic/Government/Business University/		
• Industry/University Cooperative Research Center		Institute for Bio- technology Center for Bio Bio Science & Technology

TABLE 8

ATTRACTION OF MAJOR TECHNOLOGY COMPANIES &
 CREATION OF HOME GROWN TECHNOLOGY COMPANIES
 BASED ON SIC CODES

	Austin	San Antonio
A. Attraction of Major Technology Companies	32	13
B. Home Grown Technology Manufacturing Companies, 1985		
1. By SIC Codes	93	62
2. Services, Software, Others	NA	NA
C. Job Creation % of State of Texas High Technology Manufacturing Employment, 1985	8.1%	5.5%
D. Service Industry Employment in Medical Center, Southwest Research Institute, and Southwest Biomedical Research Institute		17,800

CASE STUDIES

The Austin/San Antonio Technopolis is not an overnight success story. It has been nearly 30 years in the making. Two key events in 1983 were pivotal for the development of the technopolis. One was the decision of locating MCC in Austin, Texas and the other was the establishment of the Texas Research and Technology Foundation in San Antonio to support research and technological innovation, especially in biotechnology.

THE MCC STORY

Four states were in the final competition for the Microelectronics and Computer Technology Corporation, MCC. These competing sites represented a mature technopolis: Raleigh-Durham, North Carolina; two developing technopolis: Austin, Texas and Atlanta, Georgia; and an emerging technopolis: San Diego, California. These four contenders were selected from a nationwide preliminary competition that included many major competitors from the East Coast, the West Coast, the Midwest, and the South. The four finalists were chosen for a broad range of reasons, but the primary selection criteria concerned:

1. ready access to universities which are leaders in teaching and research in microelectronics and computer sciences;
2. good quality of life to facilitate recruitment of technical personnel (e.g., primary and secondary education facilities, affordable housing);

3. presence of industry infrastructure related to MCC technologies;
4. large potential employee base;
5. easy access by air from major metropolitan areas;
6. supportive state and local government environment; and
7. the overall cost of operation of MCC.

Each of the four finalist sites met certain criteria on this list more completely than other criteria, but each of the areas had a major research university(s) and each of the areas had a perceived, affordable high quality of life. Many potential candidate areas that were outstanding on all but one of the criteria missed making the final competition because they lacked one fundamentally important criteria: a major research university. This was one item that could not be argued like more subjective issues such as quality of life.

Many reasons have been offered for MCC's decision to locate in Austin. Two reasons offered by observers outside of Texas which we consider myths are: (1) that Texas bought MCC, and (2) that Admiral Bobby Ray Inman (the founding president of MCC) had strong ties to Austin--he is a University of Texas alumni and has lived in Texas--and consequently influenced the vote in favor of the area where he wanted to live, which was Austin. While Texas did offer substantial economic incentives, this effort reflected a Texas-wide fund raising program in the private sector that was viewed as an investment in the future, not an expenditure of funds that would not be recouped.

State funds were not tapped. In terms of the second myth (concerning Admiral Inman's ties to Austin), it could be argued that the Admiral had stronger ties to San Diego than he did to Austin, Texas, because of his navy ties to the area. In fact, the vote on the part of the MCC selection team was unanimous for locating MCC in Austin, Texas before Inman cast his vote.

Based on interviews with key participants in each of the four competing sites and MCC site selection team, and in keeping with the theme of this paper, one central issue stands above all others as the reason why MCC decided to locate in Austin: the segments of the Technopolis Wheel, especially state-wide, were balanced and working. First and/or second level influencers in academic, business and government organizations pulled together to propose a "Texas Incentive" that set it apart from the other three areas. The Governor of Texas and his high level representatives coordinated, organized and worked with the Regents and high level administrators of the University of Texas at Austin and Texas A&M University to find ways to demonstrate strong state-wide support (i.e., in terms of endowed chairs, professorships, student support) for the Departments of Electrical Engineering and Computer Science. A state-wide funding effort with a funding goal of \$23 million was initiated and carried out by business leaders from Dallas to Houston to Amarillo to fund these academic incentives. In addition, local banks and the Austin business community put a package together to subsidize mortgage loans for potential MCC employees to the amount of \$20 million. Dedicated attention was even

given to other incentives such as offering staff and resources to help the spouses of MCC employees find suitable employment in the Austin area.

A pointed example of the need for a balanced and working Technopolis Wheel is provided by the volunteer team of local academic/business/community leaders who met daily in a "war room" and worked for two intense weeks to craft and finalize the "Texas Incentive" for MCC. These prominent leaders and their support staff came from the following professions: state government, law, public relations, developers, industry, consulting firms, and the University of Texas and Texas A&M. Individually these team members represented a range of talents and professional skills. Together they had strong ties with and a working knowledge of all segments within the Technopolis Wheel: The University of Texas and Texas A&M, state and local government, and the state and local business community. The mayor and staff of San Antonio helped initiate the spirit of cooperation by joining the Austin effort when it became clear that there should be only one Texas finalist and Austin was the most appropriate. For the two weeks between the preliminary and final selection decision, there was a remarkable spirit of cooperation where Texans from each of the segments of the Wheel gave freely of their time and talents to win MCC for Texas and Austin. They were driven by the spirit of competition with the other three finalist sites and the vision of what MCC meant for the Austin/San Antonio Corridor, the state of Texas, and for the competitive advantage of U.S. high technology industry. The

spirit of a team of prominent individuals working together for the common good was so strong that arguments over parochial issues were put aside.

Although the other sites also made impressive offers to MCC in many different ways, none of them came close to displaying Texas's spirit for their MCC bid. It is interesting to note that while for Texas the synergy was there in an intense way in 1983, by 1987 it was less apparent outside of Austin for several reasons: a general state-wide economic slowdown, questions over adequate state government funding for education, and concerns about local government inhibiting high-tech development and economic growth in general.

Retrospectively, in a sense, Austin the winner in the MCC competition, lost, and the cities that lost became the winners. When Austin won MCC, government, academic, and business leaders in other states with "high-tech fever" saw or had the fear that Texas and its universities (principally the University of Texas at Austin and Texas A&M) had the momentum to outdistance their efforts in developing academic institutions of excellence necessary for a Technopolis. They envisioned their flagship universities and states being stripped of some of their most valued resources: outstanding professors and their students, and entrepreneurial business and community leaders. They envisioned other companies following the lead of Lockheed, 3M and Motorola either relocating old divisions or moving new divisions to the developing technopolis of Austin, Texas. Their fears were

unfounded. Shortly after MCC selected, Austin, Texas became the only state to actually cut appropriations for higher education.

By 1987 in Austin, there was a loss of synergy between the private sector and local government. Some would argue that the development of the area was moving too fast and that this was reflected in soaring land prices and a declining quality of life. On the other hand, others would argue that the city council has, either by action (e.g., increased electric rates, a web of building permits, or time and effort spent on countless meetings on "minor" issues) or nonaction (e.g., making no decisions on important projects such as building a new airport or a new convention center) played too great a role in slowing economic development.

An important impact of the state's approach to funding for higher education and of changing Austin City Council policies over several administrations in handling economic development was that they caused academic talent and business leaders to hesitate to locate in a region where the rules of operation are constantly changing. Indeed, even some long term Austin-based technology businesses are questioning whether to expand in Austin. Some are being tempted to relocate to more accommodating, stable areas within and outside of Texas. The MCC competition demonstrated that for the institutional segments of the Technopolis Wheel to work, there needs to be attention to detail. However, more importantly, technopolis participants (i.e., academic/business/community leaders) cannot become so consumed with

the detail that they lose the long-term vision. The details are often what drive the participants apart. It is the vision that binds the participants to a long term policy which makes the activity attractive to others and which sustains long-term, steady development of the technopolis.

CASE STUDY: THE DEVELOPMENT OF BIOTECHNOLOGY IN SAN ANTONIO

In 1983, Mayor Henry Cisneros launched "Target '90. Goals for San Antonio to Build a Greater City," a long-range, community-wide planning project for the City of San Antonio. Members of the Target '90 Commission included first and second level influencers from all segments. The Target '90 process helped build a remarkable consensus about the priorities for and direction of the city through 1990. The final report targeted 177 specific action initiatives to build the future of San Antonio. A key section of the report focused on developing San Antonio as a key center for biotechnology in the future.

The plan focused on expanding upon extensive university, private/profit, non-profit and military research entities already located in San Antonio, including Southwest Foundation for Biomedical Research, Southwest Research Institute (the third largest private research institute in the nation), the University of Texas Health Science Center, the Air Force's School of Aerospace Medicine at Brooks Air Force Base, the U.S. Army's Health Service Command and Brooke Army Medical Center at Fort Sam Houston.

In March, 1984, the UT Health Science Center in San Antonio with encouragement of the Mayor's Office succeeded in winning a \$75,000

planning grant from the National Science Foundation to develop a University-Industry Cooperative Research Center for Biosciences and Technology. The UICRC grant focused on developing a partnership between the Health Science Center and industry nation-wide. It brought enormous credibility and prestige to the effort for building the Research Center. The focus from the start was to link basic research with opportunities for local economic development and jobs.

At the same time, the HSC had proposed to the community through Target '90 an Institute for Biotechnology. The institutional segments of the Technopolis Wheel then began to focus momentum for a major research presence in biotechnology through the creation of a new institution, The Texas Research and Technology Foundation which was formally established in 1985. This Foundation is a non-profit economic development organization to support scientific research and technological innovation. Its objective is to promote and build upon San Antonio's existing and extensive technology base. The board of the Foundation includes first and second level influencers from the city's civic, business, academic, scientific and professional communities. The Foundation's method seeks to link the university, industry and government. In this regard, it has done the following:

- Established the Texas Research Park with a private donation of 1500 acres;
- Provided 50 acres of land to the Institute of Biotechnology to be developed in collaboration with The University of Texas Board of Regents and UT Health Science Center;

- Created an Invention and Investment Institute to facilitate a technology venture or incubator center and venture funding; and
- Supported an Institute of Applied Sciences to be developed in collaboration with The Southwest Research Institute to transfer basic research discoveries and the know-how of local scientists to private companies and government agencies.

From 1983 to 1987, interest in and programs for biotechnology increased. Ten of 13 public and private colleges and universities in the city now offer curriculum in the biomedical/biotechnology areas. The most notable example is The University of Texas at San Antonio. UTSA has established a non-thesis masters degree program in biotechnology. It was the first of its kind in Texas and is one of a handful of such programs nationally. In fact, in June 1986 the growth of the classes in engineering and biotechnology warranted the authorization by the UT System Board of Regents of a \$27.9 million engineering/biotechnology building at UTSA. (Even area high schools have developed programs in high technology and biomedical instruction.)

In April 1986, the UT System Board of Regents formally approved locating the UT Institute for Biotechnology in the Texas Research Park. By that time, Concord Oil Company had donated 1500 acres to the Texas Research and Technology Foundation to develop the research park with the Institute as its first project. The Foundation's land committee which secured the donation was composed of top influencers in the

city. In addition, the Foundation planned to raise \$20 million in cash for building construction, equipment and the endowment of the Institute. In January 1987, the UT System Board of Regents approved \$10 million to be matched by the private sector to build a biotechnology research building at the UT Health Science Center.

Today, San Antonio can claim a new research park, a biotechnology institute that links the university with industry, and a growing critical mass in the biotechnology industry. One important indication of that mass is Table 9, which lists 18 biotechnology companies that are now operating in San Antonio.

CONCLUSION

A number of key points emerged from the Austin/San Antonio Corridor study. They are:

- The research university has played a pivotal role in the development of the technopolis by:
 - achieving scientific preminence;
 - creating, developing and maintaining the new technologies for emerging industries;
 - educating and training the required workforce and professions for economic development through technology;
 - attracting large technology companies;
 - promoting the development of home-grown technologies; and
 - contributing to improved quality of life and culture.
- Local government has had a significant impact, both posi-

TABLE 9

A SAMPLING OF SMALLER BIOMEDICAL/BIOTECH FIRMS
IN SAN ANTONIO

Asgrow Research	MG Industries
Biomedical Development Corp.	Mission Pharmacal Company
Continental Water System Corp.	Pharmotex, Inc.
Crystalline Water	Rothe Development, Inc.
Gesco International, Inc.	Science Unlimited Research Foundation
Healthgenics, Inc.	Stanbio Laboratories, Inc.
Intex	Synectics Research, Inc.
Kinetic Concepts, Inc.	Systems Research Laboratories, Inc.
MCLAS Technologies, Inc.	The Praxis Corporation

vely and negatively, on company formation and relocation, largely from what it has chosen to do or not to do in terms of quality of life, competitive rate structures and infrastructure.

- State government has had a significant impact, both positively and negatively, on the development of the technopolis through what it has chosen to do or not to do for education, especially in the areas of making and keeping long-term commitments to fund R&D, faculty salaries, student support and related educational development activities.
- The federal government has played an indirect but supportive role largely through its allocation of research and development moneys to universities, onsite R&D programs and defense-related activities.
- Continuity in local, state and federal government policies has an important impact on maintaining the momentum in the growth of a technopolis.
- Large technology companies have played a catalytic role in the expansion of the technopolis by:
 - maintaining relationships with major research universities;
 - becoming a source of talent for the development of new companies;
 - contributing to job creation and an economic base that can support an affordable quality of life.

- Small technology companies have been increasing steadily in number and size in the area. They have helped in:
 - commercializing technologies;
 - diversifying and broadening the economic base of the area
 - contributing to job creation;
 - spinning companies out of the university and other research institutes; and
 - providing opportunities for venture capital investment
- Influencers have provided vision, communication and trust for developing consensus for economic development and technology diversification, especially through their ability to network with other individuals and institutions.
- Consensus among and between segments is essential for the growth and expansion of the technopolis.
- Affordable quality of life, while subjective and hard to measure, is important in the development of a technopolis. It can be a major source of friction between advocates and adversaries of the growth of the technopolis.
- The very success of the development of a technopolis can lead to greed and many dissatisfactions. The result can be a shattering of the consensus that originally made the technopolis possible.

The Austin/San Antonio Corridor is a developing technopolis with promise. The area has been achieving scientific preeminence, developing and maintaining new technologies for emerging industries, and attract-

ing large technology firms while creating home-grown technology companies. It still has a way to go before reaching maturity.

In conclusion, there needs to be a broader vision of the future. A future that is not lost in local and state economic set-backs or interminable resolutions about affordable quality of life. A future that comes from utilizing the Corridor's most important resource - its intellectual resources found within its institutional segments. A future that provides a vision for effectively linking government, business and academia.

SELECTED BIBLIOGRAPHY
ON AUSTIN/SAN ANTONIO CORRIDOR

1. *Academe-Industry Linkage Forum Proceedings*. Austin, Tx.: United San Antonio and The San Antonio Medical Foundation. 1984.
2. "Austin Chamber of Commerce 1983 Annual Report." *Austin Magazine*. The Austin Chamber of Commerce. January 1984.
3. "Austin Chamber of Commerce 1984 Annual Report." *Austin Magazine*. The Austin Chamber of Commerce. January 1985.
4. "Austin Chamber of Commerce 1985 Annual Report." *Austin Magazine*. The Austin Chamber of Commerce. January 1986.
5. "Austin Community Profile 1986-1987." Austin Chamber of Commerce. 1986.
6. "Austin Economic Review-Living Up to Expectations." *Austin Magazine*. The Austin Chamber of Commerce. September 1981. pp. 5a-16a.
7. "Austinite of the Year: Frank McBee." *Austin Magazine*. The Austin Chamber of Commerce. January 1987. pp. 30-8.
8. Brooke, Ann. "Plugging into Austin's Booming Electronics Industry." *Austin Magazine*. The Austin Chamber of Commerce. October 1980. pp. 39-47.
9. "Creating an Opportunity Economy." Final report of SRI Project 7799 prepared by SRI International for the Austin Chamber of Commerce. April 1985.
10. Defense Contract Administration Services Region News Release on Defense Contracting, January 15, 1986.
11. "Directory of Austin Area High Technology Firms 1986-1987." Austin Chamber of Commerce. 1986.
12. Downing, Diane. "Casting a High Tech Spotlight." *Austin Magazine*. The Austin Chamber of Commerce. January 1984. pp. 32-5.
13. Downing, Diane E. "Thinking of the Future: The Promise of MCC." *Austin Magazine*, The Austin Chamber of Commerce. August 1983. pp. 105-10.
14. "Economic Growth and Investment in Higher Education: Summary and Selected Bibliography." Bureau of Business Research, The University of Texas at Austin. 1987.
15. "The Economic Review and Forecast." Supplement to *Austin Magazine*. The Austin Chamber of Commerce. October 1985.
16. "The Economic Review and Forecast." Supplement to *Austin Magazine*. The Austin Chamber of Commerce. October 1986.
17. "The Emerging Economic Base and Local Development Policy Issues in the Austin-San Antonio Corridor." Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin. Policy Research Project Report Number 71. 1985.
18. English, Sarah Jane. "A Vintage Friendship." *Austin Magazine*. The Austin Chamber of Commerce. September 1983. pp. 46-52.

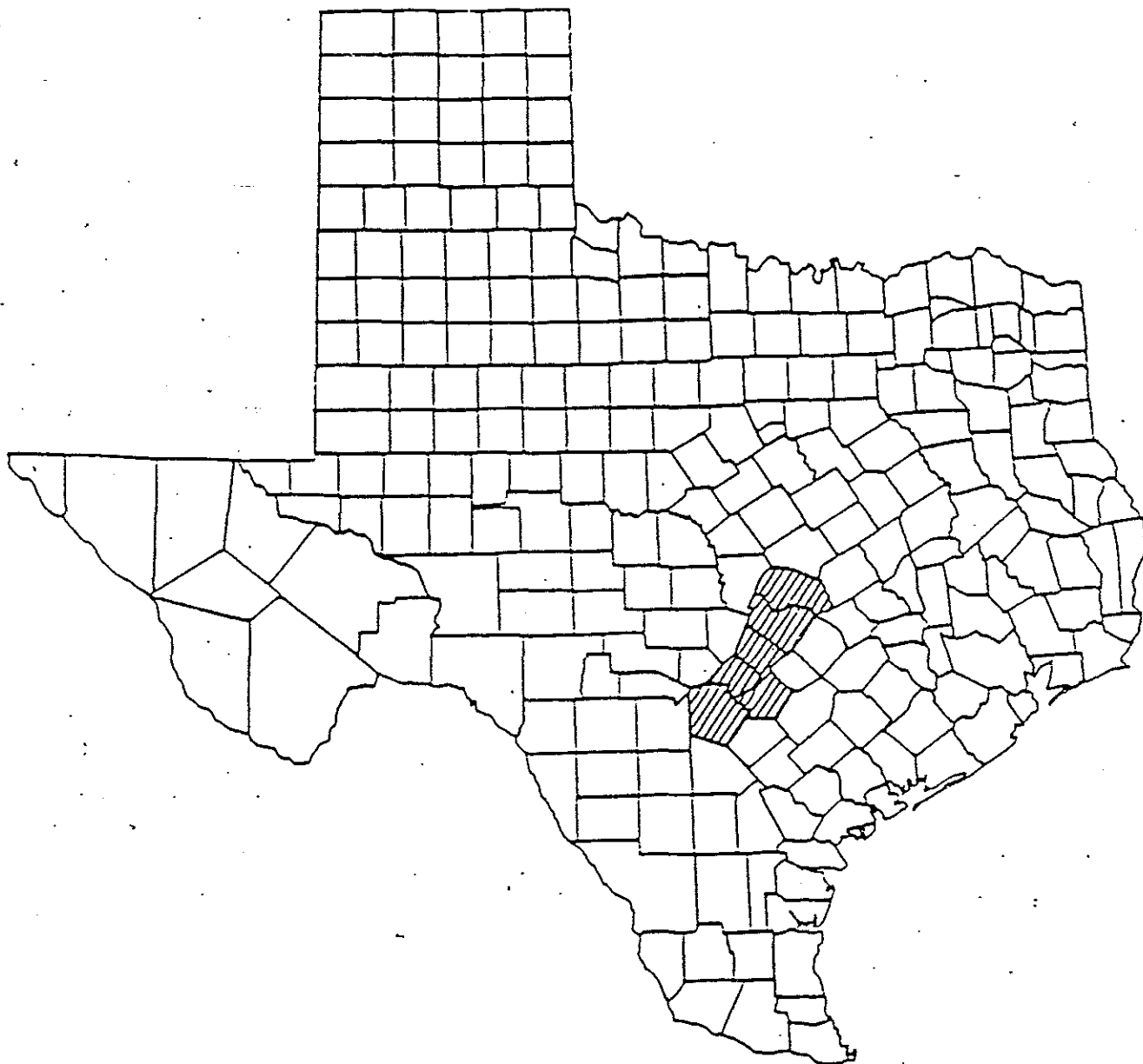
19. Farley, Josh and Norman J. Glickman. Date. "R&D as an Economic Development Strategy: The Microelectronic and Computer Technology Corporation Comes to Austin, Texas." Department of Planning and Growth Management, City of Austin. 1985.
20. Franks, Jeff. "Austin/San Antonio Corridor." *Prospects International*. pp. 25-55.
21. "The Future of the Austin-San Antonio Corridor." Proceedings of *The Future of the Austin-San Antonio Corridor*. Austin, Tx.: The Greater Austin-San Antonio Corridor Council, Inc., San Marcos, Tx. and The Population Resource Center, New York, New York. 1985.
22. "Growing Research Activity Catches On Here." *Austin in Action*. October 1961. pp. 8-19.
23. "High-Tech Companies Team up in the R&D Race." *Businessweek*. August 15, 1983. pp. 94-5.
24. Ladendorf, Kirk. "The Anticipation Ends: MCC Moves In, but is Still Feeling Some Growing Pains." *The Austin American-Statesman*. September 12, 1983.
25. Lineback, J. Robert. "Texas Cash Fuels Electronics Boom." *Electronics*. June 16, 1983. pp. 95-6.
26. Long, Mary Kathryn. "Austin, Texas: An Analysis of Business Growth and Development." MBA Professional Report, University of Texas at Austin. 1982.
27. McBee, Frank W. "Education & the Business Community." Special briefing to Friends of Higher Education conference. Austin, Tx. February 11, 1987.
28. McBee, Frank W. Jr. "What's Best for Texas and Austin." Text of speech given at Annual Meeting of the Austin Chamber of Commerce. Austin, Tx. January 21, 1986.
29. "MCC Impact Assessment: Economic, Demographic, and Land Use Impacts of the Microelectronics and Computer Technology Corporation." Joint research project of the Graduate Program in Community and Regional Planning, The University of Texas at Austin and the Department of Planning and Growth Management, City of Austin. 1984.
30. "1982 Economic Review." *Austin Magazine*, The Austin Chamber of Commerce. October 1982.
31. "1984: The Year in Review, The Year Ahead." *Austin Magazine*, The Austin Chamber of Commerce. October 1984.
32. "1987 Target Market Program Economic Development." Austin Chamber of Commerce. 1986.
33. Provine, John. "The Makers of High-Tech." *Austin Magazine*, The Austin Chamber of Commerce. November 1984. pp. 8a-28a.
34. "Quality of Life: Austin Trends 1970-1990." Research report prepared by students as part of classwork under Dr. Dowell Myers, Community and Regional Planning Program, School of Architecture, University of Texas at Austin. June 1984.
35. "Quality of Life Indicators for Austin." Report by the Quality of Life Advisory Committee to the Quality of Life Division, Austin Chamber of Commerce. February 1986.
36. "Research Venture Gets U.S. Approval on Computer Work." *The Wall Street Journal*. March 5, 1985.
37. Ridgway, Susan M., et al. "The Year in Review." *Economic Review*. 1984. pp. 9a-24a.

38. "San Antonio: On the Fast Track for Biomedical/Biotech Growth." Department of Economic and Employment Development, The City of San Antonio. 1986.
39. "San Antonio's Electronic Industry." Department of Economic & Employment Development, The City of San Antonio. February 1987.
40. Segal Quince Wicksteed, Economic and Management Consultants. "University-Industry Research Links and Local Economic Development: Food for Thought From Cambridge and Elsewhere. Unpublished study. February 1987.
41. Shahin, Jim. "MCC: Keeping the Promise? Texas Pins Its Hopes on a New Deal." *Texas Technologies*. November 1985. pp. 9-17.
42. Shahin, Jim. "Courting MCC." *Texas Technologies*. November 1985. p. 11.
43. "Statistical Handbook 1986-1987." The University of Texas at Austin, Office of Institutional Studies. 1986.
44. Susskind, Hal. "It Has a Lot of Plus Factors, But How Recession-Proof is Austin's Economy?" *Austin Magazine*. The Austin Chamber of Commerce. June 1980. pp. 3a-16a.
45. Szilagyi, Pete. "The Miracle Chips." *Austin Magazine*. The Austin Chamber of Commerce. March 1980. pp. 27-30.
46. "Technology Resource Inventory Volume One: Biosciences in San Antonio." Texas Research and Technology Foundation. June 1986.
47. "Telecity. San Antonio: The Telecommunications Advantage." San Antonio Economic Development Foundation. 1986.
48. Tempest, Rone. "Texas Pays High Price for Luring High-Tech Venture." *Los Angeles Times*. February 21, 1984.
49. "United We Stand...." *High-Tech Marketing*. April 1985. pp. 70-1.

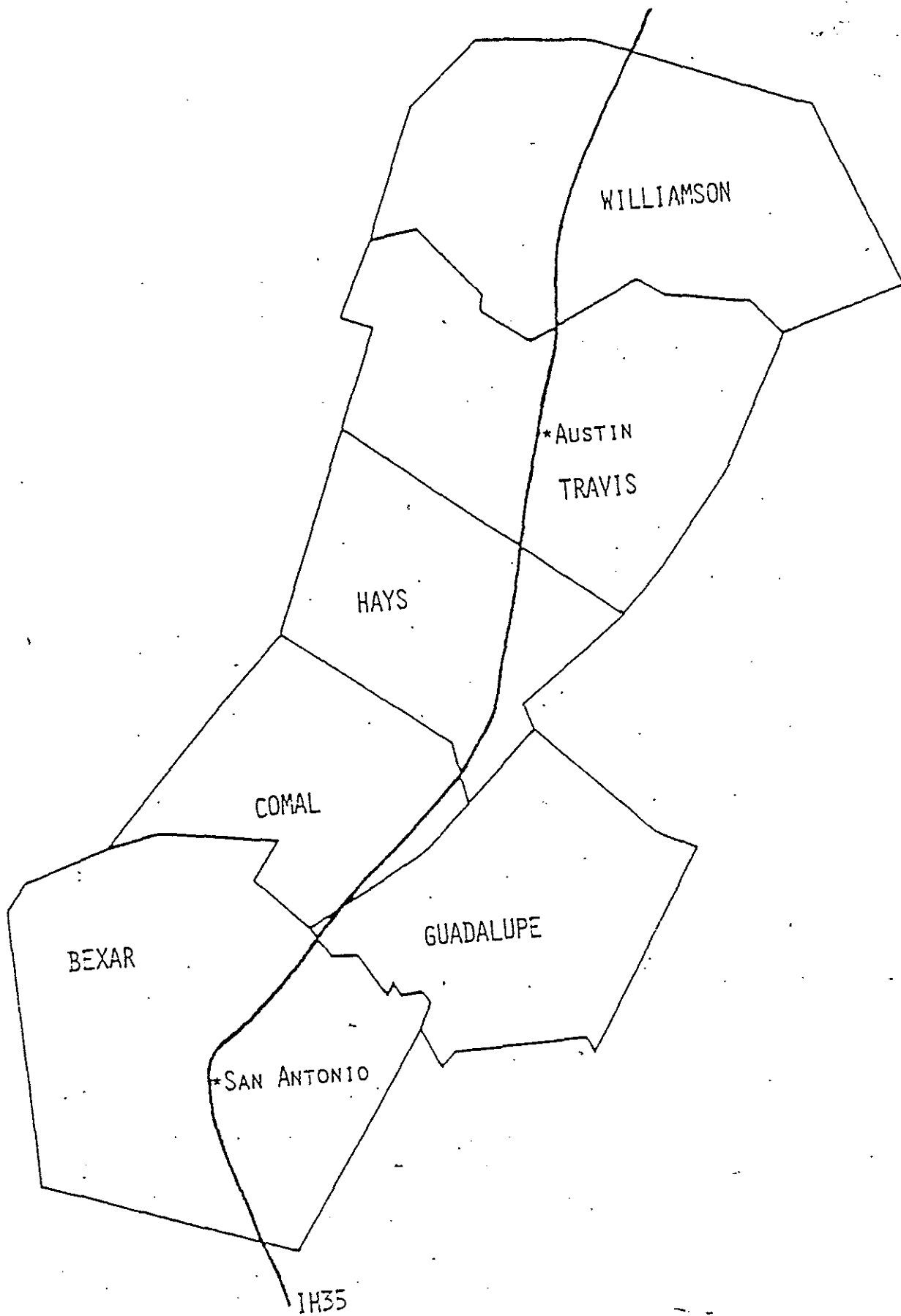
GENERAL SELECTED BIBLIOGRAPHY

1. Allen, David N. and Victor Levine. Nurturing Advanced Technology Enterprises: Emerging Issues in State and Local Economic Development Policy. New York, New York. Praeger Publishers. 1986.
2. Bates, James Vance. "Decisional Factors in Corporate Site Location." MBA Professional Report, University of Texas at Austin. 1983.
3. de Gennaro, Nat. "Economic Impacts of the University of Arizona." Division of Economic and Business Research, College of Business and Public Administration, The University of Arizona. 1987.
4. Harrigan, Kathryn Rudie. Strategies for Joint Ventures. Lexington, Mass.: Lexington Books. 1985.
5. Hisrich, Robert D., ed. Entrepreneurship, Intrapreneurship, and Venture Capital. Lexington, Mass.: Lexington Books. 1986.
6. Konecni, Eugene B. and Robert Lawrence Kuhn eds. Technology Venturing. New York, New York: Praeger Publishers. 1985.
7. Konecni, Eugene B., et al. "Commercializing Technology Resources for Competitive Advantage." IC² Institute, The University of Texas at Austin. 1986.
8. Krzyzowski, M, et al. "Developing High Technology Industry." in H. Brazer and D. Laren, eds., Michigan's Fiscal and Economic Structure. Ann Arbor: University of Michigan Press. 1982.
9. Larsen, Judith K., et al. "Industry-University Technology Transfer in Microelectronics." Cognos Associates and Program in Information Management, School of Public Affairs, Arizona State University. 1987.
10. Ouchi, William. The M-Form Society: How American Teamwork Can Recapture the Competitive Edge. Menlo Park, Ca.: Addison-Wesley Publishing Co. 1984.
11. "The Quality of Life in Four American Cities." Special market research study for The Governor of Texas' MCC Task Force. Shipley & Associates, Inc. under direction of Neal Spelce Communications. 1983.
12. Rogers, Everett M. and Judith K. Larsen. Silicon Fever. Growth of High-Technology Culture. New York, New York: Basic Books, Inc. 1984.
13. Ryans, John K. and William L. Shanklin. Guide to Marketing for Economic Development. Columbus, Ohio. Publishing Horizons. 1986.
14. Segal Quince Wicksteed, Economic and Management Consultants. "University-Industry Research Links and Local Economic Development: Food for Thought From Cambridge and Elsewhere." Unpublished study. February 1987.
15. Simison, Robert L. "Quiet War Rages on Technology's Front Line." *The Wall Street Journal* December 24, 1985. p. 4.
16. Tatsuno, Sheridan. The Technopolis Strategy. 1986.
17. Watkins, Charles B. "Technology Transfer From University Research in Regional Development Strategies." *Journal of Technology Transfer*. 1985. pp. 10-1.

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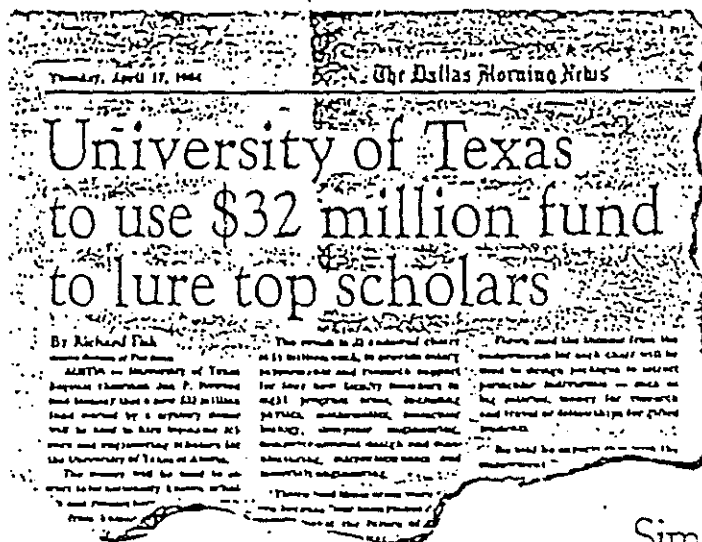


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