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IS THE BLOOM OFF UTAH'S HIGH TECH ROSE?

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INTRODUCTION

During much of the 1980s, the creation of high technology companies has been a critical element of economic development strategies nationwide. While much has been written about the high tech regions of Silicon Valley in California and Route 128 in Massachusetts, little is known about the influence and importance of high tech companies on the economies of less recognized areas. In 1986, the Bureau of Economic and Business Research (BEBR) at the University of Utah, began an extensive, multi-phase study of Utah-based high technology ventures. In addition to conducting an annual survey of high tech companies, historical case studies were completed on both well-established and emerging high technology ventures. The objectives of the study were to identify the players, determine their importance in the state's economic picture, and describe the strategic issues facing technology venture managers. This effort has been sometimes difficult, but always rewarding. A synopsis of the findings from this four-year study is presented here.

The survey was initially sent to more than 700 companies located throughout the state. To qualify as a high tech venture, a company had to meet criteria set forth by the Bureau of Labor Statistics. This definition closely parallels those developed by the Brookings Institution and a research group at the University of California at Berkeley. These groups define high technology as:

> ...companies with a proportion of technology-oriented workers greater than the average for all manufacturing industries, or 6.3%; and a ratio of Research and Development (R&D) expenditures to sales about the same as the average for all industries, or 3.1%.

This article is one of a series on the high technology sector of Utah's economy. Financial support for this research was provided by the Centers of Excellence, Department of Community and Economic Development, and the University of Utah. This support is gratefully acknowledged. Special recognition goes to Gary Ricks, a research analyst at BEBR for his efforts in gathering the data used in this study.

Each year, new companies were added to the survey list, and existing ones dropped as they either discontinued their R&D efforts, discontinued business activity, or moved out of state. When new companies were added to the list, employment and financial information dating from 1986 was included, when possible, in order to establish trends. By the end of 1989, 359 high technology companies had been contacted and surveyed. Data from previous years have been recalculated.

PROFILE OF UTAH'S HIGH TECHNOLOGY SECTOR

High technology companies have come into their own as important segments of Utah's economy. For purposes of evaluation, high tech companies in the state have been grouped into the following segments:

Aerospace Components and Equipment
Analytical Equipment and Measuring Devices
Biomedical and Medical Products
Chemicals
Communications Equipment
Composite Materials
Computer Equipment
Electronic Components
Lasers/Optics
Pharmaceuticals
Plant Products
Robotics
Software/Systems Developers
"Other" (Not Elsewhere Classified)

The 359 high tech companies surveyed in 1989 employ approximately 37,000 people and reported sales of more than $4.5 billion,(Table 1). Of the total high tech ventures in the study, 218 are manufacturing firms, and include some of the state's largest manufacturing concerns (Table 2). Roughly 30 percent, or one in three individuals working in Utah's manufacturing sector, is employed by a high tech company.

Twenty-nine companies are branch operations of organizations located outside of Utah. Sixteen of the 29 branch operations entered the state through a purchase or buy-out of a "home-grown company"; that is, a company founded by a Utah entrepreneur. In 14 of the 16 buy-outs, the original founders are no longer involved in the organization.

Table 1
Characteristics of
Utah's High Technology Companies

	Number of Companies	Total Employment	Technical Employment[a]	Total Sales[b]	R&D Spending[b]	Utah-Based[c]
Aerospace Components	6	11,914	2,337	$1,266,938.0	$320,802.0	4
Analytical/Measuring Devices	13	380	96	28,627.5	3,401.8	13
Biomedical/Medical Products	45	4,557	501	428,966.1	20,695.0	39
Chemicals	9	204	37	15,742.4	1,178.0	7
Communications Equipment	24	963	827	97,908.0	15,389.0	24
Composite Materials	10	372	88	20,940.5	3,731.2	7
Computer Equipment	33	6,016	2,103	758,025.5	118,192.0	31
Electronic Components	33	4,920	706	700,155.2	75,938.8	26
Lasers/Optics	7	298	60	13,987.0	1,805.0	7
Pharmaceuticals	8	90	54	4,838.5	3,928.0	8
Plant Genetics	4	218	107	10,215.0	5,260.0	4
Robotics	4	66	15	750.0	550.0	4
Software/Systems	141	5,791	1,752	1,090,908.6	83,959.8	134
Other	22	1,009	186	82,938.0	11,788.2	21
Total	359	36,798	8,269	$4,520,940.4	666,663.9	329

[a] Scientists, engineers, and computer programmers.
[b] Numbers in thousands of dollars. Numbers may not total due to rounding.
[c] Number of companies which are headquartered in Utah.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

Table 2
Major High Technology Companies in Utah

Company	Employment[a]	Sector	Product
Thiokol Corporation	6,700	Aerospace	Solid propulsion systems, ordnance and composite products for space and defense.
Hercules Aerospace Company	4,530	Aerospace	High energy solid propellents and very high performance structures for DOD, NASA, and commercial applications.
Unisys Corporation	3,000	Computers	Engineering functions including systems integration, electronic warfare, and command communication links.
WordPerfect Corporation	1,600	Software	Office automation software including word processing software, database and spreadsheet packages, and a graphics presentation package.
Signetics	1,600	Electronics	Semiconductors, integrated circuits, and wafer fabrication.
Deseret Medical, A Division of Becton Dickinson Corp.	1,560	Medical	Peripheral catheters and other health care products.
National Semiconductor	1,250	Electronics	Semiconductors; analog, microprocessors, telecommunications, memory, gate arrays.
Evans & Sutherland	1,200	Computers	Special purpose digital computers and software, principally used for graphics and flight simulation.
Varian-Eimac	1,000	Electronics	Electronic vacuum tubes.
Novell, Inc.	900	Software	Business-wide networks that integrate minicomputers and mainframes.
Iomega Corporation	920	Computers	High performance, removable mass storage products for desktop computers.
Abbott Critical Care Systems	920	Medical	Disposable medical devices used in a critical care environment.
TOTAL EMPLOYMENT	25,180		

[a] Utah employment only.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

Branch organizations employed more than 16,000 people in 1989, or about 43 percent of Utah's total high tech employment. In comparison, over 90 percent of the high tech companies doing business in Utah are headquartered here; a large share have been founded by Utah entrepreneurs. Within this group, it is not uncommon to find one of the early founders still at the helm -- maintaining an active role in the company's growth and development.

Locational Distribution

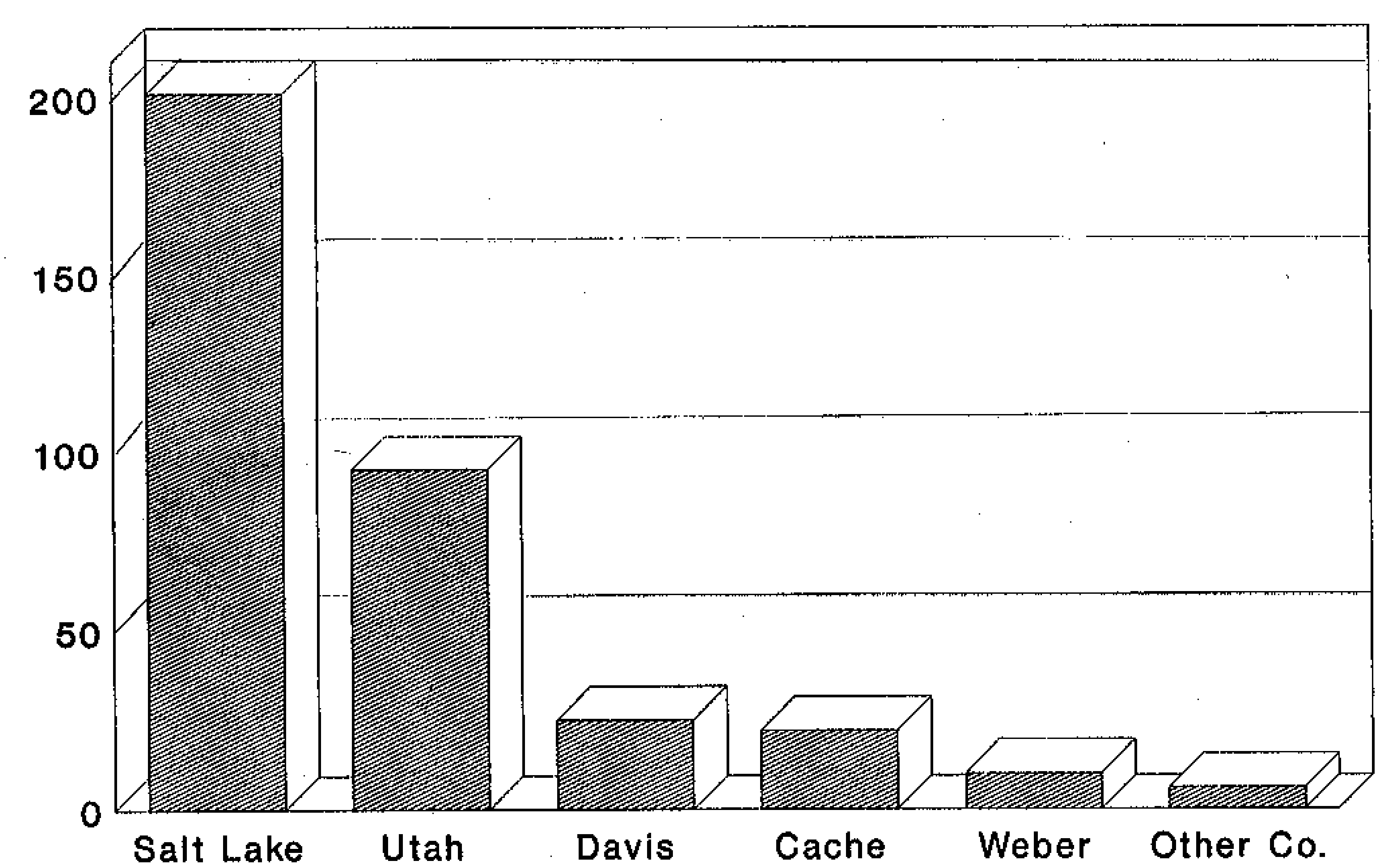
Geographically, Salt Lake and Utah Counties appear to be the location of choice for operating a high tech company in Utah. High tech companies can be found in many counties throughout the state, but Salt Lake and Utah are home to 83 percent. The largest critical mass is in Salt Lake County with 201 high technology companies. Utah County boasts the second largest agglomeration with 95 companies; 85 percent are located in the Provo/Orem area which has a high concentration of software companies (Exhibit 1). In 1989, 50 percent of the high tech companies located in the Provo/Orem area were software developers.

Employment in the High Tech Sector

A size distribution of Utah's high tech sector resembles a pyramid - a large base comprised of many small companies (40 percent of Utah's high tech firms have fewer than 50 employees; these companies account for slightly more than half of total high tech employment), and relatively few large high tech employers (only 12 high tech companies in Utah employ more than 500 people, but this small group accounts for 43 percent of total high tech employment).

Almost 12,000 employees work for aerospace component manufacturers. As a group, aerospace component manufacturers represent less than 2

Exhibit 1
Location of Utah Technology Firms
by County, 1989



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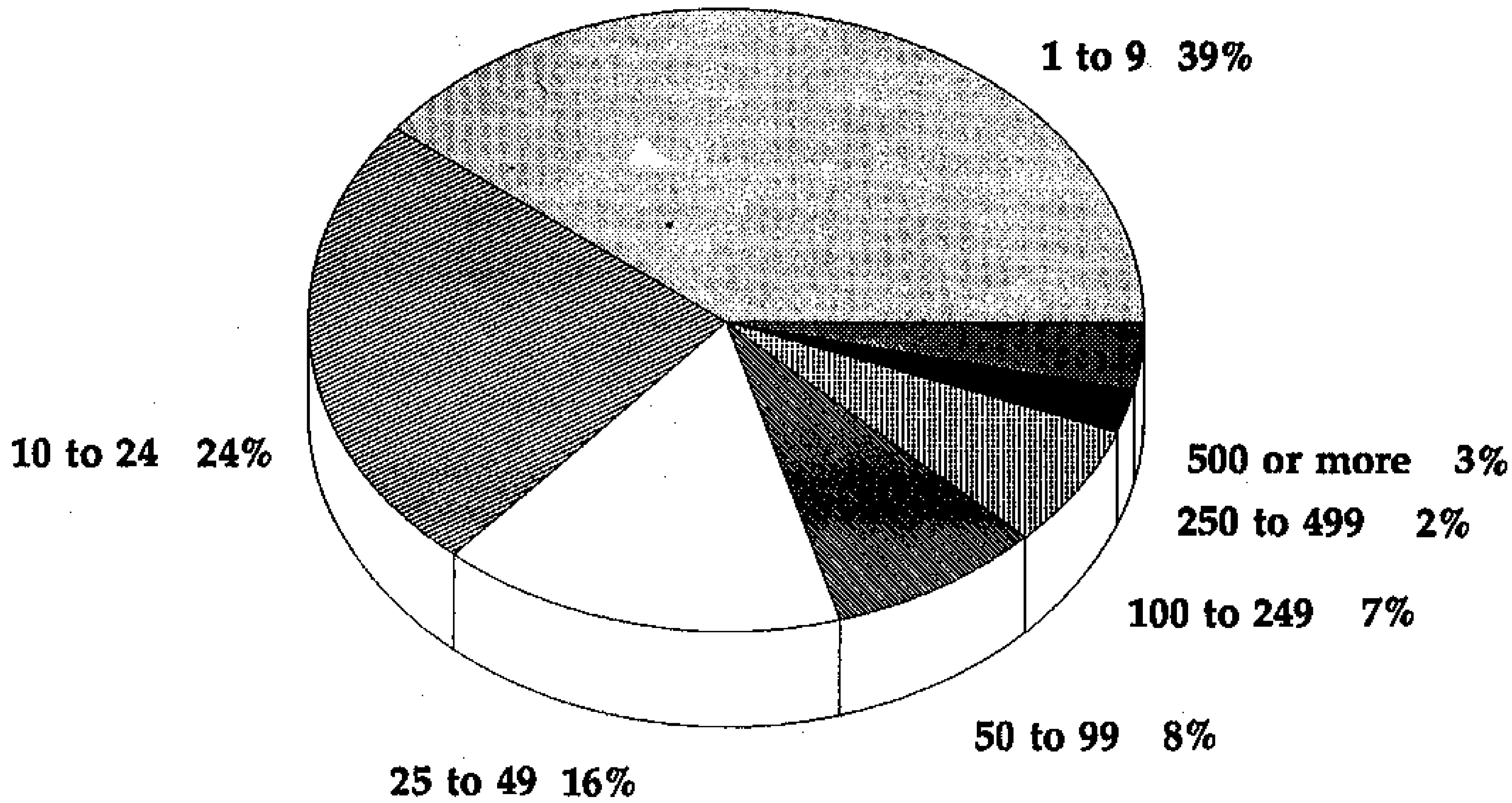
Distribution of High Tech Firms by Number of Employees



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percent of all high tech companies; however, they account for 32 percent of total high tech employment. Most are large, well-established firms primarily involved in research, development, testing and evaluation for the Department of Defense or the National Aeronautics and Space Administration.

Software developers are on the other end of the spectrum. Almost half of the companies in Utah's high technology sector are involved in software development. This group, consisting of 144 companies, employs approximately 5,800 people. With just a handful of exceptions, this segment is characterized by many small companies - most have fewer than 25 employees. Other segments with considerable employment levels include: (1) Computer Equipment (6,016); (2) Electronic Components (4,920); and (3) Biomedical/Medical Products (4,557).

On balance, Utah's high technology sector is characterized by high employment concentrations in a few firms. The importance of this small group is illustrated by the impact they bring to bear on total high tech employment. While over half of the companies surveyed added to their work forces in 1989, employment increases overall were negligible. During 1989, several large high tech companies made significant reductions in their work forces. These reductions more than offset the employment gains reported at smaller organizations.

Product Sales

In 1989, high technology companies in Utah reported sales in excess of $4.5 billion, and R&D expenditures of $666.6 million. Two segments -- aerospace and software -- each reported combined sales of more than $1.0 billion. Each of these segments have one or two companies which account for a major share of the reported revenues. At approximately 81 percent of sales, pharmaceutical companies reported the highest ratio of R&D spending of any research sector. With few exceptions, these companies are quite young and still in the early product development stage. Some have yet to market a product.

Only a handful of high tech companies sell products exclusively in the regional market (Utah and surrounding states). Typically, those that do are small software companies which have not yet reached a point where market expansion is feasible.

Roughly 25 percent of Utah's high tech companies limit their product sales to the domestic market only. More than one-half of those companies that sell only in the U.S. are software firms. Company size (too small), and product modification difficulties were the reasons most often given for not pursuing a foreign market. In contrast, 67 percent of Utah's high tech firms market products internationally. However, many indicated that foreign sales were limited to just one or two countries.

The Role of the University in Fostering High Tech Development

Universities play a dual role in the creation and sustenance of high technology activities. In nearly every successful high tech region in the U.S. there exists one or more research universities. The ties between entrepreneurs and such universities are well-documented. Utah is no exception. Universities in Utah have played an integral role in the development of the state's high tech base. Of the 413 companies tracked from 1986 through 1989, 54 represented that they were spin-offs from technologies or research conducted at a university; overwhelmingly these came from either the University of Utah, Brigham Young University or Utah State University. Another group consisting of 23 companies indicated that they have licensed technology initially undertaken at one these universities, making further refinements and ultimately integrating it into the company's existing product line. Medical product developers are the most likely candidates to have spun-out of, or licensed technology from, a university.

Utah's universities also play an important role by providing well-educated people for high tech companies. Over half of the high tech companies located in Utah were founded by a graduate of a Utah university. Furthermore, interviews with some of the state's largest high tech companies reveal that a significant portion of these organizations' technical needs are being met with Utah's university graduates. The existence of strong science, engineering, and computer programs at the state's institutions of higher education has been, and should continue to be, a critical factor in high tech development in Utah.

Sources of Funding for High Tech Companies

Financing a high tech venture is a concern of entrepreneurs throughout most of the country. Well over 80 percent of Utah's high tech companies were founded with a combination of owners' resources, and the resources of friends and relatives. Fewer than 3 percent of Utah's high tech firms were initially financed with institutional venture funds, although biomedical companies have been quite successful in securing venture capital at later stages of their development.

High tech companies in Utah have raised over $109 million in institutional venture funds; however, the pool of venture capital in the state is small, and most have had to secure money from outside the state. Furthermore, venture capitalists are very specific about the characteristics they look for when investing their money. Most Utah high tech companies either do not meet these requirements, or the entrepreneurs are unwilling to give up equity and/or control of the company in return for capital. For these reasons, follow-on funding and growth financing for high technology companies in Utah generally comes from working capital generated through company sales.

Educational Characteristics of Utah's High Tech Entrepreneurs

Given the complexities of developing new technologies and products, it is not surprising that more than 50 percent of the high tech company founders have more than 16 years of education. Approximately 35 percent indicated that they had between 12 and 16 years of education. Only 3 percent indicated they had fewer than 12 years of schooling. Of the largest research sectors, founders of biomedical/medical companies tended to have graduate degrees more often than founders of other companies. Founders of software development companies rank second highest, while founders of computer equipment companies have the lowest ratio of graduate degrees (Table 3).

Table 3
Educational Profile of Founders
Selected Research Sectors

Research Sector	Years of Education			No Response[a]
	1 - 12	12 - 16	16+	
Electronic Components	3%	28%	41%	28%
Computer Equipment	7%	46%	28%	18%
Biomedical/Medical Products	2%	20%	66%	12%
Software/Systems	1%	41%	49%	9%
All Companies	3%	34%	52%	12%

[a] Represents percentage of companies not responding to question.
Note: Numbers reflect percentage of founders attaining the specified level of education. Many companies reported having more than one founder.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

Engineering, business, and science appear to be the primary fields of interest for high tech entrepreneurs. Almost half of the founders with graduate degrees are graduated from one of Utah's colleges or universities. Although all institutions in Utah are represented, graduates from the University of Utah and Brigham Young University head the list.

A HISTORIC OVERVIEW OF HIGH TECH DEVELOPMENT IN UTAH

For its size, Utah has been extremely fortunate in the development of home-grown high technology companies. Utah's high technology industry has a long history dating from the early 1900s, specifically in the defense and electronic sectors. Yet, it was not until the mid-1970s that the formation of high tech companies began to hit the double digit mark. Only 70 companies currently in existence were founded prior to 1975. Fully one quarter of these early technology companies were electronics manufacturing concerns who, for the most part, were in Utah as a result of national expansions. A notable exception was Evans & Sutherland, a home-grown computer company.

Evans & Sutherland

Founded in 1968, Evans & Sutherland is one of Utah's oldest, and most successful high technology companies. The founders, David Evans and Ivan Sutherland, were two of the early pioneers in the development of computer graphics technology. The company designs digital computers, software systems, and display devices that are used in applications which require intensive, high-speed computation and which are aided by visual presentation. In 1989, the company reported sales of $136 million and employed approximately 1,200 people in Utah.

By 1979, the state was experiencing a surge in both the creation of high technology companies and the range of technologies under development (Table 4). Two of Utah's most notable successes came from this era - WordPerfect Corporation and Novell, Inc.; both are home-grown, software companies.

Table 4
Creation of High Tech Companies in Utah by Founding Date

Research Sector	Prior to 1970	1970 to 1974	1975 to 1979	1980 to 1984	1985 to 1989
Aerospace Components	5	0	0	3	2
Analytical/Measuring Devices	1	2	4	5	3
Biomedical/Medical Products	6	5	9	23	10
Chemicals	1	1	3	4	1
Communications Equipment	3	4	4	8	5
Composite Materials	2	3	0	2	5
Computer Equipment	4	3	6	19	7
Electronic Components	9	7	9	12	1
Lasers/Optics	0	1	1	2	5
Pharmaceuticals	1	0	1	2	6
Plant Genetics	1	1	2	0	1
Robotics	0	0	1	3	0
Software/Systems	7	4	24	70	60
Other	4	1	5	6	8
Total	38	32	69	159	114

Note: One company was founded in 1990.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

WordPerfect Corporation

WordPerfect was formed in 1979 with the express purpose of developing a word processing program that was a significant departure from the Wang standard -- the most commonly used word processing system on the market in the late 1970s. When the personal computer was introduced to market in the early 1980s, WordPerfect was one of only a handful of companies with a user friendly word processing program. The ensuing demand for applications software, combined with a series of strategic development and marketing decisions made by WordPerfect's founders, have resulted in a company that is now one of the largest independent personal computer software companies in the world.

Novell, Inc.

Novell's early years were a bit rocky, but this company has become a world-class leader in the development of networking software. Rather than producing for a growing market, Novell has grown its own market; that is, convincing the end user that networking is both a valuable and viable tool. The company's success is impressive. In 1989, Novell employed approximately 900 people in Utah and reported sales in excess of $400 million.

Software Development

The 1979 surge in the creation of technology companies turned into a virtual explosion by the early

1980s as high tech development took center stage throughout Utah and much of the nation. Of particular importance to Utah has been the spectacular growth in the creation of software development companies. Several factors are responsible for this phenomena. First, the barriers of entry into software development are unusually low; specifically, they are not capital-based. Second, Utah has several well-established software development companies to serve as role models for up-and-coming entrepreneurs. Finally, the contribution made by Brigham Young University is impressive. Both the Computer Science Department and the Technology Department at BYU have long emphasized the development of highly sophisticated software programs. From 1980 through 1985, 86 software start-ups were formed in the state; roughly 46 percent of the total high tech start-ups during that period.

Biomedical/Medical and Computer Equipment

The number of biomedical/medical products manufacturers, and computer equipment manufacturers also increased during this period, although at a much slower rate for several reasons. Most importantly, the costs associated with the start-up of a high tech manufacturing facility can be enormous. And, as discussed previously, the amount of venture capital available to Utah start-ups is limited. Furthermore, few if any entrepreneurs have the personal resources needed to fully develop, manufacture and market a new biomedical or computer product. In the case of biomedical companies, product development costs can be particularly high if the product requires FDA approval.

By the end of 1989, 359 high tech companies were doing business in Utah. While this is roughly the same number as in 1986 (361), Utah's high tech sector is far from stagnant.

Of the 361 companies active in 1986, only 316 were still in business by the end of 1989. Another eight companies were still in business, but had either discontinued R&D activities, or transferred development programs to locations outside Utah. Over the course of the past four years, 53 new high technology companies have been formed. Not all have been successful. In fact the software segment has the highest mortality rate of all segments in the high tech industry, followed by the biomedical/ medical and the computer segments.

High Tech Employment Trends

Employment growth in Utah's high tech industry is a reflection of national trends. Essentially, it is slowing down. From 1986 to 1987, employment in Utah's high tech industry increased more than 5 percent, several times that of the state's total non-agricultural employment growth rate for that same year. Due to a series of unfortunate events -- the stock market crash in October of 1987, increased foreign competition, consolidations and mergers, intense price competition and the rising cost of capital -- high tech employment in Utah plunged in 1988 (Table 5).

By the end of 1989, most segments had either stabilized or were expanding, yet high tech employment grew less than 1.0 percent as Aerospace Equipment manufacturers collectively reduced their work forces by 1,100 people in 1989. This dichotomy highlights an important issue in the growth of Utah's high tech industry. As indicated earlier, a sizable number of Utah's high tech companies are relatively young, small, home-grown concerns. From 1986 through 1989, these smaller organizations provided almost all the new jobs created in the high tech sector (Table 6).

As indicated in Table 6, from 1986 through 1989, employment at small companies (500 people or less) increased by 3,800. At the same time, larger companies reduced their collective employment base by more than 2,200 people. Of the 12 companies with 500 employees or more in 1986, seven were branch operations. It would appear that home-grown high tech companies offer the greatest potential for industry-wide expansion.

The changing occupational mix of Utah's high tech industry is another important trend. By their very nature, technology development companies tend to have more employees who fall into the technical disciplines, i.e., scientists, engineers, and computer programmers. These positions typically require

Table 5
Four-Year Employment Trends
1986 - 1989

Sector	1986	1987	1988	1989
Aerospace Components	13,781	13,104	13,142	11,918
Analytical/Measuring Devices	314	355	349	380
Biomedical/Medical Products	4,117	4,434	4,580	4,557
Chemicals	207	208	206	204
Communications Equipment	932	885	850	963
Composite Materials	342	318	320	372
Computer Equipment	6,032	6,721	6,107	6,016
Electronic Components	4,499	4,733	4,822	4,920
Lasers/Optics	266	266	259	298
Pharmaceuticals	49	78	74	90
Plant Products	228	316	200	218
Robotics	42	47	60	66
Software/Systems	3,850	4,948	4,907	5,791
Other (NEC)	594	733	764	1,009
Total	35,253	37,146	36,640	36,802

Note: Employment levels are for high tech companies only.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

advanced degrees, and are generally higher paying than those at the production level. After remaining at 24 percent of total high tech employment for three years, technical employment dropped to 22 percent of total employment in 1989; again, the largest loss was in the aerospace group. At the same time, production level employment gained a slightly larger share of the total in 1989 (42.6% in 1988 and 43.4% in 1989).

Taken as a whole, a casual assessment of the current trends in Utah's high technology sector would suggest that the industry is in a downturn. However, a more detailed approach suggests that only certain segments are in decline, some are neither increasing nor decreasing in any meaningful measure, while others are increasing at a rapid pace.

Segment Trends

Aerospace

Aerospace companies have traditionally held an important place in Utah's high technology sector. Since 1986, aerospace manufacturers have accounted for at least 30 percent of total high tech employment. Furthermore, this segment is dominated by the activities of a handful of very sizable companies. Therefore, it follows that employment fluctuations at these companies could have a significant impact on the sector as a whole, and indeed this has been the case.

For each of the past four years, employment in Utah aerospace companies has been declining as a relative percent of total employment. In 1986, aerospace accounted for 39 percent of the state's total high tech employment. By the end of 1989, aerospace accounted for only 32 percent of total employment due to a loss of over 1,800 people. Aerospace companies nationally are struggling to remain profitable in the face of declining business opportunities and reductions in the federal defense budget. Even the commerical aerospace manufacturers are grappling with cost and productivity issues. Some of this downturn may be ameliorated by recent events in

Table 6
Employment Trends by Company Size
1986 Base Year

	1986 Employment Levels:			
	0	1 - 99	100 - 500	500+
Number of Companies	55	324	22	12
Number Headquartered in Utah	53	268	16	5
Number No Longer in Business[a]	4	41	1	0
1986 Employment Total	0	5,285	3,929	26,039
1989 Employment Total	438	7,015	5,565	23,784
Average Annual Growth Rate	-	9.9%	12.3%	-2.9%
Number of Jobs Created (Lost)	438[b]	1,730	1,636	-2,255
Relative Share of 1986 Total High Tech Employment	0.0%	14.9%	11.1%	73.8%
Relative Share of 1989 Total High Tech Employment	1.2%	19.1%	15.1%	64.6%

[a] Includes companies that have moved from Utah.
[b] By the end of 1989, these 55 companies employed a total of 438 people.
Source: Bureau of Economic and Business Research, University of Utah, unpublished data (1990).

the Middle East, but many aerospace firms are looking for ways to reduce their dependence upon military contracting. Over the long term, this particular segment will see a continued shakeout of weak and marginally productive companies.

Computer Equipment

Computer equipment has been another volatile segment. After a considerable employment jump in 1987, this segment has been slowly declining over the past two years, both in real terms and as a percentage of total high tech employment. A steady weakening in domestic demand for personal computers, strong foreign competition, and constant pressure to reduce prices will combine to keep this segment of the high tech sector in a flat or declining growth pattern. Furthermore, as the construction of computer manufacturing facilities requires large amounts of capital, it is unlikely that Utah will see an acceleration in the number of computer equipment start-ups. Rather, growth will have to come from expansion of existing facilities. The two most likely candidates for considerable growth in this segment are Evans & Sutherland Computer Company and Iomega Corporation.

Chemicals/Plant Genetics

The "neutral" segments of Utah's high tech sector include chemicals and plant genetics. These two segments were at essentially the same employment levels in 1989 as in 1986, although plant genetics experienced a large increase from 1986 to 1987 but dropped below the 1986 figure in 1988. Analytical/ measuring devices is another segment that will likely remain flat.

Software/Electronic Components

The high tech success stories include software developers and electronic component manufacturers. Together, these two segments have increased the high tech employment base by 2,362 people since 1986. Nationally, the software market is continuing a trend of strong, steady growth. Utah's software segment is a reflection of this vitality, and continues to be the fastest growing segment of Utah's high technology sector. The worldwide outlook is bright as the software market is expected to continue its explosive growth. Industry analysts are projecting that this market could hit $1 trillion by the year 2000. Utah's software development companies will continue to take advantage of the rapidly growing demand for software products both domestically and abroad.

Utah's high tech electronic components segment is a highly fragmented cross-section of companies manufacturing a wide range of products. Nonetheless, there is a relatively high employment concentration in the semiconductor group of this segment. Primarily due to increased foreign competition, a downturn is expected in the manufacture of semiconductors which could result in employment declines at Utah-based semiconductor facilities. Demand for other electronic components such as printed circuit boards, electronic coils and transformers, is tied to key end-user markets (automobiles, telecommunications, and computers). In light of this, it may be difficult for Utah's electronic component manufacturers to maintain their present level of growth.

Health Care Products

The "Health Care" group (biomedical/medical products, pharmaceuticals) also shows future potential. Most industry analysts agree that the shake outs which occurred in the mid-1980s resulting from government-introduced cost containment measures are over. Growth will be fueled by demographics and prevalent disease conditions. Specifically, the aging populations in the United States and its major trading partners, will continue to spur demand as the elderly require increased medical attention. The market for disposables, surgical appliances, supplies, and electromedical equipment hold the most promise for continued growth whereas the demand for X-ray and related products will remain stagnant.

Communications/Composite Materials

Other segments which appear to have stabilized and may see future expansion include communications equipment and composite materials. The communications segment is comprised of a complex group of technologies which include radio communication and detection equipment (RCDE), satellite systems, microwave systems, and fiber optics. Utah's communications segment is concentrated in two of these areas - RCDE (58%) and satellite systems (16%). Much of the demand for products in these two groups is driven by military contracting, although an increasing number of products in RCDE that were initially designed for military use are now established in the civilian market. Over the long term, steady growth is expected for RCDE as the result of increased industrial and commercial demand, especially for mobile and fixed radio equipment and television broadcasting equipment. Slow growth is projected for the satellite sector primarily for those companies who are able to reduce their reliance on military contracts and develop commercial applications instead.

Composite materials have been used primarily in the aerospace industry, although other promising uses include the construction of sports equipment, automotive, and industrial products. However, due to the expense of composite fibers, the greatest demand in the foreseeable future will continue to come from aerospace. Healthy growth in this segment will be dependent upon material unit cost reductions, and further expansion into non-military markets such as medical implants, industrial machinery, and storage of corrosive chemicals.

Other Segments

There are several small, but rapidly growing segments in Utah's high tech sector. Included are pharmaceuticals (part of the health care group), robotics, and laser/optics manufacturers, many of which are still in the early R&D stages. These segments, representing a very modest portion of high tech activity, should continue to increase as companies in each group move from the R&D phase and begin production and manufacturing activities over the next few years.

CONCLUSION

Is the bloom off Utah's high tech rose? Certainly, there are segments presently in a period of retrenchment, namely aerospace and computers. And, there is no question but that these two segments have held important places in Utah's high tech sector and further reductions in either will continue to negatively impact the sector as a whole. On the other hand, it is possible that the composition of Utah's high tech sector will change as the software, electronic components, and health care group segments continue to expand.

For its size, Utah has been tremendously successful in the high tech arena. There are at least a dozen companies in the state which are widely recognized as leaders in their respective fields.

Given the current successes, there is a proclivity to believe that with the right ingredients, these "home runs" could be common occurrences. Indeed, there are small companies in Utah which do have the potential to become major players in the technology field. But there are many more that are "me-too" companies. These cater to a very narrow niche in an existing, established market that simply does not have growth potential. The most successful high tech companies in Utah are those that either created the market for their products, or were early entrants in a fledgling market.

The high tech playing field is changing. Venture funds are harder to acquire, global competition is increasing, foreign governments are putting greater amounts of capital into developing new technologies. All of this spells difficult times ahead for U.S. companies.

However, in retrospect, small, home-grown technology companies will also help augment the high tech sector in Utah. These are companies that are "invested" in the state; they have individuals at the helm who want to live and work in the state. Over the course of the past four years, employment growth at these smaller technology companies has been impressive. Indications are that these companies may provide the impetus behind future growth in the high tech sector.

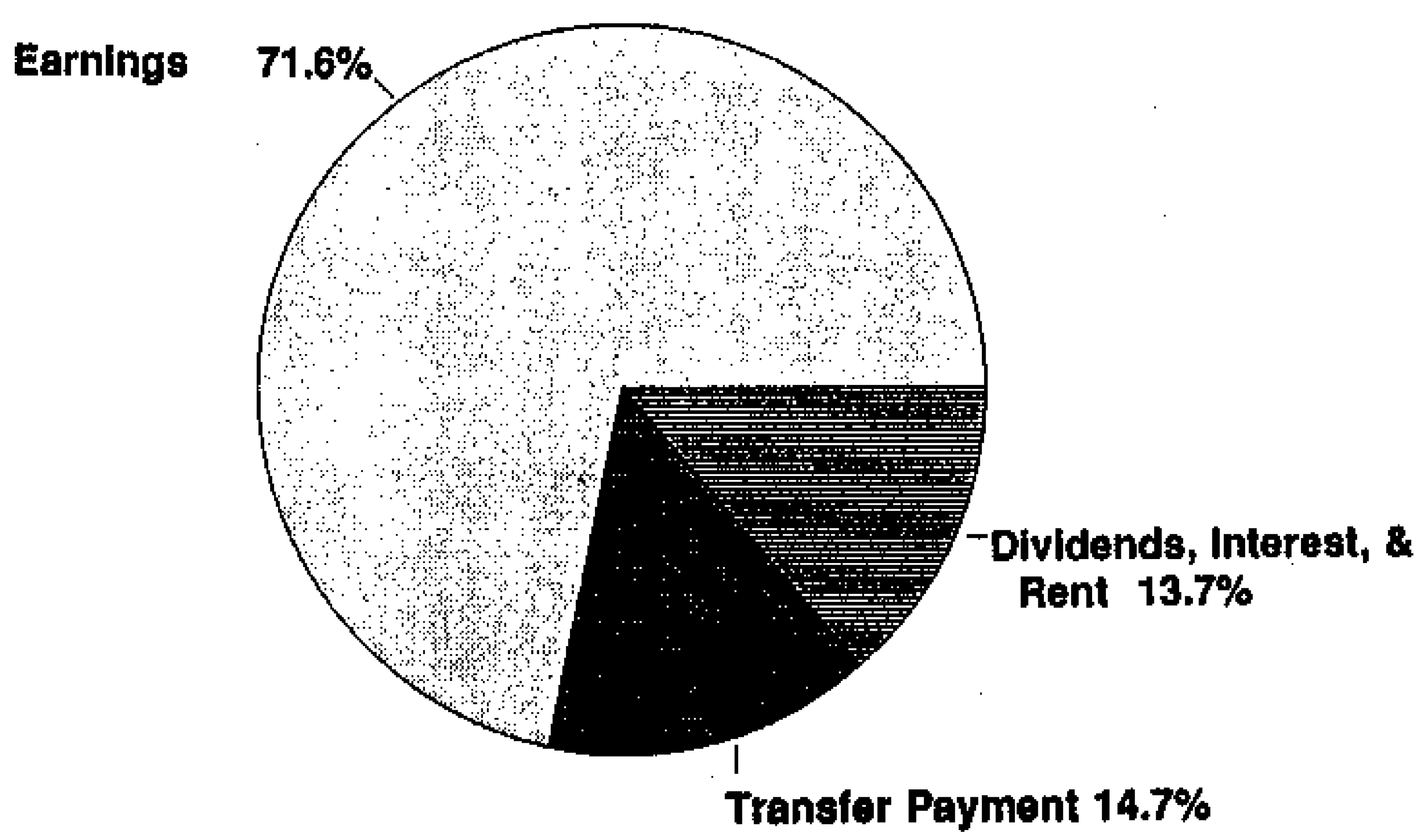
There is also a plethora of high tech companies in Utah which are still in the early development stages. It is simply a matter of time before these companies will move into the manufacturing and production phase. At that point, their contribution may become invaluable to both Utah's economic growth and the expansion of the state's high tech sector.

In any case, with the advent of the European Community picture in 1992 and the present changing situation in the Middle East, it is difficult to predict Utah's future in the high tech arena.

ERRATA

The following chart is reprinted with a correction on the identification of pie chart segments. Transfer Payments was identified incorrectly in the May/June 1990 issue, Figure 4, page 5.

Figure 4
Percent Distribution of Personal Income by Type — State of Utah, 1988



Data Source: U.S. Department of Commerce

Utah Business Statistics

UTAH DATA	May 1989	May 1990	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
Total Personal Income (seasonally adjusted) (mil. of dol.) (qtly.)	22,061	NA	NA	NA	21,247	NA
New Corporations (no.)	525	645	22.9%	493	451	9.3%
New Car, Truck, and Motor Home Sales (no.)	5,762	NA	NA	NA	5,107	NA
Agriculture						
Average Prices Recorded by Farmers (dol.)						
Beef Steers and Heifers (cwt) (thous.)	71.50	77.20	8.0%	74.03	70.14	5.5%
Lambs (cwt)	64.30	46.60	-27.5%	56.60	60.38	-6.3%
Milk Wholesale (cwt)	11.30	12.70	12.4%	13.23	11.83	11.8%
Alfalfa Hay, Baled (per ton)	83.00	85.00	2.4%	84.92	80.08	6.0%
Cattle Slaughtered (live weight) (thous. of lbs.)	48,283	46,707	-3.3%	47,835	47,021	1.7%
Construction						
Total Construction (thous. of dol.) 1	75,716.6	113,630.4	50.1%	81,489.4	68,623.7	18.7%
Residential	44,049.4	60,154.2	36.6%	40,439.2	33,729.0	19.9%
Nonresidential	18,786.7	31,041.4	65.2%	24,502.2	21,979.4	11.5%
Additions, Alterations, and Conversions	12,880.4	22,434.8	74.2%	16,548.1	12,915.2	28.1%
Total Permit Construction (thous. of dol.) 2	78,937.7	131,887.0	67.1%	89,110.4	73,813.7	20.7%
Residential	45,873.4	65,019.7	41.7%	42,030.1	35,186.1	19.5%
Nonresidential	19,975.7	41,743.7	109.0%	31,766.9	24,794.5	28.1%
Additions, Alterations, and Repairs	13,088.6	25,123.6	92.0%	15,313.4	13,833.1	10.7%
New Dwelling Units (no.)	563	768	36.4%	522	470	11.1%
Employment						
Civilian Labor Force (thous.)	781.7	788.6	0.9%	794.4	770.2	3.1%
Total Employed Persons	738.1	750.5	1.7%	760.6	733.3	3.7%
Unemployed Persons	43.6	38.1	-12.6%	33.9	36.5	-7.3%
Percent Total Labor Force	5.6	4.8	-14.3%	4.3	4.8	-11.0%
Employees on Nonagricultural Payrolls (thous. of jobs)	690.0	723.4	4.8%	703.3	672.5	4.6%
Manufacturing	102.4	105.3	2.8%	103.9	101.1	2.8%
Mining	7.9	8.7	10.1%	8.4	7.9	5.7%
Contract Construction	26.7	27.3	2.2%	26.5	25.4	4.3%
Transportation, Communication, and Utilities	40.4	42.6	5.4%	41.8	40.2	3.9%
Wholesale Trade	38.5	40.5	5.2%	39.1	36.8	6.2%
Retail Trade	126.3	135.1	7.0%	131.1	123.4	6.2%
Finance, Insurance, and Real Estate	33.0	34.1	3.3%	33.5	33.2	0.8%
Services 3	164.2	176.0	7.2%	171.6	160.4	7.0%
Federal Government	40.6	41.4	2.0%	40.3	39.6	1.7%
State Government 4	41.0	42.9	4.6%	40.9	39.1	4.8%
Local Government 4	69.0	69.5	0.7%	66.2	65.3	1.4%
Average Weekly Hours						
Manufacturing	39.3	39.8	1.3%	40.0	40.3	-0.8%
Mining	40.5	42.8	5.7%	41.7	40.6	2.9%
Wholesale Trade	37.2	36.9	-0.8%	36.2	37.6	-3.7%
Retail Trade	27.4	26.4	-3.6%	27.0	27.5	-2.0%
Amount of Unemployment Compensation (thous. of dol.)	5,134.3	5,256.6	2.4%	4,929.2	5,386.6	-8.5%
Finance						
Savings, Savings and Loan Association (mil. of dol.)	2,195.5	1,860.7	-15.2%	2,048.6	2,329.3	-12.0%
Tax Collections by the State of Utah (thous. of dol.)						
Total Tax Collections	247,349.8	62,185.2	-74.9%	163,127.9	149,054.1	9.4%
Sales and Use Tax	136,088.8	6,572.2	-95.2%	58,408.7	55,303.3	5.6%
Motor Fuel Tax	10,603.5	10,583.9	-0.2%	11,718.8	10,988.3	6.6%
Individual Income Tax	45,765.0	21,371.6	-53.3%	54,018.4	52,320.2	3.2%
Corporation Franchise Tax	2,913.8	-897.4	-130.8%n	4,305.8	7,138.9	-39.7%
Production						
Crude Oil to Refineries (thous. of bbls.)	5,057.5	3,728.2	-26.3%	3,532.6	4,450.6	-20.6%
Crude Oil (thous. of bbls.)	2,478.3	2,379.6	-4.0%	2,327.2	2,562.5	-9.2%
Natural Gas (mil. of cu. ft.)	24,104.0	26,925.1	11.7%	23,936.8	23,013.1	4.0%
Coal (thous. short tons)	1,703.0	2,013.0	18.2%	1,847.3	1,559.6	18.5%
Tourism/Travel						
Air Passengers (total no. on and off)(S.L. Int'l Airport)	871,611	892,313	2.4%	1,006,148	905,088	11.2%
Highway Traffic Count Across State Lines	43,017	43,866	2.0%	42,184	NA	NA
Transient Room Taxes (thous. of dol.)	1,336.8	166.6	-87.5%	537.4	546.5	-1.7%
Visits, State, Nat'l. Parks, Monuments (thous.)	1,513.7	1,489.2	-1.6%	1,123.9	1,111.2	1.1%
Utilities						
Telephone Lines in Service (Mt. Bell)(Residential)	497,893	513,236	3.1%	506,522	492,998	2.7%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	185,601	193,377	4.2%	188,869	183,315	3.0%
Electric Customers (Residential)	483,723	489,106	1.1%	486,480	479,569	1.4%
Electric Customers (Commercial)	47,754	50,131	5.0%	49,013	47,379	3.4%
Natural Gas Customers (Residential & Commercial)	471,888	485,288	2.8%	478,921	464,229	3.2%
Natural Gas Customers (Industrial)	569	573	0.7%	568	556	2.1%

Utah Business Statistics

UTAH DATA	May 1989	May 1990	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
Davis County						
Non-Ag. Employment (thous.)	57.3r	59.9f	4.5%	56.8	54.6	4.0%
Unemployment Rate	4.7r	4.2	−10.6%	4.0	4.3	−8.3%
Auth. Permit Construction (thous. of dol.)	9,825.5	13,224.5	34.6%	10,858.8	8,294.2	30.9%
New Dwelling Units (no.)	90	86	−4.4%	74	65	14.9%
Postal Receipts (thous. of dol.)	687.4	651.6	−5.2%	640.0	498.4	28.4%
Electric Customers (Residential)	49,097	49,610	1.0%	49,457	48,453	2.1%
Electric Customers (Commercial)	3,602	3,628	0.7%	3,652	3,565	2.4%
Natural Gas Customers (Residential)	51,719	52,803	2.1%	52,287	51,036	2.5%
Natural Gas Customers (Industrial)	57	56	−1.8%	56	54	3.4%
Telephone Lines in Service (Mt. Bell)(Residential)	56,802	60,144	5.9%	58,337	55,958	4.3%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	11,881	12,812	7.8%	12,342	11,613	6.3%
Salt Lake County						
Non-Ag. Employment (thous.)	352.1r	367.2f	4.3%	360.4	344.9	4.5%
Unemployment Rate	5.1r	4.3	−15.7%	3.9	4.4	−12.2%
Auth. Permit Construction (thous. of dol.)	33,100.5	54,346.9	64.2%	37,448.3	31,842.3	17.6%
New Dwelling Units (no.)	186	241	29.6%	185	178	3.9%
Postal Receipts (thous. of dol.)	8,457.7	8,008.3	−5.3%	8,086.8	8,301.4	−2.6%
Electric Customers (Residential)	242,876	245,914	1.3%	244,487	241,248	1.3%
Electric Customers (Commercial)	20,858	21,193	1.6%	21,036	20,641	1.9%
Natural Gas Customers (Residential)	224,667	228,376	1.7%	226,215	222,226	1.8%
Natural Gas Customers (Industrial)	243	244	0.4%	245	239	2.7%
Telephone Lines in Service (Mt. Bell)(Residential)	234,257	242,074	3.3%	238,363	232,051	2.7%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	112,343	117,237	4.4%	114,779	111,751	2.7%
Utah County						
Non-Ag. Employment (thous.)	84.7r	91.2f	7.7%	88.5	83.9	5.5%
Unemployment Rate	4.5r	4.0	−11.1%	3.9	4.1	−6.3%
Auth. Permit Construction (thous. of dol.)	10,406.3	21,714.8	108.7%	13,415.8	11,871.3	13.0%
New Dwelling Units (no.)	79	150	89.9%	85	70	21.7%
Postal Receipts (thous. of dol.)	1,368.2	1,657.9	21.2%	1,590.0	1,312.8	21.1%
Electric Customers (Residential)	53,843	53,244	−1.1%	53,251	52,716	1.0%
Electric Customers (Commercial)	5,958	7,563	26.9%	6,725	5,995	12.2%
Natural Gas Customers (Residential)	62,964	64,322	2.2%	63,642	62,281	2.2%
Natural Gas Customers (Industrial)	75	74	−1.3%	73	71	3.7%
Telephone Lines in Service (Mt. Bell)(Residential)	65,418	66,107	1.1%	66,384	65,420	1.5%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	21,428	20,628	−3.7%	20,433	20,770	−1.6%
Weber County						
Non-Ag. Employment (thous.)	65.0r	67.3f	3.5%	65.7	63.2	3.9%
Unemployment Rate	6.0r	5.6	−6.7%	5.1	5.7	−10.8%
Auth. Permit Construction (thous. of dol.)	6,096.2	9,397.2	54.1%	6,728.9	5,340.0	26.0%
New Dwelling Units (no.)	62	57	−8.1%	44	46	−3.8%
Postal Receipts (thous. of dol.)	659.5	688.7	4.4%	704.3	684.4	2.9%
Electric Customers (Residential)	54,228	54,800	1.1%	54,449	53,846	1.1%
Electric Customers (Commercial)	5,051	5,095	0.9%	5,052	4,975	1.5%
Natural Gas Customers (Residential)	50,611	51,242	1.2%	50,866	50,156	1.4%
Natural Gas Customers (Industrial)	85	83	−2.4%	84	84	0.5%
Telephone Lines in Service (Mt. Bell)(Residential)	47,345	46,947	−0.8%	47,221	46,868	0.8%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	12,246	13,203	7.8%	12,653	12,105	4.5%

1 Obtained from U.S. Bureau of the Census Construction Statistics Division.
2 Obtained from *Utah Construction Report.*
3 Includes services by nonprofit and religious organizations.
4 Includes public schools and college institutions.

NA Not Available
n Not meaningful due to negative data.
r Revised
f Forecast

Sources:

Personal Income	U.S. Department of Commerce, Bureau of Economic Analysis.
New Corporations	Utah Secretary of State.
New Car and Truck Sales	Utah State Tax Commission, Economic and Statistical Unit.
Agriculture	U.S. Department of Agriculture, Utah Agricultural Statistics Service, *Utah Agriculture.*
Construction Data	U.S. Bureau of the Census and Bureau of Economic and Business Research, *Utah Construction Report.*
Employment Data	Utah Department of Employment Security.
Savings Information	Utah Savings and Loan Institutions.
Tax Collections	Utah State Tax Commission.
Crude Oil Production	Utah Department of Oil, Gas, and Mining and Area Oil Refineries.
Natural Gas Production	Utah Department of Oil, Gas, and Mining.
Coal Production	U.S. Department of Energy.
Air Passengers	Salt Lake City International Airport, Statistics Division.
Highway Traffic Count	Utah Department of Transportation.
Visits to State and National Parks and Monuments	U.S. Forest Service, Utah State Parks and Recreation Department.
Utilities Data	Cooperating Utah Utility Companies.
Postal Receipts	Postmasters in Davis, Salt Lake, Utah, and Weber Counties.

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Salt Lake City, Utah

NATIONAL DATA	May 1989	May 1990	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
U.S. Gross National Product (seasonally adjusted) (bil.) (qtly.)	5,174.0	5,451.6	5.4%	5,315.6	5,022.2	5.8%
Total Personal Income (seasonally adjusted) (bil. of dol.)	4,356.8	4,622.9	6.1%	4,492.3	4,214.9	6.6%
Industrial Production Indexes (seasonally adjusted) (1987=100)	108.3	109.7	1.3%	108.4	107.0	1.3%
New Plant and Equipment Expenditures by Business (bil.) (qtly.)	470.9	506.8	7.6%	491.7	448.4	9.7%
Net Exports of Goods and Services (bil.) (qtly.)	–51.3	–27.0	–47.4%	–37.4	–61.8	–39.5%
Exports of Goods and Services (bil.) (qtly.)	628.8	661.7	5.2%	644.6	587.7	9.7%
Imports of Goods and Services (bil.) (qtly.)	680.0	688.7	1.3%	682.1	649.6	5.0%
Index of Leading Indicators (1982=100)	144.2	146.0	1.2%	144.8	144.5	0.2%
Price Indexes						
Consumer Price Indexes (not seasonally adjusted) (1982-84=100)						
CPI-U (All Urban Consumers) All Items	123.8	129.2	4.4%	126.5	120.7	4.8%
CPI-U (All Urban Consumers) Food & Beverages	124.7	131.1	5.1%	128.0	121.1	5.7%
CPI-U (All Urban Consumers) Housing	122.1	127.1	4.1%	125.2	120.3	4.1%
CPI-U (All Urban Consumers) Transportation	116.0	117.7	1.5%	115.8	111.2	4.2%
CPI-U (All Urban Consumers) Medical Care	147.5	160.8	9.0%	154.5	142.7	8.3%
CPI-U (All Urban Consumers) Energy	97.4	96.7	–0.7%	96.1	91.2	5.3%
Producer Price Index (not seasonally adjusted) (1982=100)						
Producer Price Index, All Finished Goods	114.2	117.7	3.1%	115.5	110.4	4.6%
GNP Price Deflator (1982=100) (qtly.)	125.8	130.9	4.1%	128.4	123.5	3.9%
Civilian Employment (seasonally adjusted)						
Total Civilian Labor Force (mil.)	123.6	125.0	1.1%	124.4	122.6	1.5%
Total Civilian Employment (mil.)	117.1	118.4	1.1%	117.8	116.1	1.5%
Unemployment Rate	5.2	5.3	1.9%	5.3	5.3	–0.5%
Construction						
Total Construction (mil. of dol.)	24,738.2	23,576.5	–4.7%	20,742.0	21,894.3	–5.3%
Residential	11,850.9	10,946.1	–7.6%	9,646.3	10,270.6	–6.1%
Nonresidential	8,269.4	7,502.4	–9.3%	7,282.4	7,674.7	–5.1%
Non-Building	4,617.9	5,128.0	11.0%	3,813.3	3,948.9	–3.4%
New Dwelling Units (no.)	132,959	118,847	–10.6%	106,743	120,489	–11.4%
Interest Rates						
Federal Funds Rate	9.81	8.18	–16.6%	8.65	8.74	–1.0%
Short Term (3-month Treasury bill rate)	8.40	7.78	–7.4%	7.79	7.77	0.2%
Long Term (30-year Treasury bond yields)	8.95	8.90	–0.6%	8.41	9.12	–7.7%
Prime Rates Charged by Banks on Short-term Business Loans (avg.)	11.50	10.00	–13.0%	10.39	10.38	0.0%
Mortgage Rates (new homes)	9.82	9.87	0.5%	9.80	9.18	6.8%

Sources: *Survey of Current Business*, U.S. Department of Commerce: U.S. Gross National Product, Total Personal Income, Industrial Production Indexes, New Plant and Equipment Expenditures by Business, Export/Import Data, Index of Leading Indicators, GNP Price Deflator, National Employment Data, Interest Rates.

F.W. Dodge Report, McGraw-Hill: National Construction Data.

Utah Labor Market Report, Utah Department of Employment Security: Consumer Price Indexes, Producer Price Index.