DOCUMENT RESUME

ED 247 791 HE 017 386

TITLE Strategy for the Eighties: High Technology Industrial Development.
INSTITUTION Kansas State Dept. of Economic Development, Topeka.
SPONS AGENCY Economic Development Administration (DOC), Washington, D.C.
PUB DATE Sep 82
NOTE 144p.; Prepared by the Planning and Community Development Division.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

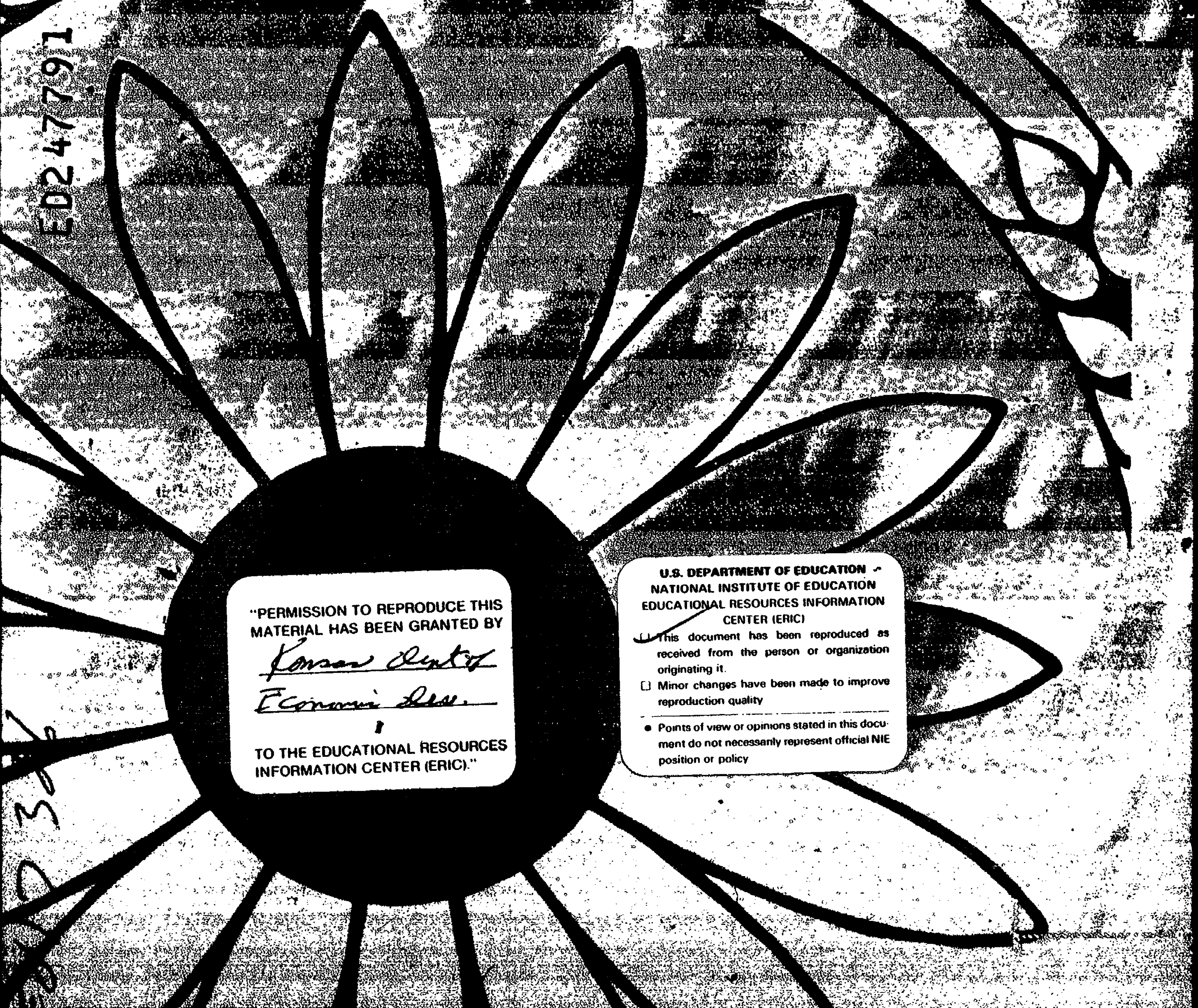
EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS *College Role; Geographic Location; Government Role; Higher Education; *Industry; Questionnaires; *Research Needs; *School Business Relationship; *State Action; *Technological Advancement
IDENTIFIERS *Kansas

ABSTRACT

The need for high technology development in Kansas is assessed, with attention to community considerations and the roles of universities and state government in fostering technology development and community considerations. After defining a high technology industry, technologically innovative industries are identified, and influences on the location of high technology plants are considered. University concerns include: the benefits of high technology development to industry and university, the research capabilities of Kansas academic institutions and the nature of research support, the types of research specialization, and what Kansas universities must do to attract high technology. Considerations for communities that wish to attract high technology industries include: benefits to the community, standards that a community should meet, and the specific communities that have high potential to attract high technology industries. The history of research and technology development in Kansas is briefly reviewed, and the involvement of other states in high technology industries is discussed. The questionnaire used to survey high technology industries is appended, along with brief descriptions of activities employed by various states to encourage technology innovation, including an "R&D Scorecard" from "Business Week." (SW)

STRATEGY FOR THE EIGHTIES:

HIGH TECHNOLOGY INDUSTRIAL DEVELOPMENT



KANSAS DEPARTMENT OF ECONOMIC DEVELOPMENT

PLANNING AND COMMUNITY DEVELOPMENT DIVISION

STRATEGY FOR THE EIGHTIES:
HIGH TECHNOLOGY INDUSTRIAL DEVELOPMENT

September 1982

Kansas Department of Economic Development

John Carlin, Governor

Charles J. Schwartz, Secretary

Prepared By:

Planning and Community Development Division

Dennis McKee, Director
Deanne Vieux, Project Coordinator
Kevin Carr
Bill Gomez
Stan McAdoo
Ed Riemann
Sandra Kampschroeder

This document was produced as a part of the Kansas Statewide Economic Development Planning Program supported by a 302(a) grant from the Economic Development Administration of the U.S. Department of Commerce. This grant is administered by the Kansas Department of Economic Development.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

INTRODUCTION

The manufacturing sector of the U.S. economy is becoming increasingly dependent on technological advancement. The future of industrial development in Kansas, as well as the country, lies with high technology industry. From 1974 to 1980, approximately 70% of the net growth in manufacturing employment in Kansas was in high technology industries. From now until the year 2000, it is estimated that over 75% of the nation's industrial growth will be in the high technology industries. Many states have placed increasing importance on high technology and have initiated concerted efforts to foster high technology industrial development within their borders. Most states within our region are, however, just starting their efforts. Kansas must do the same to remain competitive.

The need for high technology development in Kansas was validated by a 1980 KDED planning survey of over 3,000 business leaders and public officials across the state. Respondents indicated a strong need to attract and develop industry in the state, especially the type of industry that would provide job opportunities for Kansas' educated youth. As a result, KDED prepared a legislative issue paper addressing this need and undertook the formulation of a strategy for high technology industrial development.

In the spring of 1982, George Morning, a Presidential Management Intern, prepared a brief evaluation of the Kansas potential in regard to high technology development. Morning concluded that research activities carried out at the state's major graduate institutions provide a strong base for high technology development, and that the aircraft industry centered in Wichita provides a base for expansion of high technology activities in that area. The essence of the report is that Kansas can compete in the high technology arena by concentrating on specific areas of technological expertise, limiting the scope of activities to those areas where the state has a competitive advantage.

In Kansas, the need for high technology development takes on added meaning. The state has a tremendous asset in its youth. Kansas universities award over 600 masters and 150 doctoral degrees annually in engineering and science alone. In addition, they award over 250 graduate degrees in business and management annually. University officials indicate that a large number of these graduates must look to other states for employment in their field. Meeting the needs of this unique potential labor force provided additional initiative for the current study.

Before embarking upon a full scale recruitment effort aimed at high technology industry, it was considered important to formulate strategies as to how Kansas could be successful. In other words, it is necessary to formulate a clearly defined plan for high technology development, given the competitive advantages and disadvantages relative to Kansas. This was accomplished by exploring what other states have done to attract high technology industry, identifying those factors that are important to business, and identifying Kansas' competitive advantages in the high technology arena. In order to determine the state's competitive position, the following three general areas were investigated: industry needs, recruitment potential, and identification of specific areas of technology suited for Kansas. The study encompasses the roles of the state, the university, the community, and the business sector in high technology development.

This report is the supporting text to the conclusions and recommendations in the Executive Summary.

HIGH TECHNOLOGY INDUSTRY: DEFINITION AND LOCATIONAL DETERMINANTS

The objectives of this section are to provide a working definition of high technology industry, to identify those industries at the leading edge of technological innovation, and to explore those locational determinants which are unique to high technology industries. This section is based on secondary data, which was found to be somewhat limited.

What is a High Technology Industry?

The term "high technology" has been used recently to categorize a broad assortment of industries. In the process, confusion has developed over what a high technology firm is. The Joint Economic Committee of Congress gives the following definition of high technology industry.

> "High technology industries consist of heterogeneous collections of firms that share several attributes. First, the firms are labor intensive rather than capital intensive in their production processes, employing a higher percentage of technicians, engineers and scientists than other manufacturing companies. Second, the industries are science-based in that they thrive on the application of advances in science to the marketplace in the form of new products and production methods. Third, R & D inputs are much more important to the continued successful operation of high technology firms than is the case for other manufacturing industries."[54]

The Bureau of Labor Statistics provides another working description. It states that a high technology firm is a manufacturing firm in which engineers and scientists makeup a 5% or greater share of total employees. Table 1, on the following page, gives examples of high, medium, and low technology industries.

TABLE 1

LEVEL OF TECHNOLOGY

High-Technology Industries 5%	Level of Technology Medium-Technology 2-5%	Low-Technology Industries 2%
Chemicals	Fabricated Metals	Food & Tobacco
Electrical Equipt.	Paper	Furniture
Instruments	Primary Metals	Leather
Machinery	Rubber & Plastics	Lumber & Wood
Petroleum	Stone, Clay & Glass	Textiles & Apparel
Transportation Equipt.		

SOURCE: Scientific American, "Marketing to the High Growth, High Technology Segments of the U.S. Economy," Spring 1982.

The high technology industries can be distinguished from medium- or low technology firms by the way they develop and manufacture products. High technology firms rely heavily on technical and scientific innovation as a means of making and maximizing a profit. Engineers and scientists are an indispensable ingredient in the process of innovation. The Committee for Economic Development describes the process of innovation in the following manner.

> The workings of technological progress can best be understood in terms of five related phases. Of course, all five phases are not necessarily present or distinguishable in every example of technological change. Similarly, these phases should not be regarded as constituting a sequence through which every technological change progresses.
>
> The first and most elemental phase is basic research. It encompasses studies of the fundamental elements and processes of the universe. Typically, the motive of basic research is to produce knowledge for its own sake, without serious regard for the possibilities of useful application.

The second phase is applied research, in which research and engineering strive to apply basic knowledge to the solution of some particular problem or need. For example, applied research in atomic energy is built on the results of basic research in physics, and applied research in chemical engineering is built on basic research in chemistry. Often, the dividing line between these two phases is more an intellectual exercise than a practical division; in reality, laboratory work flows from one successful (or unsuccessful) experiment to another.

Once an applicable idea is proven in a laboratory setting, it still must go through testing and refinement in the third stage, development, to determine its commercial practicality. This phase includes the construction of pilot models and demonstration plants, as well as any related feasibility studies management may call for.

The combination of these first three phases is popularly labeled R & D (research and development). The general label invention is also applied to these activities. They have drawn a great deal of attention for scientific reasons, and many efforts have been made to measure their costs and benefits. But, if technological progress stopped with these functions, society would gain comparatively little from it.

Realizing the fruits of invention requires a fourth phase in which it is incorporated into a full-scale producing plant. Moreover, this first-of-a-kind plant (called a pioneer plant) must be supported by capital investment, access to raw materials, labor, power, marketing facilities, and, of course, consumer demand for the output. The sum total of all these actions is termed innovation.

The fifth phase of technological progress is the diffusion of the innovation throughout the economy. This final stage consists of replicating in a succession of other plants and firms the products and processes that have proved successful in a pioneer plant. How fast such diffusion occurs will depend on such factors as market receptivity, competitive conditions, the age of existing capital stock, and the overall pace of economic activity.[15]

There are several significant traits identified in the <u>Scientific American</u> study that are characteristic of high technology firms.

Technically Competent Management

The senior executives in high technology firms are more heavily reliant on technical expertise. Their decision-making responsibilities include research and development, patent law, technology licensing, etc. Middle managers tend to be engineers operating in sales, service, and manufacturing areas. Client contact tends to be with like people as the bond of technical "language" is critical.

High R & D Contributions

Each of the high technology industries will spend in excess of 51% of net income each year on R & D in the early phases of the firm's growth cycle.

According to Business Week's 1981 R & D scoreboard, Merck, which has a facility located at the University of Kansas, rated tenth in the nation for total R & D dollars spent per employee ($8,462). Marion Laboratories located in the Kansas City metropolitan area spent $7,921 per employee. Boeing, according to Business Week, spent $8,357 per employee -- the most spent by any aerospace firm. Appendix A provides the complete "1981 R & D Scoreboard."

Rapid Growth

During the early stages of development, the successful new technology firms see revenue advances at rates in excess of 100% per year. This early growth rate is vital to the young firms' ability to draw necessary venture capital. Generally, high growth rates continue, fed by high profit earning ratios throughout the early phases. Finally, the growth rates slacken as the product base reaches maturity, with newer technologies replacing part or all of the original markets.

Typical Growth Cycle

Many major U.S. industries have passed through this technology curve, as product usage has become standardized, volume flattens, and growth rates diminish. The steel mills and windmills, glass containers and vacuum tubes are all examples of products in the last stages of their growth cycles. In twenty years or so, interferon and the 64K RAM computer memory chips will join them.

Cluster Effect

High technology industries tend to cluster around their source of raw material . . . brainpower. Traditional industries were bound to transportation routes or sources of raw material. Technology-intensive firms tend to cluster around research activities, medical facilities or educational institutions. Basic research supplies the foodstuff on which new technologies thrive. High technology firms, with generally short product life cycles, require large numbers of engineers to redesign the products and scientists to develop new applications from laboratory work on basic research.

The term Advanced Technology Centers (ATC) is used to describe areas that host technology-intensive firms. Most people are familiar with the Stanford/MIT scenario . . . Ph.D's setting up businesses outside the campus gates. However, there is less awareness of the importance of the National Institutes of Health in Rockville, Maryland to that area's bioengineering and medical instruments business. Similarly, Wright Paterson Air Force Base in Dayton, Ohio does a substantial amount of Air Force research, and has attracted several small aerospace firms.

An "ATC" tends to grow geometrically with key engineering personnel attracting new high technology firms and existing firms attracting new engineers. Further, the start-up is often engineers from larger companies who have good ideas. Finally, the truly large centers (like Santa Clara Valley) add the dimension of interlocking technologies requiring the ability to bring together several disciplines, all locally available.

Personnel Movement

Of all the characteristics attributable to high technology firms, this is cited often as the most challenging in terms of forming long-term relationships. The movement takes two forms. On the one hand, the high growth company continues to add increasingly specialized people, starting from a small corps handling all tasks from advertising to finance and moving to a more traditional division of responsibility. Coupled with this fact is the inability to initially attract experienced specialists. On the other hand, there is considerable shifting between firms, all operating within the Advanced Technology Center.

High Technology Industries and Job Growth

Overall, the high technology industries accounted for 75% of the growth of jobs in the manufacturing sector from 1955 to 1979.[2] It is true that new technology can displace labor but the real net impact is job creation. Another reality is that jobs are more plentiful and secure in industries that adopt to new technologies because those industries remain competitive.

When high technology industries are making locational decisions, the importance of labor cannot be overemphasized. The states that develop strategies that emphasize human resources development are more likely to be the most successful.

High Technology Growth in Kansas

In order to identify the importance of high technology industry to the economic development of Kansas, analysis was made of the growth patterns of such industries since 1970. Data derived from County Business Patterns[85] provided the basis for analysis. In defining high technology industry in Kansas, the standard definition of 5% of the employees of a given industry as scientists and engineers was used.[69]

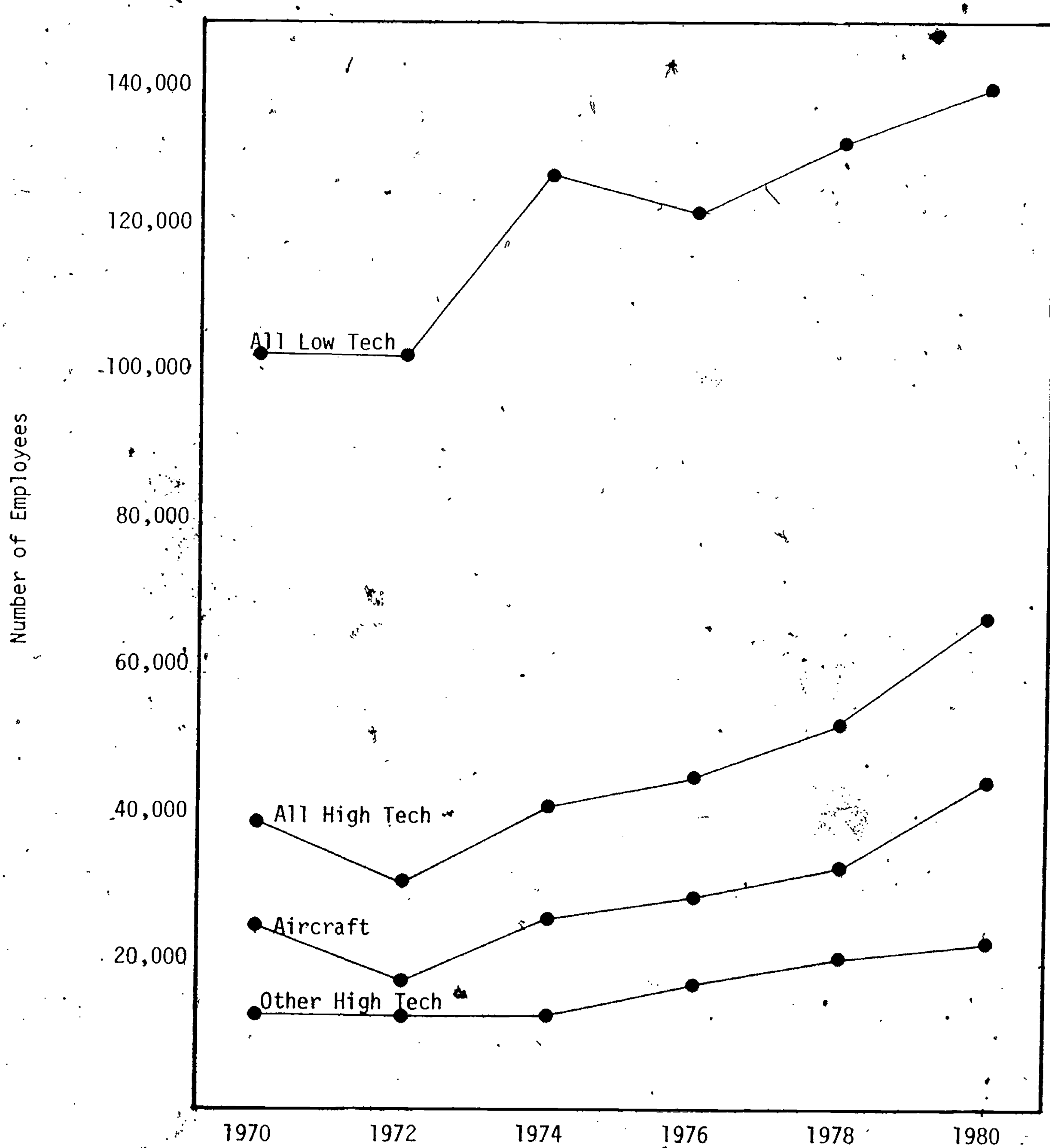
The Kansas Occupational Staffing Patterns: Manufacturing report, as well as an interview with the author of the report,[CC] were referred to using this standard definition to obtain manufacturing categories (S.I.C.'s) which can be termed high technology industries in Kansas. The resulting S.I.C.'s are:

S.I.C.	
28	Chemicals and Allied Products
357	Office and Computing Machines
36	Electrical and Electronic Equipment
372	Aircraft and Parts
38	Instruments and Related Products

The analysis centers on total employment growth, comparing high technology to low technology industries at two-year intervals from 1970 to 1980.

CHART 1

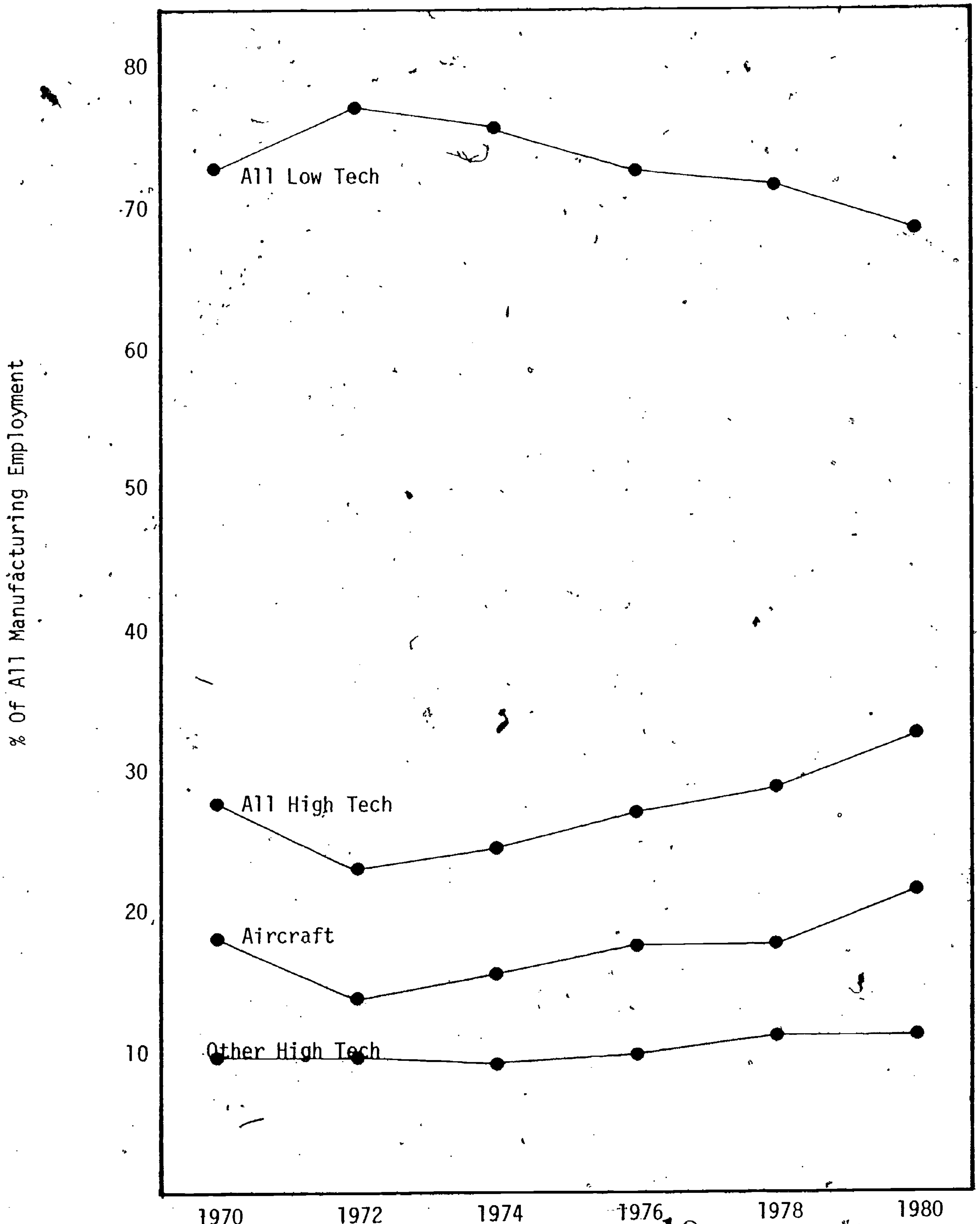
Manufacturing Employment: High and Low Technology Industries
1970 - 1980 Kansas



Source: Basic data derived from County Business Patterns
U.S. Bureau of the Census

CHART 2

Percent of Manufacturing Employment: High and Low Technology Industries
1970 - 1980, Kansas



Source: Basic data derived from County Business Patterns
U.S. Bureau of the Census

Due to the magnitude of the aircraft industry in Kansas, this industry was separated from the remaining high technology industries. The three resulting categories of analysis, then, are aircraft, "other high technology," and "low technology?"

From 1970 to 1972, the employment levels for low technology and other high technology industries remained relatively constant with the aircraft industry experiencing a reduction in employment (see Charts 1 and 2). From 1972 to 1974, low technology employment climbed dramatically, with the aircraft industry increasing substantially. During the same time, other high technology employment also increased at a moderate pace.

From 1974 to 1976, employment continued to increase for the aircraft industry and other high technology industries while low technology experienced a slight reduction in employment. From 1976 to 1980, employment in the aircraft industry increased sharply, as did employment in low technology industries. Other high technology industries also grew at a substantial rate during this period.

Although manufacturing growth in Kansas has been experienced in all three categories from 1972 to 1980, the composition of the manufacturing base has become more oriented toward high technology. In 1972, high technology accounted for 23% of all manufacturing employment, compared to 32.8% in 1980. This was primarily due to increased activity in the aircraft industry, although significant growth has occurred in other high technology industry. From 1974 to 1980, net growth in manufacturing in Kansas was 38,523 jobs. The aircraft industry accounted for 18,810, or 48.8% of this net growth. Other high technology industries accounted for 7,954 jobs, or 20.6% of this growth. Therefore, high technology industries accounted for 69.5% of the new growth in manufacturing from 1974 to 1980.

Determinants of High Technology Plant Locations

Many sources seem to agree that high technology industries keep the American economy competitive. Despite this opinion, there is sparse data available concerning the locational decisions of high technology companies. The scientific and technological infrastructure of the prominent ATC's give them a tremendous comparative advantage as an incubator to spinoff new companies and promote the expansion of established high technology firms. However, there is a school of thought that suggests that these areas are reaching their "holding capacity" when new growth is considered. High wage structure, congestion, lack of available land for expansion, cost of land, skilled labor shortage, over-regulation, cost of housing and high taxes are forcing high technology companies to reconsider future plans. Many companies in prominent areas have announced that they are locating new facilities in other regions.

Because of the general lack of information on high technology industries and their importance to the United States economy, the Joint Economic Committee (J.E.C.) conducted a survey. The survey had two objectives. The first was to find out more about how high technology companies go about choosing a site. The second objective was to ask what their expansion plans are for the future. A copy of the J.E.C. letter and the survey instrument that was sent is shown in Appendix B. The survey was conducted between October 1981 and May 1982. There were 691 questionnaires returned. The J.E.C. made no attempt to stratify the sample by state or by region. California provided 322 respondents, Massachusetts provided 190 respondents and there were an additional 179 respondents from the other states.

The firms that returned the surveys were generally young and produced a variety of high technology products. The J.E.C. indicated that semiconductor firms dominated the sample. However, telecommunications, research, aerospace, chemical, and medical instruments are also represented in the sample. Table 2 shows the types of industries responding.

TABLE 2

INDUSTRIES RESPONDING TO J.E.C. SURVEY

	Responding
Semiconductor	29.5%
Telecommunications	12.8%
Research	9.4%
Aerospace	8.5%
Chemical	2.8%
Medical Instruments	7.6%
Other	29.4%
Total	100.0%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

Respondents most frequently listed their products to be computer-related, specialized measuring instruments, and advanced guidance systems.

These companies served national and international markets as illustrated in Table 3. The responding firms indicated there had been no significant change in their markets over the past five years.

TABLE 3

GEOGRAPHICAL MARKETS OF J.E.C. RESPONDENTS

Predominantly International	34.0%
Predominantly National	62.2%
Predominantly Regional	2.3%
Predominantly In-State	2.5%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

Table 4 indicates the size of the responding firms. It is noteworthy that over 214 firms (31%) had fewer than 50 employees, and over 518 firms (75%) reported 500 or fewer employees.

TABLE 4

EMPLOYMENT SIZE DISTRIBUTION OF J.E.C. RESPONDENTS

Employees	Percent
0 - 50	31.0%
51 - 100	14.0%
101 - 500	30.0%
501 - 1,000	7.0%
1,000+	18.0%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

There were over 276 respondents that indicated they were single-plant firms. However, 193 did indicate they had six or more plants and permanent offices. Table 5 shows the number of plant locations of respondents.

TABLE 5

NUMBER OF PLANTS OF J.E.C. RESPONDENTS

Number of Plants	Percent
1	40%
2	13%
3	9%
4	6%
5	4%
6+	28%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

In general, the typical respondent to the survey is a small, young, high technology firm with fewer than 500 employees operating in one plant. The company serves a national or international market and is likely to be in electronics, telecommunications, research, aerospace, or medical instruments. The report stated that annual sales are likely to be between $1 million and $10 million.

The J.E.C. survey separated factors that influence choice of a region from factors that influence choice of a location within a region. Firms were asked to rate 12 factors that were thought to influence regional preference.

Labor skills and availability were rated higher than labor costs. A region's tax climate was listed as the third most important factor.

As the following table indicates, respondents were asked to rate each attribute as "very significant, significant, somewhat significant, or no significance" with respect to their location choices. The percent of very significant and significant responses were added together to obtain an index of overall importance.

A "catch-all" category, "other" received comments by 84 of the respondents. Although this might be expected for a "catch-all" category, the written responses were bunched around only two concerns. First, where the founder of the company was born was often listed as a significant "other" factor in the location choices. Second, public attitudes toward business were also frequently cited as an "other" factor in the survey.

TABLE 6

FACTORS THAT INFLUENCE THE REGIONAL LOCATION CHOICES OF J.E.C. COMPANIES

Rank	Attribute	Percent Significant or Very Significant
1	Labor skills/availability	89.3%
2	Labor costs	72.2%
3	Tax climate within the region	67.2%
4	Academic institutions	58.7%
5	Cost of living	58.5%
6	Transportation	58.4%
7	Access to markets	58.1%
8	Regional regulatory practices	49.0%
9	Energy costs/availability	41.4%
10	Cultural amenities	36.8%
11	Climate	35.8%
12	Access to raw materials	27.6%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

As the following table indicates, once a region was selected, the respondents were asked to rate factors that influenced their location choice for a particular state. Availability of technical workers was the prime concern. Professionals such as engineers and scientists tend to be more mobile than technical workers. Once a region is selected by a high technology firm, the state and local tax structure moved to a second place ranking in the decision making process. Community attitudes toward business ranked third when it was time to select a state or city. State and local taxes do make a difference to high technology industries. There are basically two reasons which can be explained in an oversimplified manner. If the tax is placed on the business, less money is left to invest in new technologies. The tax on a business reduces the rate of return on investment. The tax on employees leaves less after-tax income and can make it more difficult to keep or recruit skilled labor. What really happens is that some high technology industries have to pay more to their employees to offset state and local taxes, which means a higher operating cost for the firm and again less return on investment. It is noteworthy that like the more traditional industries, high technology firms prefer a location that is supportive rather than antagonistic, and they like to be recognized for their contribution to the community (e.g., creating jobs and adding to the tax base). Table 7 illustrates the factors influencing locational choices.

TABLE 7

FACTORS THAT INFLUENCE THE LOCATION CHOICES OF J.E.C. COMPANIES WITHIN REGIONS

Rank		Percent Significant or Very Significant
1	Availability of workers	96.1%
	Skilled	88.1%
	Unskilled	52.4%
	Technical	96.1%
	Professional	87.3%
2	State and/or local government tax structure	85.5%
3	Community attitudes towards business	81.9%
4	Cost of property and construction	78.8%
5	Good transportation for people	76.1%
6	Ample area for expansion	75.4%
7	Proximity to good schools	70.8%
8	Proximity to recreational and cultural opportunities	61.1%
9	Good transportation facilities for materials and products	56.9%
10	Proximity to customers	46.8%
11	Availability of energy supplies	45.6%
12	Proximity to raw materials and component supplies	35.7%
13	Water supply	35.3%
14	Adequate waste treatment facilities	26.4%

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of Congress of the United States, June 1, 1982.

Current and Future Plant Distributions by Region

The 691 high technology firms that responded represent 1,831 plants and permanent offices currently in operation. They indicated that they intended to nearly double the number of facilities by 1986. Table 8 shows the number of planned expansions by geographic region.

TABLE 8

ACTUAL AND PLANNED DISTRIBUTION OF HIGH TECHNOLOGY PLANTS AND PERMANENT OFFICES BY REGION, 1981 to 1986

Regions	(1) Percent Distribution of Existing Plants	(2) Percent Distribution of Planned Plant Additions	(3) Percent Distribution of Future Plants, 1986[1]	(4) Percent Change in Column 1 & Column 3[2]
New England	16.8%	15.5%	16.3%	-3.0%
Midwest	7.2%	10.2%	9.6%	33.3%
Mideast	10.5%	8.2%	9.5%	-9.5%
Southeast	7.2%	10.1%	8.4%	16.7%
Southwest	9.3%	11.4%	10.2%	9.7%
Mt. & Plains	5.1%	6.3%	5.6%	9.8%
Far West	24.1%	18.1%	21.6%	-10.4%
Overseas	10.7%	14.2%	12.2%	14.0%
Canada	3.5%	3.4%	3.5%	0.0%
Latin America	2.2%	1.4%	1.8%	-18.2%
South America	1.5%	1.2%	1.4%	-6.6%
Total Plants & Permanent Offices	1,831	1,329	3,160	72.5%

1. This is the distribution that would prevail if plant expansion, closure, and location plans over the next five years are realized.

2. Projected percent change in the regional distribution of high technology plants and permanent offices from 1981 to 1986.

SOURCE: Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of the United States, June 1, 1982.

One objective was to gain insight into the reasons behind shifts in high technology industries, from regions of high concentrations of these firms to regions of low concentrations. The second objective was to gather information on a regional basis that can be used to determine if a particular state or local area has the potential to be successful in high technology industrial development.

TABLE 9

J.E.C. RESPONDENTS' PREFERENCES FOR EACH REGION BY REGIONAL ATTRIBUTE

Rank	Attribute	New Eng.	Far West	Mid-east	South-east	South-west	Mt. & Plain	Mid-east
1 & 2	Labor cost/ availability	36.3%	32.4%	34.6%	75.2%	68.5%	53.2%	43.0%
1 & 2	Labor productivity	49.2	53.7	41.8	54.6	63.1	63.2	53.7
3	Tax climate within the region	8.0	22.8	17.3	91.2	86.3	68.7	31.5
4	Academic Institutions	96.6	93.0	79.9	28.9	41.3	27.2	68.0
5	Cost of living	13.2	9.0	22.9	90.6	76.2	72.2	49.6
6	Transportation	70.7	69.9	73.8	43.0	48.4	31.7	66.0
7	Access to market	76.5	81.5	76.1	42.3	53.2	30.6	62.7
8	Regional regulatory practices	16.0	27.1	25.1	72.9	71.7	56.9	35.2
9	Energy costs/ availability	10.5	46.0	21.1	74.8	70.7	49.3	29.9
10	Cultural amenities	90.9	87.1	75.2	18.8	31.0	20.3	41.9
11	Climate	21.4	93.2	20.8	62.1	82.7	50.5	11.6
12	Access to raw materials	64.0%	71.3%	64.6%	41.1%	61.9%	37.9%	61.9%

Respondents were asked to rate each attribute as "excellent, good, average, poor." Each attribute index was calculated by aggregating percent of excellent and good responses for each region.

A low preference rating is indicated by a double line and a high rating by a single line. Ratings that are not underlined represent intermediate scores for that attribute.

The New England, Far West, and Mideast regions received a poor rating on four of the five most important factors that seem to determine the location of high technology companies. Academic institutions did receive a high rating in all three of these regions. Those same regions received high preference ratings for the relatively unimportant attributes for high technology firms.

The Mountain and Plains states received good ratings on four of the five most important locational factors from the firms that were surveyed. When considering academic institutions, however, the survey ranked universities in the Mountain and Plains region as the lowest in the nation. This would indicate that perhaps the biggest obstacle to the recruitment of high technology industry to Kansas is the perceived low quality of the regions academic institutions. The findings of this study indicate this commonly held perception to be erroneous. The following section of this report presents the results of the renowned <u>Gourman Report</u> which ranks Kansas graduate institutions among the nation's elite.

THE UNIVERSITY'S ROLE IN FOSTERING TECHNOLOGICAL DEVELOPMENT

This section details university actions which can put Kansas in a competitive position to develop high technology activities. The section describes:

- the benefits of high technology development to industry and university,
- the research capabilities in Kansas academic institutions,
- the nature of support for university research in Kansas,
- the types of research specialization in Kansas, and
- what Kansas universities must do to attract high technology.

The link between the university and innovation is a direct one. Basic research (exploration for and verification of new ideas and ways of doing things) is the most important component of innovation, and most basic research done in the U.S. is conducted in a university setting. Due to the fact that industry funds most of its own basic research and the federal government funds most university basic research, industry and the university can be characterized as being isolated from each other. Both sides have a great deal to gain from cooperative relationships directed at research and innovation. The university can provide industry with needed basic research, while industry can provide the university with the funding it desperately needs to maintain academic standards.

Under the "New Federalism" policy, states and localities must assume a greater share of the responsibility for economic development. Included in this policy is funding for research in universities, which can fuel growth in high technology industries. Universities in the state feel financial stress. They are definitely interested in developing closer ties with the private sector to assure funding. Due to the fact that the state's universities are so dependent on the state legislature, they are naturally concerned with the state's attitude toward assuming a greater share of the responsibility for carrying on research and development activities, which provide additional avenues for industrial development in Kansas.

Benefits of High Technology Development

Research and development activities provide universities several benefits. They provide relevant experiences for university faculty and students. Also, patent and license income from inventions can significantly add to a university's income, while providing an incentive for industry to fund research. The university stands to improve itself by linking with industry in a number of ways: funding of research projects, joint research ventures, training in applied fields, industry-funded fellowships and scholarships, equipment and general grants, and increased opportunities for faculty consulting. At the same time, industry benefits from these inventions because it does not have to maintain all of the fixed costs related to research. These benefits are the incentive for industry to fund research. Refer to Appendix D for a detailed discussion of research relationships between universities and industry.

The university also offers industry continuing education opportunities, extension services, as well as special courses and training programs. A number of universities which have strong ties with industry provide "industrial associate" programs, which allow industrial scientists and researchers an opportunity to view first-hand the research going on at the university. Industry also derives an invaluable benefit from access to faculty consulting on a variety of highly technical subjects.

Research Capabilities in Kansas Academic Institutions

A recent report [44] has referred to the biotechnology industries as the greatest potential for large scale high technology development in Kansas. This view is generally validated, although a number of specific research advantages in Kansas must be closely examined. Universities in the State of Kansas conferred a total of 13,353 master's degrees and 1,617 doctoral degrees from the 1977-78 school year through the 1980-81 school year (4-year period).[31] KU and KSU combined conferred approximately 57% of all master's and 99% of all doctor's degrees. In the high technology disciplines, these two universities accounted for approximately 75% of all master's and 97% of all doctoral degrees. The following tables present a listing of masters degrees and doctorates in general areas related to high technology.

TABLE 10

MASTER'S DEGREES CONFERRED IN KANSAS BY UNIVERSITY
(1977-1978 through 1980-1981)

Program Classification	KU	KSU	WSU	ESU	PSU	FHSU	Wash-burn	Baker
Agribusiness, Ag. Sciences, Ag. Production	0	325	0	0	0	0	0	0
Engineering & Engineering Related Technologies	306	274	93	0	76	0	0	0
Life & Physical Sciences	321	185	66	66	48	47	0	0
Health Sciences	203	27	125	0	0	37	0	0
Math & Computer Science	77	116	21	14	22	11	0	0
HIGH TECHNOLOGY TOTAL	907	927	305	80	146	95	0	0
Business & Management	529	120	164	122	83	47	0	0
All Other Programs	2,941	2,140	1,488	1,371	1,089	657	67	75
TOTAL MASTERS DEGREES	4,377	3,187	1,957	1,573	1,318	799	67	75
% State Master's Degrees	32.8	23.9	14.7	11.8	9.9	6.0	5.0	5.6
% State Hi-Tech Master's	36.9	37.7	12.4	3.3	5.9	3.9	-	-

SOURCE: Kansas Legislative Research Department, "Number of Graduates Receiving Degrees or Other Recognition at Kansas Institutions of Higher Education, 1977-78 to 1980-81," April 1982.

TABLE 11

DOCTORAL DEGREES CONFERRED IN KANSAS BY UNIVERSITY
(1977-1978 through 1980-1981)

Program Classification	KU	KSU	WSU
Agribusiness, Ag. Sciences, Ag. Production	0	99	0
Engineering & Engineering Related Technologies	50	42	3
Life & Physical Sciences	241	113	4
Health Sciences	22*	0	10
Math & Computer Science	14	31	0
HIGH TECHNOLOGY TOTAL	327	285	17
Business & Management	13	0	0
All Other Programs	635	340	0
TOTAL DOCTORAL DEGREES	975	625	17
% State Doctoral Degrees	60.3	38.7	1.1
% State Hi-Tech Doctoral	52.0	45.3	2.7

SOURCE: Kansas Legislative Research Department, "Number of Graduates Receiving Degrees or Other Recognition at Kansas Institutions of Higher Education, 1977-78 to 1980-81," April 1982.

The tables on the preceding page identify general areas of relative strength in the state's universities at the graduate level. Several reports have been published in the last decade ranking university academic programs at the departmental level. One of the most widely-used studies in the Gourman Report,[76] published in 1980, which ranks both graduate and undergraduate programs in all major fields of study. Rankings are developed from an analysis of faculty and student research, library facilities, and curriculum. Since high technology industry is basically dependent on graduate institutions, an analysis of the Gourman Report graduate rankings is in order.

Science

The state's universities are particularly strong in many areas of science. The University of Kansas and Kansas State University are rated 9th and 15th in the nation, respectively, in their graduate entomology program. In botany, KU ranks 28th while KSU ranks 42nd. Both universities also rank in the elite in bacteriology and microbiology. The University of Kansas is rated by Gourman as being in the top 40 graduate institutions in biology, biochemistry, geology, geography, computer science, and astronomy. The KU Medical School ranks 39th in the nation, while the KU Pharmacy School is ranked 30th.

Engineering

Kansas State University ranks 14th in agricultural engineering, 22nd in industrial engineering, and 34th in mechanical engineering. The University of Kansas ranks in the top 40 in electrical engineering, chemical engineering, and aerospace engineering. While the Gourman Report did not rate graduate programs in aeronautical engineering, the Wichita State University program is nationally recognized.

Business

The University of Kansas MBA program is ranked 43rd in the nation while KSU's agricultural economics program is ranked 19th.

Graduate science and engineering programs that have successfully linked with high technology industrial development rank similar to Kansas and Kansas State (Utah, Rensselaer, Purdue, North Carolina). Since the research findings indicate the existence of nationally renowned science and engineering research programs to be the most significant variable in the locational decision process of high technology firms, it appears that Kansas has the potential for high technology development.

The preceding rankings are for general fields of study. More detailed analysis provides areas of specialization within these fields. For example, one of the areas of specialization available in the KU Department of Medicinal Chemistry is "physical and chemical approaches useful in preventing chemical breakdown of drug substances." Kansas has a comparative advantage over other states in a number of scientific and engineering areas of specialization. A number of these are indicated in each university's summary of research capabilities of faculty and other research staff.

Existing Areas of Specialization in Kansas Graduate Institutions

On-campus visits were made to KU, K-State, and Wichita State to determine the nature of research specializations relating to industry. Assuming that the state must initially specialize in specific areas where it already has a comparative research advantage over other states, the following specialties represent areas of immediate potential.

Kansas State University

Kansas State University has a great deal of contact with the agricultural industries, primarily through the commodity groups rather than directly with manufacturers. Under the School of Agriculture, four departments are involved through the Agricultural Experiment Station (AES). Research is conducted in four basic areas: photosynthesis, biological nitrogen fixation, genetic vulnerability, and protection against biological hazards.

The AES has competed successfully for grants in all of these four areas, through the departments of biochemistry, biology, entomology, and plant pathology. The AES seeks to bring more departments into competition for grants in these areas of research.

Recent research developments include new crop variety development, study of wood for fuel, control of southwestern corn borer, grain dust in feedstuffs, screening wheat protein, fuel from agricultural wastes, control of musk thistle, cereal fortification and nutrition, bacterial endotoxin, insect chemical reception, and the role of wheat flour lipids in baking. In the future, genetic engineering, water resource management, reduction of pesticide application, and alternative energy are major areas for grant activity in the AES. Kansas State University officials state that the scope of agricultural research could be enhanced if the national agricultural commodity councils' check-off programs were to allocate a higher percentage of funds into research.

The Engineering Experiment Station (EES) functions in a capacity similar to that of the Agricultural Experiment Station. The College of Engineering has a publication summarizing the areas of specialization of its faculty and service laboratory researchers. Specialties exist in every engineering department: agricultural, chemical, civil, electrical, industrial, mechanical, nuclear, and the service laboratories.[32]

The above mentioned research areas do not include all areas of KSU with solid potential for high technology development. The Departments of biology and biochemistry work through the AES in areas of applied research. Research specialties also exist in botany, bacteriology, microbiology, and entomology. The computer science department also offers potential for high technology development. The graduate business program and agricultural economics program add to the ability of KSU to develop links with high technology industry.

University of Kansas

At the Lawrence campus, the areas currently receiving the most support for research from combined sources are pharmaceutical chemistry and electrical engineering. The University of Kansas ranks in the elite group of graduate programs (i.e., top 50 in the Gourman Report) in the areas of electrical engineering, computer science, entomology, biology, bacteriology/microbiology, botany, biochemistry, chemical engineering, geology, geography, aerospace engineering, astronomy, mathematics, business administration, economics, medical, and pharmacy. The university is world famous for research in pharmaceutical chemistry.

The University of Kansas has compiled a campus-wide summary of the research capabilities that "relate to industrial applications".[81] This summary briefly describes each staff member's research capability that might be of interest to industry. The summary includes approximately 50 faculty, many with dual areas of specialization that relate to high technology industry. The departments of physics, chemistry, electrical engineering, business, chemical and petroleum engineering, architectural engineering, systematics and ecology, physiology and cell biology, aerospace engineering, space technology, biochemistry, medicinal chemistry, pharmaceutical chemistry, pharmacology and toxicology, and pharmacy are represented. In addition, the University Transportation Center, Remote Sensing Laboratory, the Kansas Geological Survey, the Energy Research Center, and the Water Resources Institute are included in the summary.

Kansas University's strongest link with high technology industry is the Pharmacy School's ties with Merck Laboratories, a locally based pharmaceutical R & D firm that located in Lawrence primarily due to the strength of the Pharmacy School. The electrical engineering program also has a large volume of funding for research from the private sector.

Wichita State University

The overall scale of research activities at WSU is not as diversified as the research programs at KSU and KU; however, in mechanical engineering, the volume is competitive with the other two universities. Existing links with industry include electrical engineering and aeronautical engineering ties to the local aircraft industry (which also contracts for use of the Beech Wind Tunnel on campus). Most of the aeronautical engineering department support, however, comes from NASA. Wichita State University's patent policy is more attractive to faculty than those at KU or KSU in that it offers an opportunity for the individual to derive more financial reward for innovation.

Similar problems are encountered among each of the three major universities in dealing with the private sector. Common problems include: (1) lack of dialogue between the universities and industry on the nature of research to be undertaken by each, (2) lack of first hand information on industry's problems, and (3) the limited amount of resources available to strengthen the science and engineering graduate programs.

Federal Support for Scientific Research in Kansas

The State of Kansas, with approximately 1.04% of the U.S. population, receives less than its "share" of federal dollars to science and engineering academic programs. In 1978, less than 3/4 of 1% of federal dollars for academic science and for research and development in higher education came into Kansas. The universities with large scale engineering and science research programs stand to get the bulk of remaining federal dollars, while most universities getting lesser amounts now from the federal government will be left out in the future.[84] The 1978 figures listed below are indicative of the level of federal funding to Kansas institutions over the past several years.

Of the 12 states in the central U.S. (see list below), Kansas ranked 7th in total federal dollars received for academic science in 1978.[51] When adjusted for population size, Kansas ranked 6th in federal support for academic science with a total of $12.66 per capita acquired. The average nationwide was $17.47.

TABLE 12

TOTAL FEDERAL DOLLARS FOR ACADEMIC SCIENCE, 1978

12 SELECTED STATES

	State	Total $
1.	Texas	$208,571
2.	Missouri	81,925
3.	Colorado	71,951
4.	Minnesota	71,547
5.	Iowa	42,573
6.	Louisiana	32,893
7.	Kansas	29,907
8.	Oklahoma	23,785
9.	Arkansas	17,631
10.	Nebraska	16,858
11.	North Dakota	7,930
12.	South Dakota	6,304

SOURCE: National Science Foundation, "Federal Support to Universities, Colleges, and Selected Non-Profit Institutions, Fiscal Year 1978," 1980.

TABLE 13

FEDERAL DOLLARS FOR ACADEMIC SCIENCE PER CAPITA, 1978

12 SELECTED STATES

	State	$/Capita
1.	Colorado	$24.90
2.	Minnesota	17.55
3.	Missouri	16.66
4.	Texas	14.66
5.	Iowa	14.61
6.	Kansas	12.66
7.	North Dakota	11.30
8.	Nebraska	10.74
9.	South Dakota	9.14
10.	Oklahoma	7.86
11.	Louisiana	7.83
12.	Arkansas	7.72

SOURCE: National Science Foundation, "Federal Support to Universities, Colleges, and Non-Profit Institutions, Fiscal Year 1978," 1980.

Of the top six states on the list, all have at least one graduate institution in science and engineering that ranks in the top 50 nationally according to the Gourman Report. None of the six selected states ranking below Kansas in federal support for academic science per capita have any university in the elite category in overall science and engineering graduate programs. Kansas, then, had the lowest per capita acquisition of federal dollars to academic science of the six central states which have "elite" research universities.

Kansas' universities were dependent on HEW for approximately half (50.5%) of federal support for academic science. Another 20.6% came from USDA, 10.4% from the National Science Foundation, 4.1% from the Defense Department, and 3.6% from NASA. The nearly $30 million in federal funds acquired by Kansas universities and colleges for academic science was dominated by KU (over $18 million) and KSU (over $11 million).

TABLE 14

FEDERAL DOLLARS TO ACADEMIC SCIENCE IN KANSAS, 1978

University of Kansas	$18,082,000	60.5%
Kansas State University	11,072,000	37.0
Wichita State University	319,000	1.1
All Other Institutions	434,000	1.4
State Total	$29,907,000	100.0%

SOURCE: National Science Foundation, "Federal Support to Universities, Colleges, and Non-Profit Institutions, Fiscal Year 1978," 1980.

The destination of federal dollars for research and development is about 50% to life sciences, with engineering a distant 2nd. At the University of Kansas, 64.4% of all federal R & D grants go to life science research, with 8.8% to social sciences and 8.5% to engineering.

The federal government has been the major supporter of basic research in the past, although the roles of government and industry are changing significantly. In 1978, industry paid only 2.7% of the bill for all university basic research (exluding development), with 72% of the bill paid by the federal government, 19% from state and local public sources, and 7% from non-profit institutions. Despite a great deal of concern with the loss of federal dollars for non-defense academic science research in the first year of the Reagan Administration, prospects remain good that "over the life of the Reagan Administration there will be reasonable growth in R & D funding."[84]

What Universities Must Do To Attract High Technology Industry

The traditional industrial location factors have some degree of applicability to high technology industries. The most important factors are availability and cost of skilled labor, the local economic development attitude, quality of general education, and the quality of the graduate school in a specific field. High technology industry, by definition, requires a location where new ideas are explored and developed and old ideas are made obsolete (in short, basic research). Since over three-fourths of all basic research conducted in the U.S. is done by universities, it follows that close ties between high technology firms and the university will allow quicker innovation of new ideas, to the financial benefit of the firm as well as the university.

The role of the applied fields of the university in regional economies is generally underestimated. Aside from jobs provided by the university and the amount of money brought in from outside the region, the university develops human resources, through educating students on region-relevant problems, enhancing the economic development potential of the region. The problem in Kansas has been that highly skilled individuals in many areas of science and engineering have little opportunity in the Kansas work force.

The potential for attracting high technology industry to Kansas is enhanced by the state's strong rating on the most significant locational factors. Kansas has strong graduate institutions, with areas of research capability well-suited to industrial application. Kansas as well has a strong primary and secondary educational system, although these facts are not perceived by high technology entrepreneurs.[56] The cost of labor in Kansas is generally lower than in other states, and the tax climate is favorable. The local economic development climates are favorable in several cities in Kansas that have high technology potential.

With favorable ratings on the basic factors relating to high technology development, the lagging factor as far as the state's potential comes down to a perception (by persons both inside and outside the state) of the calibre of the research capabilities of the state's major universities.[R,NN,VV] A joint promotional effort involving communities, universities, and the state, concerning Kansas' ability and willingness to accommodate high technology, is crucial.

The most important advantages offered high technology industry by universities are: recruitment of university graduates as employees, availability of university programs to further the education of personnel, availability of skilled technicians, a graduate department well-established in the specific field of research, and some sort of grant-processing entity that can relate to corporate needs.

The state's major research universities can provide a more suitable climate for high technology development by expanding engineering research and innovation capabilities. The goal of attracting high technology industry into Kansas depends a great deal on enhancement of basic research programs in areas of existing specialization. Pursuit of this goal, as stated by the National Commission on Research,[49] must be done without subversion of proper university purposes or hazards to university academic freedom. The Commission suggests, however, that these potential problems are manageable and that university-industry relationships are necessary in order to strengthen the innovative process, strengthen the universities financially and academically, and improve the rate of advancement in U.S. technology.

As stated by officials at KU, K-State, and Wichita State, there is a need to promote the importance of research strengths that presently do exist in Kansas relative to the process of economic development.[R,NN,W] There also needs to be a better communicative network among Kansas industry, government, the legislative and the general public on how these strengths can benefit the state.

If the state's graduate programs are to provide a credible base for high technology development, it may be necessary that programs with industry link potential be enhanced. This modification would require a universal understanding and acceptance of the role of graduate programs and their importance to the industrial development of the state. The universities and the state must take a more active role in publicly promoting the concept of university-industry relationships.

It is apparent that the state's graduate schools have areas of specialization relative to each other as well as areas where both are strong. The state must continue to preserve a degree of specialization among universities in narrow fields of study, in order to avoid the unnecessary expense of duplicating highly specialized equipment and to enhance industry-link potential as much as possible.

Industry Incentive

The university must be willing to work out agreements on research projects with industry. A problem that must be addressed is the difference in the nature of research between universities and industry. Academic research is normally "unstructured" with wide dissemination of results. Industrial research focuses on developing a product or process, creating a strong patent position, and developing commercial applications, with restricted dissemination of results to the scientific community. A compromise on these divergent traditions is necessary if university and industry are to collaborate in research and development.

Corporations entering into research projects with the university should be allowed major input into the direction of research at the outset of the research project. Patent rights to products which will be consumed by the general public must generally remain with the company if it is willing to pay a fee to license the technology; results should be disseminated by the university to the entire business community.

Several potential hazards to the university exist in developing cooperative research relationships with industry, all basically related to loss of academic freedom in the form of more structured research aimed at high technology fields of study. It is the university's charge to preserve the academic environment while securing links with industry which will support the university.

Each university that wishes to get involved in the high technology arena must establish a mechanism for financing investment in salaries, equipment, and research projects. Officials at all three institutions visited are generally satisfied with current conditions, although some improvement was desired, especially at KU.

The university wishing to develop and/or enhance research relationships with industry should develop a cooperative research policy which should be communicated to all research personnel. Research personnel should also be provided with legal guidance and be informed of the risk of delay of publication of research results due to potential patent applications (while industry must give up some of its proprietary security). (An agreement between Exxon and MIT has proven effective in handling these problems. University professors are given long-term support from Exxon, free of red tape, with 20% of their sponsored research time to use in investigating whatever they wish, and 80% investigating Exxon's specified problem. MIT has first rights to patents, with Exxon receiving royalty-free rights to use patents).

The university must allow industrial scientists to participate in a capacity that will afford them the ability to put the research findings into the innovation stage. This problem has restricted the number of cooperative research agreements between industry and the universities.

The basic means of developing science and engineering programs in the state would involve (a) recruiting and retaining outstanding research faculty, and (b) keeping scientific instrumentation and equipment up-to-date. It is the consensus of the literature as well as research officials of all three major universities in the state that attracting nationally renowned faculty provides a base for full development of a research program.

Faculty Incentives

In Kansas, as is true nationwide, science and engineering faculty are being attracted by the private sector (e.g., Geology professors lost to oil companies). In addition, a number of universities committed to high technology development have attracted outstanding faculty (e.g., KU recently lost one of its outstanding microbiology professors to East Carolina University -- see Appendix E). While the state's universities cannot compete with huge salaries offered in the private sector, it should offer enough incentive for those dedicated to academics to come to the state.

A nationally or internationally renowned professor will tend to attract funds for research and equipment to his or her department, will attract a support research faculty who wish to work around the leading faculty member, and will attract top students. The increase in patent royalties will aid the university financially.

High technology industry will be attracted to outstanding professors in science and engineering. Once leading faculty are present, equipment and general grants, industry-funded projects, joint research projects, and new research programs will follow. Ample consulting opportunities in the geographic vicinity of the university are one of the prime attractions in recruiting outstanding faculty in any area of science, engineering, or business.

Several types of incentives could aid in the recruitment (or retention) of outstanding research faculty. One of these incentives involves flexibility of the university to offer competitive salaries to these outstanding professors. In addition, the university could offer a bonus to the principal investigator who lands a sizeable research grant. This proposed bonus would have to be significant enough to encourage leading faculty to go after grants, not only for their own research, but for supplying other departmental faculty with research opportunities. The acquisition of major grants by one faculty member often supports several others in the department, and is naturally an attractive force in development of overall department faculty.

In the areas of science and engineering, it is becoming commonplace for established universities to offer "start-up" funds to new faculty. These funds are used by new faculty to obtain equipment they need to conduct research. The Research Equipment Committee of KU reported this to be a necessity in recruiting new faculty.

Perhaps the most a university could do for an outstanding research professor is to guarantee consulting relationships, primarily through development of high technology industry. This can only occur, however, once industry is present. In addition to this, a bonus for grant acquisition, the distinguished professor program, and offering financial rewards for outstanding research should be expanded.

A number of additional incentives could be considered by the universities. For example, assistance in transportation to consulting opportunities, guaranteed research assistants, and assistance in publishing results could be strong attractive forces for recruiting and retaining outstanding research faculty.

Modernization of Scientific Equipment

Updating of scientific equipment is the second crucial area of university development of science and engineering research programs. Graduate programs with outdated equipment will lose faculty, students, and research dollars. Kansas universities have primarily relied on grants received by faculty to provide scientific equipment, in addition to limited state support. According to the KU Research Equipment Committee, for example, the condition of scientific equipment has eroded research programs, diminished the ability to attract quality faculty, and in general handcuffed research efforts.[82]

The KU Research Equipment Committee surveyed the major (over $50,000 per item) scientific equipment needs on campus, and identified a shortage of approximately $4.6 million in equipment for existing research programs. The following actions are derived from the Committee's recommendations, and generally apply to all graduate universities;

- Strengthen the advocacy base of campus service laboratories by developing a coordinated plan for budgeting equipment and personnel needs.

- Use existing potential financing mechanisms for bringing scientific equipment up-to-date.

Other Means of Strengthening Science and Engineering Programs

Aside from faculty salaries, bonuses, and consulting opportunities, the state's universities can continue to encourage research through three additional methods, none requiring major funding from public sources.[84]

(1) Direction of a higher percentage of major patent royalties to the source of the patent. Currently, KU and KSU have patent policies in which the university conducts the patent process and acquires over 95% of royalties generated. In the case of sizeable potential royalties, the outstanding professor might be attracted by an opportunity to participate more on his/her own in the patent process. By allowing a higher percentage of royalties to be returned to the source, the net result should be more total reserach dollars coming into the university.

(2) The universities should also assist in the effort at allowing more industry write-offs for donations of scientific equipment to the university. Recent improvements have been made at the national level; more are needed. Such credits help not only to provide modern equipment to the university, but also help industry's ability to purchase new equipment.

(3) Kansas State University officials can encourage the state agricultural commodity councils to provide more funds for research in Kansas.

The state's universities can continue to attract outstanding high school students by conducting on-campus science fairs, and can attract outstanding baccalaureates in science and engineering by providing information on colleges with large undergraduate science and engineering programs.

The "industry-university technology transfer symposium" is a very effective means of linking industrial research needs with university capabilities. A recent symposium at Tulsa, Oklahoma[2] proved successful in allowing several universities (including KU and KSU, as identified in Appendix F) to describe their research capabilities in detail to the right audience -- firms needing the type of research capabilities available at those universities.

Officials from all three major universities in the State felt that a series of industry-specific packets describing the state's research capabilities in narrow areas of specialization would be very helpful in attracting high technology firms.[R,NN,W] For example, one packet listing the research personnel, specialties, equipment, and other facilities available within the state in the area of environmental engineering, directed at the right audience, would be valuable in recruitment.

Of vital importance is establishment of one or more engineering research centers which provide an environment where research, development, and manufacturing can occur through a close association with academic research programs. Given that the one major role of the state university's research is to attack problems encountered in the state, the engineering research center could serve as a mechanism for identifying and directing university research activities.

The state's universities should become involved in investigating the National Science Foundation's future establishment of Technology Centers,[84] and continue to work through the Kansas Congressional delegation, which assists in establishing vital industry-university linkages for Kansas.

The universities must also be willing to assist the local community as well as the state in the recruitment of high technology firms, by indicating what they can do to help the industry meet its needs in setup and operations. Exhibiting cooperation between the university and the community is a very important factor in high technology industrial recruitment.

Another key factor is the ability to provide skilled labor by academic program adjustment, including expansion or redirection of extension programs. The skilled labor problem is often (and erroneously) thought of as a chicken-egg situation, i.e., the prospective industry needs skilled labor to fill its needs, while potential employees need relevant job prospects before acquiring special skills. In Arkansas, for example, both state vocational training programs and university engineering programs have been adjusted to accommodate major high technology firms. The University of Arkansas-Little Rock has made a series of strong commitments to industry, providing skilled technicians and giving students relevant experience at a skill applicable within the Little Rock area. In a few years, a university without an engineering program has developed into a high technology center of significant magnitude.

This study concludes that universities in Kansas must play a critical role in the development of high technology industry. In places that have been successful in the high technology arena, universities have strong research programs, faculty, and federal support for academic science. Kansas rates highly on these factors.

A comparison of activities of states that have implemented actions relative to high technology development yields the following conclusions:

- There is a strong relationship between successful high technology industrial development and nationally "elite" graduate programs in science and engineering.

- The factors that make strong research programs relate to faculty, equipment, curriculum, and grant structure.

- Kansas has these basic ingredients needed to compete in the high technology game.

- The state developed these ingredients without a major consciousness toward high technology development.

- The changing nature of support for universities requires action by the state to provide university-industry linkages.

- Competition for faculty will increase, and if quality faculty already present are to be retained, the state must offer incentives accordingly.

- In short, the state cannot afford inaction.

Based on these conclusions, it is recommended that:

1. In preparation for the FY 84 budget, KDED develop a program to serve in a catalytic role between industry and the universities of the state in order to foster cooperative research relationships.

2. During FY 83, KDED complete an inventory of graduate research programs in the state relative to high technology industry.

3. During the 1983 legislative session, KDED develop and implement a strategy to better inform the Kansas legislature of university research specialties and equipment, programs and personnel needs as they relate to high technology development.

4. During the 1983 U.S. Congressional Session, KDED and the universities encourage the Kansas Congressional delegation to seek to improve the potential for university-industry linkages by increasing federal tax write-offs for donations of scientific equipment, examining the agricultural commodity checkoff programs, and exploring the possibility of a National Science Foundation Technology Center in Kansas.

5. During FY 83, each university establish cooperative research policies to be more in tune with industry's needs: allowing industrial input into research programs, stressing long-term commitments by industry and faculty, allowing more structured research toward commercial applications.

6. As an ongoing policy, universities provide enough flexibility in academic programs to be in tune with the needs of high technology firms considering location in the given community.

7. In preparation for FY 84 budgets, each university assess scientific equipment needs of departments and non-departmental service labs and formulate plans to eliminate any deficiencies.

8. During FY 83 and FY 84, KDED prepare industry-specific research capabilities packets.

9. As an ongoing policy, university personnel become more involved in recruitment efforts aimed at high technology industry.

10. During FY 83, KDED conduct an industry/university transfer conference, in conjunction with all universities in the state.

11. During FY 83 and FY 84, KDED and the universities prepare a strategy and conduct a promotional campaign to inform Kansans of the importance of current research activities, the financial state of the universities, and the potential for high technology development in the state.

COMMUNITY CONSIDERATIONS IN FOSTERING RESEARCH AND TECHNOLOGY DEVELOPMENT

This section describes the research findings with regard to what a community should consider in order to encourage high technology industries to locate or expand within its jurisdiction. The purpose of this section is to:

- List the benefits to a community of high technology industries;
- List the several essential standards that a community should meet in order to attract high technology industries;
- Describe the community's role in recruiting high technology industries;
- Explain why Kansas communities are becoming increasingly attractive to high technology industries and identify those Kansas communities that show a high potential in attracting such industries; and,
- Recommend actions by KDED to assist communities in implementing a program.

> "Recently many state and local governments have entered into competition with one another for the nation's high technology companies. State and local governments are revamping their institutions to provide an environment more conducive to the growth of the high technology industries . . ."[56]

Because of the very nature of these specialized businesses with their highly paid professional staffs and their research emphasis, they are prime recruitment targets.

Community Benefits

The benefits that can be derived to a community by the presence of high technology industries are substantial. From the community's perspective, the targeting and development of high technology industries makes sense in that in the United States such industries have increased productivity twice as fast as low-technology firms and have expanded employment nine times as fast. As a result, these high technology industries demand and usually get the location they desire.[27]

Summary of Key Community Criteria

There are several standards that are considered when high technology industries determine whether or not to locate or expand within a particular community. These factors (in no rank order) are listed below.

a. Community Factors:

1. Proximity of a suburban area,
2. Availability of moderately priced housing,
3. Existence of a quality education system, and
4. Social and cultural offerings.

b. University Factors:

1. Existence of a graduate school with a significant research program,
2. Strong graduate departments in crucial areas,
3. Library resources, and
4. Availability of extension education programs.

c. Geographic Factors:

1. Proximity to a jet airport,
2. Proximity to an urban area, and
3. Climatic and environmental features.

d. Economic Factors:

1. Availability of labor pool with desired skills,
2. Proximity to markets,
3. Availability of inputs,
4. Existence of a base of complementary research and development industries; and
5. Proximity to other company facilities.

e. Site Factors:

1. Flexibility for expansion,
2. Proximity to University,
3. Proximity to residential areas, and
4. Availability of roadways and utilities.[57]

In addition to these standards, several other factors have also been recently identified as important criteria for making location decisions. They include (in no rank order):

Labor Costs
Tax Climate
Cost of Living
Regulatory Practices
Energy Costs/Availability
Community Attitudes Toward Business[56]

Community's Role

The historic role that communities have played in the overall process of development and maintaining advanced technology research centers has been diverse. At the Purdue Industrial Research Park in West Lafayette, Indiana, community support was simply applauding the efforts of the university; at the University of Utah Research Park in Salt Lake City, Utah, it came in the form of the public provision of utilities and roadways; and at the Greater Ann Arbor Research Park, in Ann Arbor, Michigan, the city and chamber of commerce were the primary development forces.[57]

If a community is committed toward the establishment of high technology industrial development it should be willing to:

1. Be visibly supportive of high technology development;
2. Assess local needs and characteristics in order to realistically target recruitment efforts. Consideration must be given to available utilities, labor pool, housing stock, transportation network, etc.;
3. Make requested and needed information quickly available to industrial prospects and clients;
4. Work with developers to help create and implement an industrial research center;
5. Provide essential community infrastructure services; and,
6. Reduce the uncertainty in the permit process so that companies understand what is required of them.[4]

In many instances where communities have been successful in recruiting high technology industries they have played a secondary role to the principle location attraction -- a nearby engineering and scientific research-oriented university. Thus, it is almost imperative that a close community/university working relationship be maintained throughout the industrial recruitment process. Neal Pierce in a June 15, 1982 commentary entitled "High-Tech Boom Carries Political Surprises" states "The single most important factor that draws a high-tech center is a nearby university with a high quality engineering school . . ."[35] Technology companies seek close proximity to educational and engineering research institutions for many vital reasons. It is important for companies to locate in a region where educational resources provide skilled and educated technical personnel, as well as opportunities for cooperative institutional research. Additionally, part-time educational opportunities for employees are an important fringe benefit toward career development.[36] If properly utilized, higher education will play the major role in helping a community or region attract high technology firms. Thus, the recruitment of high technology industries to a particular area should not be considered a community effort nor a university effort but a combined community/university effort.

Future Outlook for Kansas

There is a growing tendency for high technology companies to look seriously at the Midwest, Southeast, Southwest and the Mountain and Plains States (Kansas is one of the Plains States) for future company expansions. The primary reasons for this departure is that the high technology industries in the already developed high technology centers (New England, Mideast, and the Far West) are being constrained by shortages of skilled labor, high taxes, housing costs, congestion, and insufficient room for expansion.[56] Thus, in Kansas' effort to recruit high technology industries, it is recommended that a promotional campaign be developed and targeted to specific desirable industries describing the virtues of Kansas' skilled labor force, low taxes, moderately priced housing, lack of congestion, and company expansion possibilities.

The Kansas communities which have the greatest potential in recruiting high technology industries are those which can most adequately meet the factors previously outlined. While many of the factors are intangible and others are very difficult to quantify there are at least nine factors that can be easily measured. Chart No. 3 illustrates these measurable factors for Kansas communities of more than 10,000 population.* Each factor on the chart was given equal weight. The higher the number of X's corresponding to each community, the greater the opportunity of a particular community to recruit a high technology firm. Lawrence, Kansas City, and Wichita rank the highest with a score of eight, Manhattan ranks second with a score of seven; and Overland Park ranks third with a score of six.

Ultimately, any strategy for high technology development is going to have community action as its foundation. In all probability, any high technology industrial development project undertaken within the State of Kansas will be developed within the jurisdictional limits of a community. It will rely on the community's tax base for infrastructure and upon its people for a labor force.

The research undertaken during the course of this study indicates that there is no universally successful procedure that has been employed by local organizations. Successful research parks have been initiated by private corporations, chambers of commerce, universities as well as by local government. Any industrial development endeavor has a better chance of success if a high degree of coordination is established among applicable entities at the local level. Therefore, it is recommended that:

1. During FY 83 KDED personnel be assigned to work directly with local entities to act in a coordinating role to initiate action in the following areas: Lawrence, the Kansas City Metropolitan Area, the Wichita Metropolitan Area, and Manhattan.

2. During FY 84 KDED personnel be assigned to provide direct assistance to communities to develop high technology industry.

*NOTE: Research undertaken during this study indicates that a city population of 10,000 is a minimum threshold to be able to provide the needed support functions and services required to sustain high technology industry. The purpose of this community/factor ranking procedure is not to exclude any Kansas community from consideration by high technology industries but only to illustrate those cities in Kansas that might be more prone to attract such industries.

CHART 3

KANSAS COMMUNITY/FACTOR RANKING
10,000 POPULATION AND UP

Communities 10,000 Population and UP	University With Nationally Ranked Overall Graduate Program (Within 15 Miles)	Nationally Ranked Science & Engineering Graduate Program (Within 15 Miles)	University with a Strong Research Capability in at Least One Area of High Technology (Within 15 Miles)	Substantial Scientific and Engineering Graduate Library Resources	SMSA	International Airport (Within 60 Miles)	Jet Air Carrier Service	University or College	Vocational or Technical Schools	Interstate Highway System	Total Score
Arkansas City						X		X	X		3
Atchison						X		X	X		3
Chanute								X			1
Coffeyville							X	X	X		3
Dodge City							X	X	X		3
El Dorado					X	X		X		X	4
Emporia			X					X	X	X	4
Garden City							X	X			2
Great Bend							X	X			2
Hays			X				X	X		X	4
Hutchinson						X	X	X			3
Independence							X	X			2
Junction City	X	X	X				X			X	5
Kansas City			X	X	X	X	X	X	X	X	8
Lawrence	X	X	X	X	X	X		X		X	8
Leavenworth						X		X			2
Leawood			X	X	X	X				X	5
Lenexa			X	X	X	X				X	5
Liberal							X	X	X		3
McPherson								X		X	2
Manhattan	X	X	X	X			X	X	X		7
Merriam			X	X	X	X				X	5
Newton						X		X	X	X	4
Olathe					X	X				X	3
Ottawa								X		X	2
Overland Park			X	X	X	X		X		X	6
Parsons							X	X			2
Pittsburg			X					X	X		3
Prairie Village			X	X	X	X					4
Salina							X	X	X	X	4
Shawnee			X	X	X	X				X	5
Topeka					X		X	X	X	X	5
Wichita			X	X	X	X	X	X	X	X	8
Winfield						X		X			2

45

STATE GOVERNMENT ROLE IN FOSTERING RESEARCH AND TECHNOLOGY DEVELOPMENT

This section details research findings concerning state activities that have occurred and are occurring to encourage industries involved with research and technology. The purpose of this section is threefold:

- describe Kansas history relating to the pomotion of research and technology;
- describe programs that other states use to encourage research and technology development; and,
- identify feasible alternatives for Kansas to use in fostering research and development activities.

The first part of this section is a chronological description of the Kansas history of research and technology development. The information relies not only on documents detailing research pursuits but also interviews with persons who have been involved in these activities.

The second part is a listing of other states' programs that encourage growth of high technology industries. Current program categories are identified. Examples are provided to illustrate the range of involvement of the 50 states.

The third part is a brief analysis of how Kansas ranks with other states, in emphasis and range of involvement of state programs. Recommendations are provided as an indication of direction for further action.

Research and Technology Development in Kansas: A Chronology of Events and Activities

The necessity of research and technological development within Kansas was recognized as early as 1943. In February of that year the Kansas Industrial Development Commission published Outline of Program of Applied Industrial Research. The report was a plea for $200,000 of state funds to be used in starting several research projects in Kansas. The rationale was to get technical jobs established within Kansas for the returning World War II veterans. The report identified feasible research activities for Kansas to pursue.[30]

Even though a public concern for encouraging research and technology development was in evidence as early as 1943, state involvement was not apparent until the early 1960's. In 1961 the Legislature created the Governor's Economic Development Committee. The committee published ten reports on the various economic sectors of Kansas, as well as a report on recommendations.[24] (See Appendix G) There were five major recommendations. In general, these recommendations were to:

- establish the Office of Economic Analysis;
- establish the Kansas Department of Economic Development;
- establish the Research Foundation of Kansas;
- form a state economic finance authority; and,
- expand the vocational education programs of the state.

In 1963, the Office of Economic Analysis, KDED, and the Research Foundation of Kansas were established by the Legislature. The purpose of the foundation was to receive and dispense research funds granted to universities. In addition, the foundation had three main responsibilities: encourage expansion of existing research and develop new research at state universities; assist the universities in obtaining research funds from public and private sources; and, correlate the research programs of state universities with state department programs.

Funding for the foundation lasted until the late 1960's. One of the foundation's contributions was a series of annual reports and various other reports that identified the research industries of Kansas and the universities' research programs. The Research Foundation Act was abolished by the Legislature in 1974.

The Research Foundation Act originally had the support of state universities because it was viewed as a funding vehicle for research. The Kansas State Chamber of Commerce supported the Act since the foundation was to serve as a centralized authority for receiving research grants and distributing them to appropriate universities engaged in such research. The political problems of such expectations and lack of consensus for the mission of the foundation have been identified as major reasons for its demise.[B,R,K,JJ]

A renewed interest in research and technology development has emerged in Kansas since 1981. In October of that year, Governor John Carlin established a Task Force on Capital Formation for the purpose of reviewing, evaluating, and recommending state initiatives to increase capital availability for Kansas businesses. Of the six recommendations transmitted to the Governor, one dealt specifically with a mechanism to provide capital to business entrepreneurs in Kansas.[74] Legislation was proposed during the 1982 session but was not enacted.

During the winter and spring of 1982, a Presidential Management Intern, George Morning, working with the Small Business Administration undertook a study for KDED. The result of that study was the report, Preliminary Study: Attracting and Developing High Technology Industries in Kansas. This report reestablishes the notion that Kansas has a good potential for industries that are engaged in new technologies, especially in the areas of biotechnology and aeronautics.[44]

As a result of the renewed interest in research and technology development, five KDED staff members were directed to study the current potential for high technology industries and research activities in Kansas. This report is an accounting of the study results. Details of other state's efforts follows.

States' Involvements in Fostering Research and Technology Development

About half of the states in the U.S. are actively involved in fostering high technology and growth industries. In general, though, state government involvement has only recently appeared. Although research and technology development activities have been occurring since the late 1950's and early 1960's, these activities have largely been the results of private industry and/or university efforts. The one prime example of state government involvement in promoting technology industries is North Carolina. The Research Triangle is a result of the early efforts of North Carolina's Governor Hodges, who was a primary supporter of the research park concept. The park was primarily developed with private industry funds.[BB,UU]

More than half of the states have research parks; many have more than one. Most of these research parks were established in the early 1960's. The table on the following page identifies which states have these facilities. Notice that most of those states with research parks are also recipients of large federal research grants and have high percentages of employment in high technology industries. Examples of this are: California, Florida, Illinois, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Texas, and Virginia. California, Massachusetts, and North Carolina are examples of states that have high percentages of employment in high technology industries but do not currently receive a large amount of federal research funding.

Most of those states that are active, whether they receive federal or private funding, provide state incentives and/or state programs aimed at fostering high technology development. California provides a good example of active state involvement.[75] Current California programs include the following:

- The California Commission on Industrial Innovation: founded in 1981, is an 18 member group of business, academic, and labor leaders who are charged with producing a strategy to maintain the state's economic strength through industrial innovation;

TABLE 15: STATES' PROGRAMS IN TECHNOLOGY DEVELOPMENT

	Research Park, Date Founded	% Federal R & D FY 78*	%U.S. High Tech Emp. 1979+	State High-Tech Forum	State Financing Programs	State Research Programs	State Training Pro.
Alabama	1961	1.9					
Alaska							
Arizona	1962		1.59			1980	
Arkansas				1980	1978	1982	
California	(16)1951-70	24.0	15.85	1981	(2)1981	1981	1980
Colorado	(6) 1956-67	1.5	1.46	1975			
Connecticut		1.2	2.60		1973,1981		
Delaware							
Florida	1	3.7	2.71				
Georgia	(2) 1963-71		.78			1980	
Hawaii					1981		
Idaho							
Illinois	(2) 1965-68	2.2	6.69	1981	1967		1978-79
Indiana	1961			1982	1981		(2)1975
Iowa				1982			
Kansas							
Kentucky	1961					1977	1975
Louisiana							
Maine			.29				
Maryland	(6) 1961-71	8.3	1.03		1978	1978,1981	
Massachusetts	(7) 1955-71	6.6	6.13		1978		
Michigan	(3) 1958-64	1.4	2.54	1981	1979	1981	
Minnesota			2.89	1981		1982	
Mississippi							
Missouri	1962	3.2			1982	1982	1981,'8
Montana					1977		
Nebraska						1967	
Nevada			.10				
New Hampshire			1.00				
New Jersey	(2) 1962-70	2.0	5.02		1977		
New Mexico	(2) 1964-70	3.9			1981		1978
New York	(2) 1954-64	5.0	10.34		1981	1961,1977	
North Carolina	(2) 1959-66		2.31	1963,1979		1980-1981	(3)'79,'8
North Dakota							
Ohio	(2) 1965	3.3	4.46		1977		
Oklahoma	(2) 1957-60						
Oregon	1963						
Pennsylvania	(4) 1956-70	3.9	5.79	1979	1967	1965	198
Rhode Island			.53				
South Carolina	1959			1981			
South Dakota							
Tennessee	(2) 1961-74	2.5		1981	1980	1974	198
Texas	(4) 1962-63	4.2	3.96				
Utah	1965		.49				
Vermont			.44				
Virginia	(6) 1961-65	3.4	1.11	1982			
Washington	(2) 1957-64	3.4	.53			1981	198
West Virginia							
Wisconsin	1963					1962	
Wyoming							

*Blank space indicates less than 10%
+Selected states

SOURCE: 25,50,56,75

59

- Energy Research and Development Project of the California Energy Commission: founded in 1975, is an agency that works to achieve technological breakthroughs;

- The State Assistance Fund for Energy of the California Business and Industrial Development Corporations: founded in 1981, is a program that makes loans to small businesses involved in developing and marketing new alternative energy technologies;

- The Office of Appropriate Technology: founded in 1976, is a program to develop technologies that rely on natural cycles and renewable sources of energy;

- The Micro Electronics Innovation and Computer Research Opportunities Program: founded in 1981, is a cooperative program between state government, industry, and universities to facilitate and expand basic and applied research in microelectronics and computer science;

- The California Worksite Education and Training Act: enacted in 1980, provides for training at the worksite;

- The Pension Investment Unit: founded in 1981, is a program in the Governor's office for the purpose of exploring means of investing more capital in businesses and industries engaged in significant technological innovation; and,

- The California Innovation Development Loan Program: founded in 1981, is a program to provide innovative financing to technology based firms for product development.

It was discovered that state programs are concerned with four types of activities: public/private forums; linking university research with technological innovation; increasing training of technical personnel; and financing technological innovation. Other states that have extensive programs are: Arkansas, Illinois, Indiana, Missouri, North Carolina, and Tennessee. A complete listing of states' programs is provided in Appendix H.

Research undertaken during this study indicates that there is no consensus as to the relative importance of state incentives and programs upon locational decisions. While there are many adamant proponents of state incentives, others do not agree such as a representative from the California Manufacturers Association who commented that such programs will not make or break a locational decision. He indicated that the three main criteria for increasing high technology firms in California are: to upgrade university faculty and salaries; to make available reasonably priced housing; and to provide energy subsidies for industries.[N] This apparent lack of consensus is supported by a soon to be published report from the Joint Economic Committee of Congress. Preliminary information from a national survey of high technology firms indicates that respondents were about equally divided as to the significance of state and local incentives.[MM] These same respondents indicated that there are definitely some actions that state and local governments can undertake to encourage business expansion. These are: to cut red tape, to reduce taxes, and then to offer financial incentives. Regardless of this exhibited lack of consensus, it seems apparent that when all other factors are equal, a locational decision could hinge on the availability of state and local incentives.

Kansas vs. Other States: The Race for Research and Technology

There is presently considerable interest throughout Kansas to encourage research and technological development in Kansas. The state must improve its efforts to participate in the development of a statewide program to promote financing, research, and training programs in technology development. A number of studies have identified existing high technology firms and appropriate research programs in Kansas.[57,24,43] There needs to be a continuous and organized effort by leaders in the public and private sectors to develop and implement a comprehensive plan. There are both short term and long term activities that the state should support and encourage for such development in Kansas. Any state activities for this effort should be with the cooperation of university and private industry leaders.

This study has indicated that if Kansas is to be competitive with other states in this region it has to initiate action. Neighboring states have begun to take action as evidenced in Appendix H. Thus it is proposed that these recommendations take place prior to FY 84.

It is recommended that:

1. The Governor establish a special committee of state business leaders, university leaders, state government officials, and legislators to study this staff report and establish priorities for development strategies for high technology industrial development. The California Commission on Industrial Innovation and the Michigan High Technology task force provide models for such a task force in Kansas. Details of these two task forces are provided in Appendix H. Staff support should be provided to the committee. This special committee should be convened in the fall of 1982 and address the following concerns prior to the 1982-83 legislative session so that the committee might advocate legislation it deems necessary:

   - skill expansion and modernization through secondary education programs, higher education programs, and vocational-technical education programs (for example, see the Illinois Industrial Training Program in Appendix H);

   - research and development links between universities and industry (such as the Missouri Research Assistance Act and the Wisconsin University Industry Research Program described in Appendix H) and through technical assistance programs (such as the Georgia Advanced Technology Development Center described in Appendix H).

   - capital availability through financing mechanisms involving state and private sector participation (such as the Indiana Corporation for Innovation Development and the Missouri Loan Guarantee Authority detailed in Appendix H): and,

   - tax laws and regulations that are impediments to growth of high technology industries.

2. The Governor, along with members of the special committee, "lobby" the Kansas Congressional Delegation to get legislation encouraging research and technology development -- as well as to get additional federal research and development funds for Kansas universities.

3. Kansas be represented on the National Governor's Association "Task Force on Technology Innovation" and be prepared to attend their upcoming meeting during the fall of 1982. Kansas must continue to actively participate in order to keep informed of what other states are doing to promote research and technology.

4. The Governor convene a conference on high technology for Kansas firms in order to provide an arena for communication.

5. The Governor direct KDED to target all current assistance programs to high technology industries.

   Examples of this targeting include: use 50% of FY 83 KIT funds for high technology firms (those that have at least 10% of their employment in research); target FY 83 Cavalry missions to areas of the country with concentrations of high technology industries; (Invite members of the special committee and/or key university personnel to go along); add a research and development column to the KDED Report to provide a communication mechanism for university and industry activities occurring in the state; make a supplement to the KDED Report that summarizes the findings of this study.

Additionally, it is recommended that the following action be taken prior to FY 85. It is recommended that:

1. State general funds be provided for the "capitalization" of research organizations existing at KU and KSU to enable them to act as non-profit corporations for their universities with private industry clients.

2. The Governor direct all state departments to give priority attention to the geographic areas of Kansas that are pursuing high technology developments. Especially important are any infrastructure development projects and maintenance projects.

3. The Governor and Legislature direct KDED to undertake the following projects and/or programs:

   - an advertising and promotional campaign directed toward out-of-state high technology firms;

   - an increase of KIT funding to allow a separate amount to be directed for use by high technology firms;

   - a promotional packet highlighting the universities' research programs, to be used for prospective firms;

   - develop several promotional pieces on specific research strengths of Kansas;

- provide one or two additional staff for a new technology development section (their responsibilities could include technical assistance to Kansas entrepreneurs in technology development, identifying associations and foundations as potential research grant donors, identify large corporations that have significant research programs in similar categories as Kansas research and approach them for research grants, and develop and maintain a listing of Kansas graduates of universities with degrees in high technology fields).

4. The Legislature financially support those research programs at Kansas universities that have national ranking and recognition. Support should include upgrading faculty salaries and/or more use of distinguished professorships, purchase of equipment and other such types of support as identified in the section of the report dealing with university participation.

The findings of this study indicate that actions should be pursued immediately; maintaining the status quo will result in falling behind the rest of the country. It is a nationally recognized fact that technology development is the key to economic growth during the 1980's and 1990's. The plains states do not currently have any well-known research parks; therefore, the field in this part of the nation is wide open. The recommendations in this report are feasible for Kansas. With reasonable targeting of efforts, and limited state funding, Kansas can continue to develop its research strengths to their potential.

APPENDIX A

R & D Scoreboard 1981

<u>Business Week</u>

A research spending surge defies recession

Spending for industrial research and development surged in 1981 even though companies were feeling the pinch of recession. The 776 companies included in BUSINESS WEEK's annual R&D Scoreboard spent more than $32 billion to develop new products and processes in 1981, or 15.1% more than those same corporations spent in 1980. That tops last year's inflation rate by a substantial six percentage points.

The 1981 increase continues an uptrend in research and development that started in the late 1970s. A growing concern that a slump in spending could cost the U. S. its technological edge prompted many industries to deepen their commitment to R&D. Companies turning out computer peripheral equipment and providing data processing services in the information processing industry led all other categories last year with a 34.2% increase in R&D spending, to $344 million. Other industrial segments posting sizable increases were: fuel (32.9%), oil service and supply (32%), steel (26.2%), office equipment in information processing (24.8%), electronics (21.4%), chemicals (21.1%), and telecommunications (20.1%).

The 1981 Scoreboard includes those publicly held companies with annual sales of more than $35 million that have R&D expenditures of more than $1 million—or at least 1% of sales. The 1981 list contains 32 more companies than last year's edition. Two industries account for most of these newcomers: electronics (including Cubic, Penril, and Communications Industries) and information processing (Beehive, Tandon, NBI, Kroy, and Docutel).

Some companies—notably Conoco, Marathon Oil, St. Joe Minerals, and Beckman Instruments—are absent from the 1981 Scoreboard because they were acquired last year. Other companies do not appear because their financial data—extracted by Standard & Poor's Compustat Services Inc. from 10K forms filed with the Securities & Exchange Commission—were not available at press time.

Recession's impact. Even with the sharp rise in real spending, some industrial categories posted increases that were less than in the previous year. Automotive R&D spending, for example, increased by only 1.3%, compared with a jump of 10.7% in the 1980 Scoreboard. Similarly, spending in the appliance industry moved ahead by 9.9% in 1981, compared with a 17.9% rise in the previous year.

The basic pattern of R&D activity established over the past few years has not changed significantly. Scoreboard companies spent 2% of sales on R&D in 1981, for example, just as they did in 1980. In a reflection of the recession, however, the companies included in the 1981 Scoreboard spent a greater percentage of profits on R&D than in 1980—39.3%, compared with 38.2% the previous year. The amount of R&D funding per employee also crept upward. In 1981 the Scoreboard companies spent $2,161 for each employee; the previous year they spent an average of $1,834.

The top spenders in R&D have also remained stable for the past several years. Ford and GM still dominate R&D spending, although their 1981 expenditures remained virtually flat compared with last year. By contrast, Checker Motors, which has announced that it will cease to build the boxy taxicabs with which it is so closely identified, boosted its 1981 R&D budget by 77%. Electronics and information processing companies are heavily represented when spending is measured as a percentage of sales and in dollars per employee. A newcomer to the Scoreboard—Telesciences—holds the top slot in R&D in the sales category. Cray Research, Amdahl, and Auto-Trol Technology have taken the lead in R&D dollars per employee.

Early indications are that the upward trend in R&D spending will continue in 1982. Companies surveyed by McGraw-Hill Publications Co.'s Economics Dept. indicated that they planned to boost R&D spending this year by an average of 17%. And with the inflation rate expected to be 6.5% in 1982, the real increase in the next Scoreboard could top 10%. ■

THREE MEASURES OF THE TOP 15 IN R&D SPENDING

IN TOTAL DOLLARS (millions)

1.	General Motors	$2,250
2.	Ford Motor	1,718
3.	AT&T*	1,686
4.	IBM	1,612
5.	Boeing	844
6.	General Electric	814
7.	United Technologies	736
8.	Du Pont	631
9.	Exxon	630
10.	Eastman Kodak	615
11.	Xerox	526
12.	ITT	503
13.	Dow Chemical	404
14.	Honeywell	369
15.	Hewlett-Packard	347

IN PERCENT OF SALES

1.	Telesciences	22.1%
2.	Kulicke & Soffa	18.9
3.	Computer Consoles	17.8
4.	Auto-Trol Technology	17.2
5.	Amdahl	17.0
6.	Cray Research	16.0
7.	Floating Point Systems	15.3
8.	Dysan	15.2
9.	Intel	14.8
10.	Applied Materials	14.4
11.	Cordis	14.0
12.	Intergraph	13.1
13.	Teradyne	12.7
14.	Genrad	12.6
15.	Anderson Jacobson	11.8

IN DOLLARS PER EMPLOYEE

1.	Cray Research	$15,060
2.	Amdahl	14,851
3.	Auto-Trol Technology	14,760
4.	Telesciences	11,130
5.	Computer Consoles	10,677
6.	Applied Materials	9,722
7.	Intergraph	9,393
8.	Onyx & IMI	9,039
9.	Apple Computer	8,532
10.	Merck	8,462
11.	Floating Point Systems	8,418
12.	Boeing	8,357
13.	Intl. Flavors & Fragrances	8,297
14.	Cado Systems	8,226
15.	Eli Lilly	8,210

*Includes $1.149 million spent by Western Electric Co. and other subsidiaries, not reported in AT&T's 10K

Data: Standard & Poor's Compustat Services Inc.

R&D SCOREBOARD·1981

GLOSSARY

Sales 1981: Includes all sales and other operating revenues.
Sales percent change from 1980: Change in sales from 1980, restated, to 1981.
Sales percent annual change: Average annual change in sales, as restated, over the last five years.*
Profits 1981: Net income before extraordinary items or discontinued operations.
Profits percent annual change: Average annual change in net income before extraordinary items or discontinued operations, as restated, over the last five years.*
R&D expenses 1981: Dollars spent on company-sponsored research and development for the year, as reported to the Securities & Exchange Commission on Form 10-K. Excludes any expenditures for R&D performed under contract to others, such as U.S. government agencies.
R&D percent change from 1980: Change in R&D expenses from 1980, restated, to 1981.
R&D percent of sales: R&D expenditures as percent of sales and other operating revenues.
R&D percent of profits: R&D expenditures as percent of net income before extraordinary items and discontinued operations.
R&D dollars per employee: R&D expenditures divided by the reported number of company employees.
Employment percent average annual change: Annual change in number of employees, using restated figures, over five years.*
Data are for calendar 1981 except for those companies reporting on a fiscal year other than calendar basis, in which case the annual data are for the most recent fiscal year reported as of May 30. Companies included in the survey are limited to those reporting 1981 sales of $35 million or more and R&D expenses amounting to at least $1 million or at least 1% of sales. With the exception of companies in telecommunications with significant manufacturing or research efforts, no regulated utilities or transportation companies are included in the survey.

*All rates of change are calculated using a log linear least squares method. A rate is indicated as NA if the rate for the first or last year is negative or if the rates for two or more years in the series are negative.

Data: Standard & Poor's Compustat Services Inc.
NA = Not available

COMPANY	SALES			PROFITS		R&D EXPENSE					EMPLOYM'T
	1981 millions of dollars	Percent change from 1980	Percent annual change (1977-81)	1981 millions of dollars	Percent annual change (1977-81)	1981 millions of dollars	Percent change from 1980	Percent of sales	Percent of profits	Dollars per employee	Percent annual change (1977-81)
AEROSPACE											
Atlantic Research	93	15.8	30.1	4	36.6	2.9	78.1	3.1	82.8	1917	NA
Bangor Punta	800	5.4	8.7	44	22.7	9.5	-12.0	1.2	21.5	833	-4.0
Boeing	9788	3.8	26.2	473	29.0	844.1	10.0	8.6	178.5	8357	12.5
Cessna Aircraft	1060	6.0	14.4	61	7.8	50.1	4.6	4.7	82.7	3232	0.3
Fairchild Industries	1339	47.7	34.9	64	59.5	23.8	130.5	1.8	37.0	1276	NA
Gates Learjet	565	34.8	24.7	22	25.4	10.3	7.7	1.8	46.1	1512	18.8
General Dynamics	5063	9.0	17.6	124	7.3	135.9	15.0	2.7	109.5	1678	3.7
Grumman	1916	10.8	8.6	20	-3.1	31.6	14.8	1.7	154.4	1106	1.9
Lockheed	5176	16.4	15.3	155	6.6	100.0	14.9	1.9	64.6	1403	7.3
McDonnell Douglas	7385	21.7	20.4	177	6.4	215.7	8.4	2.9	122.1	2905	5.5
Northrop	1991	20.3	3.4	48	-6.5	192.2	106.7	9.7	401.3	6121	3.4
Rockcor	59	11.6	22.1	2	26.5	2.1	57.8	3.5	87.7	2070	NA
Sierracin	61	0.6	33.5	-1	NA	1.6	11.0	2.6	-141.4	1324	NA
TRE	128	5.1	13.5	18	45.6	7.6	99.9	5.9	42.9	3163	8.0
United Technologies	13668	10.9	28.1	458	24.8	735.8	11.4	5.4	160.8	3879	9.4
INDUSTRY COMPOSITE	49091	12.4	20.9	1668	17.6	2363.2	15.9	4.8	141.6	3717	7.1
APPLIANCES											
Hoover	750	-9.7	6.8	-19	NA	8.3	7.3	1.1	-44.1	503	-7.9
Magic Chef	674	6.0	27.4	16	-6.6	7.0	17.9	1.0	43.3	926	NA
Reece	43	-6.7	4.8	-3	NA	2.8	-5.7	6.5	-81.3	2852	-1.7
Rival	93	6.9	6.1	8	11.3	1.1	11.2	1.2	14.5	616	1.5
Ronson	37	-36.7	1.2	2	4.2	0.7	-54.3	1.9	38.6	1540	NA
Singer	2834	1.7	5.7	38	-16.3	47.9	4.6	1.7	124.7	726	-6.4
Whirlpool	2437	9.5	6.0	135	4.6	34.1	5.1	1.4	25.2	1767	-3.6
Zenith Radio	1275	7.5	7.8	16	17.0	57.7	20.7	4.5	369.9	2061	4.2
INDUSTRY COMPOSITE	8143	3.6	7.4	193	-0.8	159.7	9.9	2.0	82.9	1136	-4.3
AUTOMOTIVE: Cars, trucks											
American Motors	2589	1.4	2.2	-137	NA	80.3	16.5	3.1	-58.8	3718	NA
CCI	267	3.7	11.8	10	29.9	1.6	-1.4	0.6	15.9	534	NA
Checker Motors	123	0.9	0.8	0	NA	1.0	76.7	0.8	-223.7	371	-10.6
Chrysler	10822	17.3	-7.4	-476	NA	249.7	-10.2	2.3	-52.5	2843	-19.2
Ford Motor	38247	3.1	-1.2	-1060	NA	1718.0	2.6	4.5	-162.1	4244	-5.0
General Motors	62699	8.6	1.7	333	-45.2	2249.6	1.1	3.6	674.7	3036	-2.6
International Harvester	7041	-23.6	2.9	-636	NA	244.9	3.2	3.5	-38.5	3731	NA
INDUSTRY COMPOSITE	121787	8.1	-0.1	-1965	NA	4545.1	1.3	3.7	-231.3	3426	-7.3

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
AUTOMOTIVE: Parts, equipment											
Bendix	4393	14.5	10.4	205	16.8	89.7	13.3	2.0	43.9	1289	-2.6
Champion Parts Rebuilders	63	NA	NA	-3	NA	0.9	-9.6	1.4	-34.6	376	NA
Cummins Engine	1962	17.8	10.2	100	10.8	58.2	36.6	3.0	58.2	2554	-0.3
Dana	2711	7.4	9.9	116	-2.0	36.8	13.9	1.4	31.8	1045	NA
Donaldson	264	12.6	16.4	13	3.3	5.7	4.2	2.2	44.9	1558	NA
Eaton	3165	-0.4	9.9	82	-5.3	94.1	26.6	3.0	114.2	1923	-0.9
Fruehauf	2175	4.5	3.1	21	-25.7	20.0	8.3	0.9	93.8	742	-3.8
Hayes-Albion	177	-3.9	-3.8	-4	NA	2.2	-12.0	1.3	-55.7	780	-14.3
Modine Mfg.	181	-10.1	6.3	7	-5.0	4.4	6.7	2.4	59.2	1634	-1.6
Raybestos-Manhattan	343	24.8	6.0	3	-27.4	4.5	-13.1	1.3	149.1	772	-2.0
Sealed Power	304	18.0	8.6	21	10.6	4.2	5.9	1.4	19.8	927	-3.6
Sheller-Globe	512	13.7	0.7	18	-22.5	5.4	7.1	1.1	30.5	579	NA
Smith (A.O.)	784	13.0	0.0	5	-26.8	20.0	4.2	2.6	369.0	2084	-7.8
Standard Products	229	7.2	10.8	6	1.5	2.7	14.6	1.2	47.6	643	-1.0
Superior Industries International	61	21.3	-7.1	-4	NA	2.1	55.7	3.5	-50.1	1860	-12.0
INDUSTRY COMPOSITE	17325	9.0	7.9	586	-1.9	350.9	18.1	2.0	59.9	1406	-2.7
BUILDING MATERIALS											
Ameron	301	3.0	6.2	16	27.8	1.5	-6.0	0.5	9.2	453	NA
Bird & Son	277	-11.7	2.3	-27	NA	2.5	6.8	0.9	-9.0	1101	-11.0
De Soto	353	4.7	1.8	12	-1.9	16.5	7.5	4.7	136.0	4280	-10.2
GAF	673	-0.7	7.0	-28	NA	8.1	-6.1	1.2	-28.7	1248	NA
Guardsman Chemicals	68	23.0	12.9	2	-5.2	2.3	8.5	3.4	123.8	3074	-3.5
Ideal Basic Industries	477	3.9	7.9	44	4.7	2.3	10.6	0.5	5.2	548	1.5
Insilco	685	6.7	13.3	34	12.1	5.1	23.2	0.7	15.0	555	4.4
Intercraft Industries	130	11.8	14.9	2	5.5	1.6	42.9	1.3	101.0	656	NA
Interpace	253	-1.0	21.6	9	4.7	2.4	21.1	1.0	27.8	563	-20.4
Lilly Industrial Coatings	109	21.3	16.7	6	31.0	1.6	4.1	1.4	27.1	1757	3.8
Manville	2186	-3.6	11.9	60	-13.7	30.2	-1.0	1.4	50.1	1119	NA
Masco	877	14.4	17.3	88	15.0	12.4	13.8	1.4	14.0	1240	6.9
Moore (Benjamin)	212	10.7	11.6	10	12.3	3.0	11.6	1.4	29.1	1944	NA
Owens-Corning Fiberglas	2375	3.9	12.2	50	-22.1	47.0	19.0	2.0	94.3	2157	1.4
Pratt & Lambert	149	41.7	14.8	4	25.5	2.4	55.5	1.6	57.5	1647	7.0
Sherwin-Williams	1537	21.6	9.4	31	79.6	9.8	10.3	0.6	31.1	415	3.3
Sikes	41	4.8	21.6	3	73.2	0.5	-5.4	1.2	14.2	652	NA
U.S. Gypsum	1491	1.1	5.4	74	2.9	13.4	3.2	0.9	18.1	754	-3.5
Valspar	153	11.6	18.8	7	30.9	4.0	10.5	2.6	59.6	3130	7.1
Walter (Jim)	2017	2.9	8.7	19	-26.0	8.8	NA	0.4	46.1	370	-1.9
INDUSTRY COMPOSITE	14360	4.6	10.1	416	-2.4	175.3	9.6	1.2	42.1	1053	-1.1
CHEMICALS											
Air Products & Chemicals	1570	10.5	14.2	126	18.0	32.1	6.6	2.0	25.5	1404	17.3
Akzona	1188	12.7	10.1	12	-5.7	32.1	13.9	2.7	276.8	2184	0.3
Allied	6407	16.1	26.8	348	27.6	152.0	44.8	2.4	43.7	2611	16.3
American Cyanamid	3649	5.6	10.7	197	7.4	164.1	15.7	4.5	83.3	3923	1.8
Betz Laboratories	253	18.8	17.2	29	19.7	7.2	20.9	2.9	25.0	3279	NA
Celanese	3752	12.1	12.9	144	14.0	104.0	10.6	2.8	72.2	3525	-1.2
Church & Dwight	127	21.6	6.7	6	6.0	3.0	1.7	2.4	46.3	5365	1.1
Crompton & Knowles	243	0.7	5.9	9	12.1	4.3	-7.5	1.8	50.7	1716	-5.2
Detrex Chemical Industries	79	3.3	7.3	4	18.8	1.6	30.3	2.0	35.5	2683	-0.3
Dexter	523	-2.2	14.8	26	9.2	18.7	16.0	3.6	70.5	3458	3.2
Diamond Shamrock	3376	7.3	23.0	230	12.3	52.7	16.5	1.6	22.9	3889	-0.5
Dow Chemical	11873	11.7	18.8	664	3.8	404.0	28.7	3.4	71.6	6332	4.3
Du Pont	22810	66.0	22.3	1081	-12.7	631.0	28.5	2.8	58.4	3560	6.2
Essex Chemical	173	13.6	22.3	6	14.7	2.7	-0.9	1.5	32.7	2802	NA
Ethyl	1757	1.0	8.7	91	-4.0	37.5	10.4	2.1	41.3	2588	-2.4
Ferro	702	1.0	14.7	26	-4.6	2.4	3.2	0.3	9.4	262	4.1
Fuller (H.B.)	329	10.7	NA	14	NA	6.0	12.9	1.8	44.5	1830	NA
Grace (W.R.)	6521	6.3	12.6	361	25.1	54.7	21.6	0.8	15.1	616	8.2
Great Lakes Chemical	150	18.6	21.5	18	14.1	4.8	18.9	3.2	26.7	4082	18.2
Hercules	2718	9.4	12.6	136	19.9	61.4	14.9	2.3	45.0	2696	-1.7
Hunt (Philip A.) Chemical	112	5.2	11.6	4	-12.9	5.8	-4.4	5.1	150.9	5563	-0.4
Intl. Minerals & Chemical	1965	10.4	11.7	154	9.4	14.1	58.4	0.7	9.2	1330	2.1
Koppers	2019	4.6	10.5	52	-8.1	18.3	11.4	0.9	35.4	909	2.1
Lawter International	88	7.5	16.8	10	6.3	1.3	8.6	1.5	13.0	4097	2.4

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Loctite	214	7.3	20.4	10	-5.4	5.8	15.6	2.7	55.9	2254	10.4
Lubrizol	878	-2.6	16.8	92	13.7	32.9	18.5	3.7	35.7	7760	4.1
MacDermid	61	6.8	13.2	4	12.0	2.7	6.1	4.5	63.2	5409	6.4
Mississippi Chemical	392	14.8	14.4	2	42.3	1.1	54.4	0.3	45.6	665	3.2
Monsanto	6948	5.7	11.6	445	2.5	220.6	7.9	3.2	49.6	3844	-1.5
Morton-Norwich Products	958	13.1	12.3	53	13.7	24.3	11.4	2.5	45.8	2312	-0.6
Nalco Chemical	667	8.1	11.8	81	12.7	30.4	9.5	4.6	37.4	6409	3.3
Olin	2001	7.3	8.2	93	-2.7	38.8	25.6	1.9	41.8	1911	NA
Pennwalt	1056	1.2	10.5	37	-2.0	26.6	8.8	2.5	72.6	2496	NA
Petrolite	297	17.1	20.6	28	17.0	7.5	18.1	2.5	27.1	3581	6.4
Products Research & Chemical	55	14.6	16.5	3	29.7	2.5	58.5	4.7	77.6	3862	NA
Quaker Chemical	107	14.1	13.8	8	11.4	4.1	10.8	3.8	49.9	4646	6.6
Reichhold Chemicals	950	7.4	8.8	17	7.6	6.4	0.6	0.7	37.4	1142	-4.7
Rohm & Haas	1885	9.3	14.5	93	23.6	76.8	14.9	4.1	82.5	5709	0.8
SCM	1938	2.4	9.5	57	12.6	34.4	0.7	1.8	60.9	1248	1.6
Stauffer Chemical	1726	1.8	9.6	150	6.2	50.6	13.9	2.9	33.8	4137	-1.0
Stepan Chemical	205	29.8	16.3	7	4.8	6.5	30.6	3.2	99.9	7270	3.4
Sun Chemical	599	16.5	15.1	35	24.4	11.4	7.5	1.9	32.3	1810	3.8
Thiokol	721	15.7	20.5	37	21.3	12.5	9.4	1.7	33.9	1406	NA
Union Carbide	10168	1.7	10.2	649	17.1	207.0	24.7	2.0	31.9	1877	-0.4
Witco Chemical	1292	9.9	20.6	39	11.6	16.3	11.6	1.3	42.3	1964	11.2
INDUSTRY COMPOSITE	**105519**	**16.6**	**15.5**	**5590**	**11.8**	**2635.2**	**21.1**	**2.5**	**47.1**	**2879**	**4.8**
CONGLOMERATES											
Avco	2326	10.6	11.6	71	-9.7	25.0	46.2	1.1	35.0	960	NA
Colt Industries	2243	3.6	10.0	110	10.8	30.5	21.4	1.4	27.8	1089	-2.4
Figgie International	770	1.4	8.3	28	20.8	8.4	12.4	1.1	32.8	548	-2.1
ITT	17306	-6.6	7.6	695	5.7	502.9	-0.4	2.9	72.4	1552	NA
Kidde	2849	12.2	17.6	99	14.5	30.4	20.6	1.1	30.6	608	5.3
LTV	7511	30.8	30.1	405	120.4	40.7	2.3	0.5	10.1	768	3.7
Lear Siegler	1531	7.5	13.1	76	19.1	17.4	13.0	1.1	22.9	725	-0.7
Litton Industries	4936	16.4	9.1	312	56.9	82.8	9.0	1.7	26.6	1080	NA
Rockwell International	7040	1.9	8.3	292	15.5	87.2	-13.7	1.2	29.9	843	-2.6
Signal	5343	11.7	12.4	214	15.4	205.1	22.2	3.8	95.8	3436	NA
TRW	5285	6.0	13.2	229	10.0	91.2	36.3	1.7	39.9	992	1.2
Teledyne	3238	10.6	9.9	412	20.0	50.5	34.7	1.6	12.2	1048	-0.4
Textron	3328	-0.3	7.5	146	3.6	107.4	16.5	3.2	73.7	2192	-6.5
Union	206	5.1	15.4	5	12.4	1.2	7.1	0.6	25.7	299	NA
INDUSTRY COMPOSITE	**63910**	**5.4**	**11.3**	**3090**	**17.3**	**1280.7**	**8.8**	**2.0**	**41.4**	**1343**	**-0.7**
CONTAINERS											
American Can	4836	0.5	9.1	77	-9.8	41.5	1.2	0.9	54.1	887	-0.8
Ball	815	16.7	16.0	29	15.6	7.1	1.7	0.9	24.4	713	NA
Continental	5194	1.5	10.1	242	14.5	41.0	11.1	0.8	16.9	751	-3.7
Maryland Cup	647	11.7	15.1	30	15.2	1.0	0.0	0.2	3.3	91	4.1
Owens-Illinois	3943	1.0	9.8	154	14.6	28.8	7.1	0.7	18.7	565	-6.4
INDUSTRY COMPOSITE	**15436**	**2.1**	**10.2**	**533**	**8.8**	**119.4**	**5.9**	**0.8**	**22.4**	**689**	**-3.4**
DRUGS											
Abbott Laboratories	2343	14.9	17.0	247	20.1	113.7	16.5	4.9	46.0	3608	4.3
American Home Products	4131	8.8	11.4	497	12.9	115.4	13.5	2.8	23.2	2343	0.2
American Hospital Supply	2870	16.9	17.3	147	16.6	52.4	26.3	1.8	35.7	1497	4.8
Baxter Travenol Laboratories	1504	9.4	15.8	151	18.8	67.8	18.1	4.5	45.0	2293	-0.2
Becton Dickinson	1066	13.2	15.3	76	11.7	43.5	11.1	4.1	57.4	2024	4.5
Bristol-Myers	3497	10.7	12.2	306	14.7	144.0	12.0	4.1	47.1	4034	NA
Chattem	75	33.2	21.3	4	20.9	1.1	7.1	1.4	27.5	2059	NA
Cooper Laboratories	236	38.7	20.1	14	12.6	10.0	56.9	4.2	69.6	2167	NA
Flow General	112	45.3	27.2	8	58.2	1.7	77.3	1.5	21.7	932	NA
ICN Pharmaceuticals	49	-22.8	-8.3	2	NA	1.9	73.4	3.9	91.3	2094	NA
Johnson & Johnson	5399	11.6	16.9	468	17.0	282.9	21.5	5.2	60.5	3669	6.1
Key Pharmaceuticals	41	74.6	76.6	6	107.1	2.0	107.6	4.9	34.2	3457	NA
Lilly (Eli)	2773	8.4	15.8	374	13.2	234.8	17.0	8.5	62.7	8210	4.0
Marion Laboratories	119	16.5	12.6	8	-8.4	11.7	19.5	9.9	148.1	7921	NA
Merck	2929	7.1	14.8	398	10.8	274.2	17.2	9.4	68.8	8462	3.9
Pfizer	3250	7.3	12.2	274	11.2	176.9	10.6	5.4	64.6	4263	0.3

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Richardson-Vicks	1088	17.1	15.7	83	19.1	2.9	-86.9	0.3	3.5	270	-6.5
Robins (A.H.)	451	4.3	10.1	44	8.8	28.6	5.7	6.3	64.6	5195	NA
Rorer Group	362	12.6	18.1	36	14.9	13.6	20.5	3.8	38.4	2843	NA
Scherer (R.P.)	170	24.8	11.2	9	0.2	1.9	22.1	1.1	22.3	968	NA
Schering-Plough	1809	4.0	19.5	179	3.8	109.1	21.2	6.0	60.8	4041	14.3
Searle (G.D.)	942	13.9	16.9	131	30.7	82.4	18.9	8.7	62.9	5055	-4.3
Smithkline Beckman	1985	12.0	23.8	370	38.5	163.9	20.6	8.3	44.3	7151	8.8
Squibb Corp	1524	14.2	17.8	41	-10.5	95.3	29.2	6.3	231.9	4144	3.8
Sterling Drug	1793	5.4	11.5	130	11.6	67.1	15.5	3.7	51.5	2633	-1.9
Syntex	711	22.7	22.8	99	25.4	65.5	20.5	9.2	66.4	6685	11.7
Upjohn	1898	7.8	14.0	182	17.9	171.6	16.5	9.0	94.4	8015	3.6
Warner-Lambert	3380	-2.9	7.9	9	-45.7	114.8	11.5	3.4	1244.7	2551	NA
INDUSTRY COMPOSITE	46507	9.6	14.6	4292	13.2	2450.6	16.3	5.3	57.1	4044	3.2

ELECTRICAL

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Acme Electric	52	4.8	12.8	3	7.3	3.3	11.8	6.3	107.9	2637	5.4
Ametek	448	12.0	10.9	26	10.2	9.8	21.0	2.2	37.0	1400	2.9
AMP	1234	6.8	18.6	135	14.8	111.0	6.7	9.0	82.4	5649	6.5
Baldor Electric	160	9.4	13.4	12	16.4	2.7	35.0	1.7	23.0	1059	2.7
Champion Spark Plug	819	2.4	9.1	30	-13.0	12.3	15.0	1.5	40.6	911	-1.2
Cherry Electrical Products	90	2.5	30.1	6	16.8	1.2	11.4	1.3	20.5	522	21.5
Duro-Test	64	5.1	6.7	5	7.5	1.4	7.7	2.2	29.8	778	-0.8
Echlin	416	37.9	12.6	13	-11.5	2.8	27.2	0.7	22.1	397	1.8
Electronics Corp. of America	45	5.9	8.7	6	21.2	1.8	2.2	3.9	30.8	1778	5.8
Emerson Electric	3429	11.8	15.1	273	15.2	78.0	14.7	2.3	28.5	1413	4.5
Franklin Electric	174	11.3	8.5	7	-7.7	2.6	6.1	1.5	36.8	772	-0.2
General Electric	27240	9.1	11.9	1652	11.0	814.0	7.1	3.0	49.3	2015	1.0
Gould	1846	14.5	14.9	86	9.4	95.9	34.9	5.2	111.0	3333	3.3
High Voltage Engineering	92	4.7	11.4	4	13.2	2.5	6.9	2.7	58.6	1271	NA
Instrument Systems	114	5.8	7.8	-6	NA	2.0	-9.1	1.8	-35.5	1000	NA
Joslyn Mfg. & Supply	148	3.2	6.7	15	66.3	1.2	71.4	0.8	7.9	600	-8.9
Kearney-National	186	206.3	31.0	7	50.2	1.7	57.5	0.9	24.8	733	NA
Kollmorgen	224	17.2	23.5	11	19.7	10.8	34.9	4.8	95.6	2409	13.1
Lightolier	112	16.3	12.1	3	30.5	3.0	6.1	2.6	85.9	1291	4.1
Lincoln Electric	527	15.5	12.5	40	9.5	8.4	11.8	1.6	21.1	NA	NA
McGraw-Edison	2429	7.3	49.3	84	12.0	28.4	3.7	1.2	33.9	835	28.2
Molex	143	17.7	28.2	16	27.7	6.6	5.9	4.6	41.4	2784	14.4
Powell Industries	57	17.2	22.0	3	32.5	1.6	618.2	2.9	60.9	3090	NA
RTE	242	16.7	9.4	7	-22.7	2.4	46.3	1.0	36.1	865	7.9
Slater Electric Inc	40	20.1	5.0	1	-27.3	0.6	30.2	1.5	84.9	876	-1.4
Square D	1144	12.9	16.8	103	14.1	24.7	23.5	2.2	24.0	1088	NA
Superior Electric	45	-9.5	12.7	1	1.9	1.3	45.5	3.0	112.2	1359	1.3
Thomas Industries	234	2.8	7.8	12	10.5	3.5	24.2	1.5	28.6	1061	-4.9
Tracor	371	18.3	22.9	19	29.8	7.1	-4.4	1.9	37.2	928	7.0
Vernitron	137	8.9	23.5	8	30.7	2.1	7.0	1.5	25.7	709	NA
Warner Elec. Brake & Clutch	154	1.2	11.7	9	8.6	4.6	15.6	3.0	48.9	1673	1.0
Westinghouse Electric	9368	10.0	11.0	438	12.9	230.0	23.7	2.5	52.5	1556	1.2
Woodhead (Daniel)	53	20.1	14.3	4	4.5	1.2	15.6	2.3	34.0	1570	3.1
Woodward Governor	156	16.1	17.3	12	16.2	6.8	33.4	4.4	54.4	2678	5.9
INDUSTRY COMPOSITE	51993	10.1	13.4	3045	11.5	1487.1	12.2	2.9	48.8	1862	2.4

ELECTRONICS

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
AVX	123	3.0	33.6	-3	NA	5.1	69.4	4.2	-175.4	1102	NA
Adams Russell	60	28.3	25.8	5	39.2	1.3	51.4	2.1	24.9	1157	NA
Altec	36	-12.3	1.7	-2	NA	0.7	16.2	1.9	-29.3	990	-8.1
American District Telegraph	427	13.7	14.3	24	8.5	7.8	28.3	1.8	33.3	817	3.3
Analog Devices	156	15.2	34.7	5	20.4	11.5	26.1	7.4	250.8	4209	21.7
Analogic	83	23.7	36.3	9	46.9	8.7	46.2	10.5	99.2	5819	NA
Andrew	114	27.6	24.4	10	28.5	5.1	9.2	4.5	52.0	2954	9.7
Avantek	82	40.5	42.5	10	61.6	7.2	64.5	8.8	76.0	4713	29.2
Aydin	100	-2.4	23.5	6	24.8	3.3	104.4	3.3	52.4	2072	NA
Barnes Engineering	57	29.8	50.7	0	49.0	0.9	105.7	1.6	346.3	814	NA
Burndy	257	1.2	14.4	33	27.5	9.4	1.5	3.7	28.7	2005	NA
CTS	210	11.5	7.8	13	1.7	4.4	29.6	2.1	33.9	650	-2.4
California Microwave	57	49.7	18.6	3	-13.4	0.9	-35.9	1.6	35.3	895	8.1
Communications Industries	52	21.7	21.5	8	32.3	0.7	76.5	1.4	9.3	774	NA
Conrac	115	-3.4	5.9	5	-4.9	9.3	7.0	8.1	197.9	5201	-6.0
Cordis	115	5.9	16.5	-8	NA	16.1	20.2	14.0	-194.9	6459	2.7

COMPANY	SALES			PROFITS		R&D EXPENSE					EMPLOYM'T
	1981 millions of dollars	Percent change from 1980	Percent annual change (1977-81)	1981 millions of dollars	Percent annual change (1977-81)	1981 millions of dollars	Percent change from 1980	Percent of sales	Percent of profits	Dollars per employee	Percent annual change (1977-81)
Cubic	228	16.2	16 8	11	11 9	1.8	90.9	0.8	16.6	482	NA
Dynascan	67	30.4	-6.7	3	28 2	2.5	16.2	3.8	83.4	4871	NA
EECO	36	-15 3	14.6	1	1.6	3.2	25.8	8.9	278.1	4544	NA
EG&G	704	13.9	16.9	34	26.1	10.5	1.0	1.5	30.8	583	NA
Edo	113	15 7	13 8	3	6 1	3.5	15.7	3.1	107.5	1907	NA
Electro Audio Dynamics	56	-29.1	1.2	-3	NA	0.9	-19.7	1.6	-28.6	783	NA
Electrospace Systems	46	35.8	43.8	3	48.5	0.8	23.7	1.8	28.5	878	33.1
General Instrument	825	14.9	16 2	68	43.0	14.3	45.9	1.7	21.0	542	2.9
Granger Associates	36	72.7	14.4	2	NA	1.3	-30.3	3.7	56.4	3190	-4.0
Gulton Industries	156	-0.5	10 6	2	-18 5	3.1	3.4	2.0	154.2	943	-1.9
Hazeltine	146	8.8	11.3	2	-11.3	7.1	12.5	4.9	380.8	NA	NA
Intermedics	159	50 9	50.6	16	52.4	9.3	92.9	5.9	57.5	4441	29.6
Johnson (E.F.)	60	39 1	2.6	3	32.2	3.9	34.1	6.6	126.3	2734	-5.8
King Radio	112	15.2	16.5	8	17.9	10.3	19.1	9.2	135.8	3429	8.8
Loral	213	17.8	18 8	21	27 6	6.4	11.3	3.0	31.0	1632	NA
M/A-Com	515	50.7	40 2	41	62.4	12.5	91.2	2.4	30.7	1548	15.8
Medtronic	314	16 0	20.8	42	33 8	25.2	32.0	8.0	60.2	5258	9.6
Methode Electronics	45	0 8	12 9	1	15 7	0.6	3.3	1.4	74.3	657	2.3
North American Philips	3030	39 5	18 4	79	11 8	52.1	56.9	1.7	66.3	1062	9.0
Nuclear Data	48	14.7	19.0	1	3 2	0.8	8.5	1.7	66.3	NA	NA
Oak Industries	507	31 5	36.6	30	109 8	16.6	78.8	3.3	54.7	1227	-14.7
Paradyne	135	78.4	72.1	18	117.5	11.7	84.3	8.6	66.8	4432	68.7
Penril	40	20.2	45.6	2	29 0	1.7	29.3	4.1	72.4	2267	NA
Pittway	399	29 4	11.2	34	2.9	3.3	24.2	0.8	9.6	575	NA
Quotron Systems	88	38.1	27 5	12	46 9	5.8	33.6	6.6	46.8	6693	14.0
RCA	8005	-0.1	8 4	54	-25.3	193.5	-1.7	2.4	358.3	1626	2.6
Raychem	525	13 6	32 8	36	32 6	45.8	43.6	8.7	128.7	5679	15.4
Raytheon	5636	12.7	14.7	324	23.0	166.1	28.2	2.9	51.3	2172	3.2
Regency Electronics	71	23.0	18 2	8	65 9	2.6	7.9	3.6	32.6	2226	NA
Sanders Associates	364	29.7	27 8	22	30.5	19.2	65.5	5.3	87.8	2677	15.8
Scientific-Atlanta	277	44.4	39.1	19	45 5	9.4	10.2	3.4	49.7	1808	NA
Sensormatic Electronics	51	28 6	39.5	10	56.0	1.0	48.2	1.9	9.7	1095	NA
Sierra Research	56	16.7	27.1	2	33.2	1.0	-4.8	1.7	59.9	993	16.6
Siliconix	60	-9 1	18.7	0	-43.0	6.4	-9.5	10.7	5044.1	3182	5.1
Soundesign	160	15 5	0.3	3	-20 8	1.3	66.4	0.8	40.7	2088	-17.2
Spang Industries	53	-0.5	9.3	6	19 3	0.7	27.3	1.3	12.1	NA	NA
Stewart-Warner	329	-2 2	2 5	15	-5.9	9.7	2.7	2.9	62.9	NA	NA
Telesciences	35	54 4	6.7	-1	NA	7.8	46.1	22.1	-965.6	11131	NA
Thermo Electron	210	20.3	34.5	8	44 6	3.6	32.6	1.7	43.6	1155	NA
Thomas & Betts	269	5.7	14 5	33	12 7	13.1	9.5	4.9	39.1	4213	5.1
United Industrial	202	22.2	16.7	11	18.0	2.4	30.9	1.2	21.9	564	NA
Varian Associates	638	15.2	21.5	2	-25.3	38.6	13.6	6.1	1781.0	3019	10.2
Varo	83	-11.6	3.8	7	-11.6	2.4	31.7	2.9	36.8	1540	-0.7
Veeco Instruments	111	5.5	24.3	10	19.8	5.3	27.0	4.8	51.9	2639	NA
Watkins-Johnson	132	-0 3	10 5	7	17.3	8.5	1.0	6.4	127.1	3344	-2.1
Wells-Gardner Electronics	79	176.8	69.3	6	NA	1.1	55.5	1.4	17.4	1732	15.3
INDUSTRY COMPOSITE	**27465**	**12.8**	**14.6**	**1132**	**13.2**	**841.3**	**21.4**	**3.1**	**74.3**	**1829**	**5.0**

FOOD & BEVERAGE

AZL Resources	111	-10.7	11.3	3	NA	1.5	13.7	1.3	44.6	NA	NA
Altair	49	-3.8	12.9	2	17.9	0.5	-24.1	1.1	27.2	1353	NA
American Crystal Sugar	384	19 0	18.1	182	25.7	2.3	33.6	0.6	1.3	757	NA
American Maize-Products	423	2.3	12 7	12	14.9	1.8	14.3	0.4	14.6	584	1.5
Amstar	1980	54.1	19.3	73	30.9	4.1	20.7	0.2	5.5	501	-1.2
Anderson Clayton	1930	13.3	10.0	51	13.4	5.3	4.2	0.3	10.2	295	NA
Archer-Daniels-Midland	3647	30.2	16.2	176	33.6	3.0	30.6	0.1	1.7	427	8.7
Borden	4415	-3.9	6.9	160	5.8	19.9	5.4	0.5	12.5	566	-1.9
CPC International	4343	5.4	11.3	218	13.7	38.5	7.8	0.9	17.6	1005	-2.2
Campbell Soup	2798	9.3	11.3	130	4.7	22.9	2.6	0.8	17.6	573	NA
Carnation	3354	3.6	10.0	172	11.9	14.1	18.5	0.4	8.2	644	NA
Central Soya	1975	12.9	8 2	20	11 6	7.7	10.0	0.4	38.7	783	2.9
Charles River Breeding Labs	39	12.3	17.8	5	27.0	0.6	6.0	1.5	11.6	548	11.1
Chatham	49	-3 8	12 9	1	33.9	0.5	-24.1	1.1	43.0	NA	NA
Coors (Adolph)	930	4.7	13.3	52	-3.5	16.8	18.2	1.8	32.4	1728	NA
Dart & Kraft	10211	8.5	10.9	348	8.0	88.9	61.6	0.9	25.6	1005	1.5
DeKalb AgResearch	652	26.5	18.1	44	NA	20.5	9.0	3.1	46.4	3306	NA
Esmark	3076	13 8	13.7	100	5.2	13.0	17.1	0.4	13.1	433	NA
Foremost-McKesson	4133	12.9	12.9	69	18.9	2.0	1.0	0.0	2.9	119	0.1
General Foods	6601	10.8	7.2	255	12.1	96.1	21.5	1.5	37.7	1814	2.8

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
General Mills	4852	16 4	14.6	197	15 2	45.4	2.3	0.9	23.1	637	NA
Hershey Foods	1451	8.7	23 3	80	22 2	5.4	18.8	0.4	6.7	430	15.0
Holly Sugar	327	58.5	10.9	15	NA	1.5	1.2	0.5	10.1	588	NA
Hormel (Geo. A.)	1434	8.5	6.0	27	10.5	2.8	18.9	0.2	10.1	355	NA
Intl. Multifoods	1088	7.5	9.0	28	7.4	1.6	-23.8	0.1	5.8	203	0.5
Kellogg	2321	7.9	11.3	205	11.0	14.8	44.6	0.6	7.1	721	0.0
McCormick	660	25.1	17.0	30	14.2	3.9	47.6	0.6	13.0	598	6.3
Nabisco	5819	4.2	9.1	266	11.9	29.2	23.2	0.5	11.0	483	-1.9
Pillsbury	3302	8.9	23 7	120	18.3	21.3	9.8	0.6	17.8	355	NA
Pioneer Hi-Bred International	478	17.8	17 6	63	20.6	14.7	17.6	3.1	23.1	6544	1 7
Quaker Oats	2600	8.1	14.9	105	12.2	27.1	17.8	1.0	25.8	877	2.7
Ralston Purina	5225	7.2	8.9	184	5.6	28.1	12.4	0.5	15.2	445	NA
Schlitz (Jos.) Brewing	882	-1.7	-1.4	-21	NA	1.6	0.0	0.2	-7.8	327	NA
Shaklee	455	10.5	17.9	25	0.7	6.2	24.0	1.4	25.3	4133	8.4
Staley (A.E.) Mfg.	2006	21.1	19.1	106	56.8	9.0	28.6	0.4	8.5	2125	0.3
U.S. Sugar	247	NA	NA	38	NA	1.7	40.0	0.7	4.6	220	16.2
Universal Foods	434	14.6	14.7	14	2.3	4.1	10.8	0.9	30.0	1134	8.8
INDUSTRY COMPOSITE	84682	10.3	11.6	3557	12.8	578.1	19.7	0.7	16.3	761	1.1
FUEL											
Agway	3828	44.0	24.6	21	15.3	2.5	10.0	0.1	12.0	NA	NA
Ashland Oil	9262	14.1	19.4	90	-12.9	20.8	46.7	0.2	23.1	605	0.5
Atlantic Richfield	27797	16.8	27 8	1671	27 8	172.6	24.8	0.6	10.3	3185	1.6
Cities Service	8546	14.8	21.7	286	23.0	29.7	98.0	0.3	10.4	1470	2.7
Exxon	108108	4.4	20 7	5567	26.7	630.0	28.8	0.6	11.3	3500	10.6
Farmland Industries	5518	16.3	17.1	7	NA	4.1	26.3	0.1	60.7	396	NA
Gulf Oil	28252	6.7	13.9	1231	17 4	191.0	42.5	0.7	15.5	3265	-0 1
Kerr-McGee	3826	10.0	18 0	211	18 0	9.7	10.2	0.3	4.6	866	0.0
Mobil	64488	7 6	21.0	2433	30.2	178.0	24.5	0.3	7.3	862	0.8
Occidental Petroleum	14708	17.9	28.1	722	117 2	72.8	14.6	0.5	10.1	1527	8.7
Phillips Petroleum	15966	19.4	28.6	879	15.1	118.0	40.5	0.7	13.4	3420	4.8
Shell Oil	21629	9 1	23.4	1701	25.2	194.0	25.2	0.9	11.4	5205	2.6
Standard Oil (Calif.)	44224	9.3	22.8	2380	28.9	182.9	38.0	0.4	7.7	4226	3.2
Standard Oil (Indiana)	29947	14.6	24 9	1922	20.0	150.0	38.9	0.5	7.8	2557	6 6
Standard Oil (Ohio)	13457	21 7	39.2	1947	84.8	53.8	119.6	0.4	2.8	949	20 1
Sun Co.	15012	16.0	25.1	1076	28.1	50.0	38.9	0.3	4.6	1110	NA
Texaco	57628	12.6	22.5	2310	33.3	155.0	30.3	0.3	6.7	2323	-1.3
Tosco	3431	43.7	35 7	23	22.9	9.2	47.4	0.3	40.8	2906	-1.2
Union Oil Co. of California	10746	7.6	19.7	791	25.2	37.0	46.2	0.3	4.7	1907	4.1
INDUSTRY COMPOSITE	486375	10.4	22.3	25269	28.3	2261.1	32.9	0.5	8.9	2287	4.2
INFORMATION PROCESSING: Computers											
Amdahl Corp	443	12 3	19.3	27	-9.9	75.1	20.3	17.0	280.7	14851	NA
Apple Computer	335	185.8	237.1	39	250.9	21.0	187.8	6.3	53.2	8533	NA
Burroughs	3318	16 1	11.5	149	-17.0	176.0	14.3	5.3	118.2	2631	6 0
Cado Systems	46	34.5	82.0	6	113.5	2.8	67.0	6.1	50.5	8226	NA
Computer Automation	76	-6.9	15.1	2	-23.1	7.2	-4.7	9.6	439.1	6305	9.6
Control Data	3101	12.1	20.5	170	29.2	201.9	10.4	6.5	118.9	3835	8.5
Cray Research	102	67.3	75.8	18	105.0	16.3	84.2	16.0	89.4	15060	52.9
Data General	737	12.7	30.6	41	10.7	74.6	13.6	10.1	182.7	5099	14.4
Data Terminal Systems	118	10.4	55 8	-3	NA	6.0	5.7	5.1	-203.6	3007	49.5
Digital Equipment	3198	35.1	31.1	343	33.2	251.2	34.8	7.9	73.2	3987	15.4
Docutel	77	44.6	30 7	7	61.1	2.5	116.3	3.3	36.4	4190	-0.5
Electronic Associates	47	7.3	15.6	1	137.4	2.2	20.8	4.6	221.7	2251	6.8
Evans & Sutherland Computer	46	33.9	55.0	9	84.5	3.9	86.7	8.4	41.1	6066	34.5
Floating Point Systems	58	36.5	32.8	6	43.9	8.8	92.0	15.3	139.2	8418	16.5
General Automation	125	-0.7	10.8	0	NA	4.8	-43.8	3.8	-1523.6	2578	NA
Hewlett-Packard	3578	15.5	28.4	312	27.9	347.0	27.6	9.7	111.2	5422	16.3
Honeywell	5351	8.7	16.7	256	19.1	368.8	24.8	6.9	143.9	3805	6.3
Intergraph	91	61.3	75.5	8	103.0	12.0	93.0	13.1	144.9	9394	NA
Intl. Business Machines	29070	10.9	12.3	3308	5.4	1612.0	6.1	5.5	48.7	4542	NA
Management Assistance	332	9.4	21.2	7	-12.4	15.2	42.0	4.6	223.2	2702	16.9
Modular Computer Systems	87	7.5	12.3	1	-23.2	8.6	26.2	9.9	744.4	5625	8 5
Mohawk Data Sciences	287	10.0	18.0	18	54.6	16.6	24.3	5.8	91.0	3140	NA
NCR	3433	3.3	10.9	208	14.6	229.2	14.0	6.7	110.1	3526	1.9
Prime Computer	365	36.3	65.3	38	80.6	27.5	35.0	7.5	73.0	5936	46.4
Sperry	5427	13.4	13.7	313	20.1	336.5	20.2	6.2	107.5	3638	1.8
Tandem Computers	208	91.2	124.6	27	227.1	17.8	103.0	8.6	67.2	6532	103.8
INDUSTRY COMPOSITE	60057	13.0	15.5	5311	9.4	3845.5	15.3	6.4	72.4	4231	7.6

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)

INFORMATION PROCESSING: Office equipment

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
AM International	653	-5.3	NA	-102	NA	16.4	33.5	2.5	-16.1	1232	NA
Barry Wright	145	16.4	22.9	13	36.0	2.7	21.1	1.9	21.3	1262	NA
Bell & Howell	701	9.6	15 0	17	5 2	35.5	17.0	5.1	205.0	3156	-3.6
CPT	101	71.0	68.0	13	75 8	4.2	110.5	4.1	33.2	4184	46.8
Diebold	386	11.2	20.1	29	55.4	4.4	14.0	1.1	15.0	680	4.8
Lanier Business Products	303	19.7	35.9	26	39.4	4.7	142.8	1.5	18.4	1163	21.5
NBI	58	76.5	127.8	7	436.0	2.4	95.9	4.1	33.1	2985	NA
Nashua	654	-2.6	12.8	9	-9.9	12.0	-27.2	1.8	128.1	1803	2.4
Pitney-Bowes	1414	12.4	25.4	70	17.4	31.1	4.1	2.2	44.8	1163	10.9
Savin	435	21.9	35.3	-2	NA	18.8	132.0	4.3	-851.7	3205	48.5
Standard Register	318	10.1	14.1	15	18 3	3.9	10.8	1.2	25.1	883	2.9
Wang Laboratories	856	57.6	60.2	78	73 3	66.9	82.4	7.8	85.7	4240	NA
Xerox	8691	6.0	14.3	598	8.4	526.3	20.8	6.1	88.0	4350	3.7
INDUSTRY COMPOSITE	**14716**	**9.3**	**17.9**	**771**	**13.2**	**729.2**	**24.8**	**5.0**	**94.6**	**3324**	**5.1**

INFORMATION PROCESSING: Peripherals, services

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
American Management	66	12.2	33 2	-1	NA	5.1	9.9	7.8	-685.3	NR	NA
Anderson Jacobson	50	19.7	24 1	2	16.4	5.9	51.6	11.8	335.3	6733	13.2
Applied Data Research	52	40.8	31.6	3	3.1	6.1	31.6	11.7	199.2	7626	NA
Applied Devices	36	-6 0	7.4	-5	NA	2.4	-1.3	6.7	-51.0	3131	NA
Applied Magnetics	74	0.7	16.5	6	24 8	3.4	29.4	4.6	56.3	1249	NA
Auto-Trol Technology	46	-8.8	41.2	-3	NA	8.0	29.9	17.2	-243.2	14761	NA
Automatic Data Processing	558	22.6	23.5	47	19.7	18.5	34.2	3.3	39.1	1294	NA
Beehive International	39	20.5	21.2	4	57.4	2.2	57.2	5.6	53.5	4902	NA
Bolt Beranek & Newman	55	17.4	20.9	1	NA	1.9	224.9	3.5	205.3	1490	16.4
Centronics Data Computer	121	-5 3	22 7	-25	NA	6.9	42.0	5.7	-28.1	3068	16.8
Computer & Commun. Technology	62	33.4	23 4	6	58.9	5.1	34.6	8.3	82.1	5099	NA
Computer Consoles	51	14.8	38.2	6	71.1	9.0	95.2	17.8	143.4	10677	22.5
Computervision	271	41.7	80.3	36	108.7	27.3	44.7	10.1	76.3	7181	NA
Comshare	83	17.0	53.9	4	30.9	6.2	29.4	7.5	158.2	5116	NA
Data Card	75	13.7	34.7	6	47.6	2.8	66.2	3.8	44.7	1735	12.6
Datapoint	396	24.3	40.1	49	53.8	34.7	24.7	8.8	71.2	5091	25.3
Dataproducts	270	49.8	21.7	17	-0.5	15.3	10.2	5.7	89.2	3132	10.4
Decision Data Computer	50	14.9	8.8	1	-6.5	1.5	24.2	3.1	113.0	1661	3.7
Dyatron	42	21.1	26.8	-4	NA	1.7	26.7	4.1	-45.2	3851	NA
Dysan	104	65.7	93 0	5	51.9	15.9	46.1	15.2	307.6	6102	NA
Electronic Memories & Magnetics	106	7.8	7.5	1	-17 4	7.6	24.4	7.1	509.3	2523	NA
General Binding	150	7.2	15 9	8	24.4	2.3	4.5	1.5	30.6	844	2.6
Informatics	150	19.4	18.6	5	68.5	6.7	13.7	4.4	130.6	2477	NA
Kroy	37	95.2	90.5	6	276.6	1.5	85.4	4.0	25.7	3074	NA
MSI Data	56	22 4	12.1	3	1.4	3.3	54.2	5.9	95.1	3738	NA
National Computer Sys.	50	17 1	18.6	3	8.7	2.6	31.6	5.1	90.4	NA	NA
National Data	76	25.8	22.7	8	32 6	0.9	-1.1	1.2	11.7	388	NA
New England Business Service	79	24.0	26.3	7	17.8	0.9	75.6	1.1	13.1	674	24.1
Onyx & IMI	41	182.8	NA	4	NA	3.2	239.0	7.8	89.8	9040	NA
Printronix	52	41.8	83.4	5	108 1	0.9	-29.1	1.8	19.9	1048	NA
Ramtek	35	40.1	43.7	2	7 2	3.5	16.7	10.0	213.4	8045	NA
Recognition Equipment	131	16.2	14 8	-8	NA	12.1	44.0	9.2	-148.4	5510	5.2
Reynolds & Reynolds	212	0.9	18.0	7	-7.0	4.8	71.9	2.2	66.9	1430	5.8
Scope	74	13.0	17.6	0	-42.6	3.5	20.7	4.8	1871.7	NA	NA
Shared Medical Systems	130	23 5	30.2	17	24.9	10.6	28.6	8.1	63.5	6708	NA
Storage Technology	922	52.8	51.8	82	56 5	53.7	36.7	5.8	65.2	3533	38.4
Sykes Datatronics	45	87.8	77.1	8	126.1	4.1	97.8	9.0	51.9	5731	72.2
System Industries	63	65 8	40.4	5	99 5	2.8	48.8	4.5	62.0	6188	16.3
Tab Products	89	7.2	16.6	3	17.1	1.5	204.0	1.6	44.0	1269	7.2
Tandon	54	137.9	154.1	5	173 8	2.9	199.0	5.3	63.7	1993	NA
Telex	178	13.6	11.5	8	5.0	9.1	2.3	5.1	112.8	2337	7.1
Triad Systems	78	38.7	84.0	9	81.1	5.3	41.8	6.8	61.4	4880	73.3
Tymshare	289	22.8	29.2	16	21.1	16.0	30.8	5.5	102.1	4052	NA
Verbatim	54	7.4	38.9	1	1.8	2.1	-4.6	3.9	207.5	1499	24.8
Wyly	147	24.5	21.4	6	31.3	2.3	-8.0	1.6	38.5	1314	NA
INDUSTRY COMPOSITE	**5800**	**26.8**	**29.3**	**365**	**35.7**	**344.1**	**34.2**	**5.9**	**94.2**	**3284**	**NA**

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
INSTRUMENTS: Measuring devices, controls											
Accuray	109	5.5	10.8	3	162.1	7.8	28.5	7.2	247.5	4253	-0.6
American Sterilizer	244	18.4	15.1	12	25.4	8.3	39.1	3.4	72.2	2256	2.3
Badger Meter	64	10.3	3.6	1	-25.6	1.7	6.8	2.6	147.6	1416	-1 9
Baird	45	21.2	15.6	1	21.0	3.0	66.3	6.7	250.8	4202	6.5
Bard (C.R.)	330	33.8	21.6	23	22.0	8.0	60.0	2.4	35.6	1304	NA
Bausch & Lomb	533	10.7	18.2	47	15.8	21.0	25.9	3.9	44.5	2061	-0.4
Bio-Rad Laboratories	50	9.2	31.4	2	22.7	3.4	12.0	6.7	166.7	4618	17.1
Bowmar Instrument	43	9.9	37.9	1	-2.6	1.4	110.0	3.3	243.9	1226	29.2
Cetec	57	1.2	12 8	1	18.4	1.4	15.2	2.5	124.8	2621	-9.8
Cobe Laboratories	97	4 6	20.9	6	20.3	8.8	4.9	9.0	150.9	5759	8.2
Coherent	69	13.4	30.9	2	8.8	4.9	17.5	7.0	298.6	4198	22.1
Compugraphic	278	0.3	21.5	-7	NA	13.2	-11.8	4.7	-198.0	3043	11.7
Computer Products	35	17.3	27.9	3	29.6	2.4	35.7	6.9	79.5	3241	NA
Dentsply International	200	-0.6	7.4	11	21.0	4.3	-6.0	2.1	39.6	NA	NA
Dickey-John	40	14 3	13.8	2	37.5	1.7	-0.1	4.4	109.0	2081	NA
Dynatech	52	24.7	32 0	4	31.7	3.7	48.5	7.1	102.3	3695	NA
Esterline	234	-4.0	17.7	20	62.1	9.8	25.6	4.2	49.8	2685	NA
Finnigan	63	46 0	27.6	0	-20.0	6.1	113.6	9.7	1692.5	5450	23.8
Fischer & Porter	191	3 2	9.9	1	-31,2	10.1	-2.9	5.3	749.4	2577	-3.6
Fluke (John) Mfg.	140	4.3	23.3	8	17 5	14.7	18.8	10.6	173.8	5504	NA
Foxboro	607	19 2	13 3	45	7.3	36.9	27.0	6.1	82.3	3076	5 0
Gelman Sciences	38	-11.7	18.8	6	39.6	2.1	17.2	5.6	36.0	3275	6.2
General Signal	1702	11.9	18.1	117	25.4	63.6	24.7	3.7	54.3	2392	NA
Genrad	169	7.4	26 1	3	2.1	21.3	50.0	12.6	725.3	7888	14.4
Gerber Scientific	93	25.1	49.3	9	74.7	6.7	25.7	7.2	75.3	5143	32.4
Health-Chem	72	7.6	8.0	3	11 3	1.1	44.6	1.5	39.6	NA	NA
Instron	58	-0.7	19.4	1	4.7	3.9	13.6	6.7	355.9	4002	7.5
Instrumentation Laboratory	123	23.7	24.5	5	14.7	11.4	15.2	9.3	216.5	4565	14.8
Itek	312	5.6	22.5	6	22.9	12.6	10.1	4.0	208.9	2673	11 7
Johnson Controls	1128	16.9	31.4	48	14.2	16.0	21.9	1.4	33.2	799	NA
Kratos	50	-8.4	23.9	3	23.3	3.6	-13.8	7.2	115.3	3876	NA
LFE	79	-3.8	8.2	1	-6.8	1.5	54.4	1.9	159.2	914	NA
Liebert	106	46.4	49.3	5	45.1	1.6	34.5	1.5	29.3	1579	NA
MTS Systems	65	-3.4	20.1	4	6.5	3.0	-3.8	4.7	85.3	3551	7.7
Mark Controls	274	4.1	25.7	5	-1.1	4.7	-2.7	1.7	94.9	947	2.8
Mark Products	69	63.9	55.9	10	70.1	1.1	163.9	1.6	11.7	1130	32.3
Measurex	120	-1.9	17.0	2	-18.5	7.3	15.6	6.1	347.5	3329	10.0
Millipore	254	9 0	21.0	10	-5.4	17.2	7.0	6.8	174.4	4462	NA
Mine Safety Appliances	324	6.1	12.1	21	12.6	7.5	7.5	2.3	36.5	1193	0.3
Moog	155	14.7	20.3	10	38.0	6.8	34.3	4.4	66.4	2326	8.9
Moore Products	65	13.0	19.2	6	12.9	3.2	20.7	4.9	52.6	NA	NA
Narco Scientific	72	3.3	15.6	2	-3.4	1.7	-1.1	2.4	69.9	1686	3.4
National Patent Development	78	6.8	13.4	0	NA	4.0	55.6	5.2	1002.8	2884	NA
Nicolet Instrument	77	37.8	46.4	5	43.3	6.6	50.1	8.5	137.2	6777	33.1
Optical Coating Laboratory	53	14.2	20.6	1	-3.4	4.0	9.3	7.5	367.8	3351	7.3
Perkin-Elmer	1116	12 0	26.5	78	32.8	71.0	14.5	6.4	90.9	4610	9 2
Puritan-Bennett	113	12.4	17.9	7	2 9	5.9	70.2	5.2	89.8	2828	9.2
Ranco	179	0 0	9.5	2	-29 0	2.3	-4.9	1.3	116.4	404	0.5
Robertshaw Controls	352	0.7	7.0	8	-4.0	7.4	8.9	2.1	94.1	850	-4.7
Sargent-Welch Scientific	82	-2.0	8.5	5	5.9	1.1	4.1	1.4	20.9	1186	NA
Simmonds Precision Products	139	5.0	21.6	10	34 2	3.4	-4.5	2.4	34.7	1125	NA
Spectra-Physics	136	-2.8	30.3	3	-3.0	11.9	14.8	8.8	474.4	5678	NA
Stryker	43	18.7	17 5	4	27.0	1.6	39.3	3.6	40.2	2843	12.5
Sun Electric	177	-9.0	13 4	-1	NA	5.5	-19.3	3.1	-740.3	1618	-0 6
Sybron	647	0.4	9.1	25	0.2	21.9	2.2	3.4	89.0	1513	NA
Talley Industries	377	-4 9	0 8	-4	NA	4.6	7.1	1.2	-106.8	707	NA
Tektronix	1062	9.3	24.3	80	17.4	91.1	17.2	8.6	113.7	3793	12.9
Teradyne	160	-3.0	25.9	4	2.7	20.3	22.1	12.7	476.6	6668	19.2
U.S. Surgical	112	29 7	43.0	12	47.1	1.3	-55.7	1.2	11.3	768	27.7
Vishay Intertechnology	37	0.9	18.0	2	6.2	0.8	-5.8	2.1	49.6	769	0.5
Visual Graphics	39	21.6	23.6	1	8.4	0.6	-20.0	1.5	51.2	993	9.4
Wavetek	45	17.1	22.3	2	11 8	4.9	16.3	10.9	238.8	4702	11.8
Western Pacific Industries	220	-11.6	18.3	30	28.4	5.6	-3.0	2.6	18.7	1407	NA
Whitehall	54	18.3	16.7	5	35.2	1.0	291.5	1.9	20.7	696	0.9
INDUSTRY COMPOSITE	**14106**	**8.8**	**18.6**	**740**	**17.4**	**647.5**	**17.6**	**4.6**	**87.5**	**2571**	**6.3**

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
LEISURE TIME											
AMF	1272	5.0	7.6	67	16 6	24.2	17.0	1.9	35.9	1133	NA
Anthony Industries	226	17 3	28 3	3	-4 0	1.1	NR	0.5	33.2	407	NA
Bally Mfg.	866	27.0	39.8	82	NA	4.4	37.5	0.5	5.4	461	NA
Brunswick	1085	13 6	6.0	43	-10.2	25.5	15.7	2.4	60.0	1204	NA
Coachmen Industries	206	64.0	-15.6	2	NA	1.5	25.6	0.7	75.5	592	NA
Coleco Industries	178	9.3	9.9	8	57.4	5.6	31.5	3.1	72.2	1856	-6.9
Coleman	359	19 5	7 5	20	3.3	4.9	40.5	1.4	24.4	1144	-2.7
Eastman Kodak	10337	6.2	15 3	1239	16 8	615.0	18.3	6.0	49.6	4509	2.4
Fleetwood Enterprises	428	-9 4	-8 8	2	-37.6	4.8	-13.9	1.1	195.9	759	-14.2
Golden Nugget	239	327.7	54.3	31	95.7	2.2	NM	0.9	7.2	590	NA
Hasbro Industries	105	5.0	11 5	4	45.5	2.9	22.6	2.7	64.9	NA	NA
Huffy	232	-2 3	15 9	6	12 4	1.9	22.6	0 8	30.6	606	4.0
Ideal Toy	217	53.3	12 5	12	NA	7.4	-8.3	3.4	60.0	NA	NA
Kimball International	248	15.5	12.7	15	10.0	2.5	75.8	1.0	16.3	473	2.1
Leisure Dynamics	46	-1 8	-2.6	-2	NA	0.9	-3.3	1.9	-42.4	NA	NA
Mattel	1134	23.9	28.8	39	0.6	24.6	8.4	2.2	62.9	NA	NA
Mego International	67	-36 4	3.1	-27	NA	1.2	-53.7	1.8	-4.5	570	NA
Milton Bradley	381	-9.3	19 6	20	15 5	14.6	5.4	3.8	73.1	2867	8.9
Norlin	221	2.0	1 7	-10	NA	2.1	-4.5	1.0	-21.2	583	-10.5
Outboard Marine	796	15.7	4.5	27	-22 8	23.4	-4.7	2.9	86.7	2250	-9.1
Polaroid	1420	-2 2	6.5	31	-22.1	121.4	6.5	8.6	390.4	7233	-1.3
Tonka	105	4 0	13.7	7	NA	1.8	18.2	1.7	26.0	868	NA
Wurlitzer	85	-10.9	0.2	-6	NA	2.4	-11.6	2.8	-39.1	1036	-7.6
INDUSTRY COMPOSITE	**20253**	**8.7**	**12.5**	**1615**	**12.7**	**896.1**	**14.6**	**4.4**	**55.5**	**3288**	**NA**
MACHINERY: Farm, Construction											
Allis-Chalmers	2042	-1.1	7.5	-29	NA	65.1	31.8	3.2	-225.7	2431	-0.2
American Hoist & Derrick	574	6 6	11 6	20	9 4	4.2	29.0	0.7	20.6	591	0.5
Barber-Greene	227	.0 4	9 6	3	-15.3	2.7	-8.6	1.2	86.9	889	-5.3
Bucyrus-Erie	496	-2.9	-2.1	38	-8.1	20.0	4.7	4.0	53.1	2970	-0.6
CMI	167	46 0	22 4	5	9 9	3.1	37.1	1.8	67.5	1475	NA
Caterpillar Tractor	9155	6 5	11 3	579	5.4	226.6	13.2	2.5	39.1	2637	1.5
Deere	5447	-0.4	11.6	251	-1 8	240.0	3.8	4.4	95.6	3943	1.1
Dover	1026	22.8	25.7	96	26 7	8.6	43.3	0.8	8.9	637	12.0
Dynamics Corp. of America	153	5.0	5.4	6	13 1	1.2	4.3	0.8	21.1	549	2.6
FMC	3367	5.0	12 0	177	8.6	105.8	12.6	3.1	59.9	2717	0.4
Harnischfeger	654	1 8	9.8	29	-7 1	17.9	25.0	2.7	61.7	2598	-4.1
Hesston	280	16 0	18.9	-5	NA	4.4	21.5	1.6	-91.0	1419	0.1
Penn Virginia	65	34.9	18.8	3	-17.2	0.9	-31.6	1.4	27.4	1379	NA
Portec	221	-11 8	14.1	8	14.4	2.9	7.4	1.3	36.7	1179	NA
Roper	428	1 9	3.2	6	-23.6	8.8	-6.0	2.1	139.2	1512	NA
Steiger Tractor	148	22 4	13 8	6	NA	2.9	52.6	2.0	46.9	3651	-3.5
Toro	247	-38.2	16 5	-13	NA	9.0	-1.9	3.6	-71.1	3378	9.1
Valmont Industries	216	41.5	23.0	10	37.8	3.0	50.0	1.4	29.6	1630	15.4
INDUSTRY COMPOSITE	**24912**	**3.9**	**11.8**	**1191**	**4.6**	**726.9**	**11.2**	**2.9**	**61.1**	**2679**	**1.8**
MACHINERY: Machine tools, industrial, mining											
Acme-Cleveland	401	-1.1	16 8	11	20 7	3.6	-2.3	0.9	32.6	624	1.8
Applied Power	169	-9 9	3.7	5	-2.9	2.1	32.6	1.2	40.6	998	-9.8
ARO	94	10.3	10 8	6	0.5	1.3	17.7	1.4	21.4	690	1.0
Briggs & Stratton	569	-19.7	12.8	25	-2.9	4.8	-9.0	0.8	19.0	583	2.6
Brown & Sharpe Mfg.	205	-9.7	18.5	6	23.3	6.7	47.2	3.2	110.2	1551	5.7
Chemineer	39	-5 4	12 4	3	17 7	0.6	38.5	1.5	21.9	1325	-7.2
Chicago Pneumatic Tool	478	0.9	12.2	6	-9.5	6.5	13.9	1.4	113.6	889	-7.9
Cincinnati Milacron	934	14.5	17.2	61	33.8	31.0	35.4	3.3	51.0	2279	1.2
Clark Equipment	1360	-11.3	1.0	30	-17.1	25.6	-5.1	1.9	85.4	1610	-7.6
Combustion Engineering	3810	21.1	16.7	147	21.5	47.3	18.4	1.2	32.1	1014	1.0
Cooper Industries	2861	22.7	32.0	241	37.3	23.5	8.9	0.8	9.8	600	13.0
Cross & Trecker	409	15.1	24.0	41	42.6	4.5	6.6	1.1	11.0	980	7.5
Duriron	145	3.5	11.4	10	16.4	2.9	20.0	2.0	28.8	1253	0.6
Ex-Cell-O	1125	10.2	24.4	57	17.2	20.9	38.4	1.9	36.8	1284	12.5
Fansteel	227	-9.6	22.1	13	33.2	2.5	1.6	1.1	19.8	1018	1.1
Farr	52	-10.7	9.9	1	-12.2	1.7	-4.9	3.3	280.8	2039	-2.0

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Giddings & Lewis	393	7.4	23.0	35	44.1	2.0	2.7	0.5	5.8	457	6.1
Gleason Works	240	-1.1	12.4	9	-5.0	6.0	42.7	2.5	67.8	1283	NA
Goulds Pumps	309	19.2	12.3	26	9.9	3.3	33.7	1.1	12.7	838	4.2
Graco	130	11.0	11.9	7	-6.0	5.4	13.2	4.1	73.7	3085	2.8
Hurco Manufacturing	44	55.2	67.4	2	17.8	1.6	24.9	3.6	73.3	3626	40.0
Hyster	584	-7.3	6.4	34	-0.1	10.6	11.6	1.8	31.1	1581	-3.4
IMC Magnetics	52	3.6	14.9	2	13.8	1.6	37.3	3.2	66.3	1193	NA
Ingersoll-Rand	3378	13.7	12.5	193	12.5	128.6	15.0	3.8	66.5	2715	-0.2
Ionics	54	20.7	16.3	2	5.0	2.3	8.1	4.3	114.5	3817	5.1
JLG Industries	64	5.5	27.3	3	10.6	1.7	18.1	2.6	64.0	1756	19.5
Kulicke & Soffa Industries	40	-19.6	35.1	2	29.0	7.6	33.3	18.9	306.6	7179	28.9
Lodge & Shipley	52	19.0	20.7	2	39.2	0.6	21.2	1.1	25.4	NA	NA
Manitowoc	297	7.1	7.0	30	7.3	1.6	39.8	0.6	6.1	461	-3.2
Materials Research	72	-0.5	42.4	2	35.4	3.5	44.7	4.9	150.0	4875	NA
McNeil	222	-0.1	9.9	6	6.5	1.5	23.7	0.7	26.4	365	NA
Mechanical Technology	51	15.9	25.4	3	33.1	1.2	-9.7	2.4	36.2	1527	NA
Midland-Ross	907	-0.1	19.3	25	3.3	8.9	-1.1	1.0	36.2	643	7.1
Milton Roy	63	13.7	15.3	4	8.9	2.8	23.3	4.5	69.4	3141	2.6
Murray Ohio Mfg.	332	12.7	11.0	9	2.8	4.5	9.8	1.4	49.5	1273	2.2
Nordson	159	6.8	31.2	10	9.9	9.6	36.7	6.1	98.5	3858	25.8
Oilgear	39	8.0	18.6	3	18.9	1.2	-5.0	2.9	41.7	1606	7.7
Pacific Scientific	74	18.4	30.9	8	29.3	2.3	32.8	3.1	27.5	2625	19.5
Package Machinery	58	1.2	5.4	1	-34.7	0.8	-1.9	1.4	160.3	948	1.8
Pall	169	20.1	26.1	25	32.4	6.2	11.2	3.7	25.1	1946	16.9
Paxall	49	-0.8	34.3	-2	NA	0.6	-0.4	1.1	-27.0	729	NA
Peabody International	424	9.5	9.2	3	-22.1	1.1	15.8	0.3	31.7	204	NA
Raymond	93	-18.1	13.2	6	10.4	3.0	-27.1	3.2	50.2	2312	-2.5
Research-Cottrell	465	22.6	19.2	12	5.1	2.9	8.7	0.6	25.0	935	7.1
Rexnord	1130	4.3	10.8	39	-5.6	15.2	18.6	1.3	39.4	902	0.8
Robbins & Myers	250	28.9	30.9	13	31.7	2.3	52.9	0.9	17.1	522	17.0
Selas Corp. of America	63	2.8	5.1	-4	NA	0.8	-5.1	1.3	-21.5	1476	0.5
Standun	47	45.4	36.0	2	307.4	0.9	31.5	1.8	47.8	1572	16.4
Sullair	179	15.9	24.1	3	-9.6	9.9	85.1	5.5	333.6	5811	NA
Sundstrand	1046	12.9	12.2	95	26.4	26.9	-7.4	2.6	28.4	1674	2.3
Timken	1427	6.6	10.0	101	6.8	16.2	18.6	1.1	16.0	773	-2.4
Torin	93	-8.1	6.8	2	-5.7	2.8	0.0	3.0	146.4	1692	-4.1
Twin Disc	210	0.6	16.4	9	3.6	4.0	-11.5	1.9	47.0	1388	1.3
Unimation	55	52.1	30.6	2	16.4	2.2	4.5	4.0	113.1	2670	NA
Union Special	103	-14.3	3.9	0	-54.5	4.6	-0.6	4.5	2816.5	1848	NA
INDUSTRY COMPOSITE	**26293**	**8.9**	**15.1**	**1387**	**13.6**	**494.5**	**14.8**	**1.9**	**35.7**	**1370**	**3.1**

METALS & MINING

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Aluminum Co. of America	4978	-3.1	10.6	296	13.2	83.9	15.2	1.7	28.3	1890	-0.4
AMAX	2799	-5.1	22.6	231	43.1	30.5	15.1	1.1	13.2	1531	7.4
ASARCO	1532	-15.7	12.7	50	-1.4	6.5	7.4	0.4	13.0	522	-0.6
BIW Cable Systems	43	19.4	18.3	2	52.7	1.4	39.4	3.3	60.8	2252	NA
Brush Wellman	199	5.5	19.5	19	24.7	3.9	-4.3	2.0	20.5	1691	7.3
Cabot	1623	15.6	37.1	110	40.7	26.6	16.0	1.6	24.1	3455	6.2
Gulf Resources & Chemical	361	9.0	17.9	13	-9.5	3.7	33.0	1.0	29.4	1315	4.7
Harsco	1158	8.9	14.1	62	8.1	2.2	1.5	0.2	3.6	142	2.8
Kaiser Aluminum & Chemicals	3226	-7.5	9.7	133	9.1	20.2	11.6	0.6	15.2	770	-2.3
Kennametal	380	16.5	23.3	34	22.7	10.3	43.3	2.7	30.5	1491	14.8
Phelps Dodge	1439	-0.1	12.4	59	44.6	10.3	21.2	0.7	17.6	704	1.2
Porter (H.K.)	631	-3.7	7.6	8	-8.3	4.2	12.1	0.7	50.6	NA	NA
Revere Copper & Brass	821	9.7	7.8	9	-1.4	2.7	79.6	0.3	28.5	410	NA
Reynolds Metals	3481	-4.7	11.0	87	4.5	30.7	-3.2	0.9	35.4	1000	-0.5
Times Fiber Communications	120	19.6	49.8	7	69.6	4.9	27.7	4.1	70.4	4848	28.5
Triangle Industries	314	7.8	10.4	3	8.9	3.0	5.7	1.0	103.1	1199	NA
INDUSTRY COMPOSITE	**23104**	**-2.2**	**13.7**	**1122**	**22.1**	**245.1**	**13.6**	**1.1**	**21.8**	**1239**	**3.1**

MISCELLANEOUS MANUFACTURING

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
ACF Industries	939	-9.9	8.4	48	7.0	8.2	25.4	0.9	17.3	672	-5.7
Acme General	52	16.7	11.8	1	-36.2	0.9	4.5	1.7	122.1	1679	NA
Albany International	376	2.9	10.3	28	14.9	10.7	-5.4	2.8	38.2	1678	0.1
Allegheny International	1908	106.6	39.6	83	53.7	23.1	187.6	1.2	28.0	438	NA
Amerace	320	1.4	4.1	10	-1.4	8.6	6.6	2.7	84.6	1668	NA
American Filtrona	94	1.8	20.3	6	14.2	1.1	NA	1.2	17.7	1087	NA
American Seating	100	8.3	15.1	3	42.5	1.5	13.9	1.5	54.2	1073	NA
American Standard	2471	-7.6	9.2	111	6.9	24.0	-11.1	1.0	21.5	562	-1.9

COMPANY	SALES			PROFITS		R&D EXPENSE					EMPLOYM'T
	1981 millions of dollars	Percent change from 1980	Percent annual change (1977-81)	1981 millions of dollars	Percent annual change (1977-81)	1981 millions of dollars	Percent change from 1980	Percent of sales	Percent of profits	Dollars per employee	Percent annual change (1977-81)
Anderson Greenwood	54	12.4	18.6	6	32.6	1.2	-20.0	2.3	21.9	1698	NA
Application Engineering	42	3.5	15.4	1	-6.7	0.7	44.6	1.6	67.0	1029	14.2
Applied Materials	77	11.9	38.8	2	41.6	11.2	38.2	14.4	583.9	9723	26.2
Armstrong World Industries	1376	4.0	5.4	47	0.8	42.0	12.3	3.1	89.2	1894	-1.4
Automatic Switch	162	9.5	15.1	20	17.7	8.1	11.0	5.0	40.0	4500	NA
Avery International	638	3.1	NA	27	NA	11.8	8.9	1.8	44.3	1511	2.2
Barnes Group	463	6.8	11.9	5	-13.9	1.3	26.5	0.3	25.5	173	1.0
Black & Decker Mfg.	1431	-0.5	16.6	66	8.2	30.5	13.7	2.1	46.4	1612	3.1
Borg-Warner	2761	3.3	7.8	172	10.6	66.5	4.1	2.4	38.6	1181	9.4
Braun Engineering	56	26.2	1.6	-1	NA	2.9	31.8	5.2	-446.8	7250	-0.4
Butler Mfg.	433	9.7	3.5	13	-9.2	3.4	20.4	0.8	25.7	794	-2.6
Centuri	61	948.5	78.8	4	NA	1.1	28.7	1.8	26.7	4448	NA
Chromalloy American	1073	9.1	13.3	44	16.1	4.2	-2.2	0.4	9.7	232	NA
Commercial Shearing	232	-0.6	9.3	13	2.9	3.6	30.9	1.5	27.2	1200	-2.6
Compudyne	84	9.3	19.4	2	40.5	1.6	35.3	2.0	102.8	1037	NA
Condec	327	19.1	9.8	2	-30.0	5.2	6.7	1.6	233.9	1033	-0.2
Conwed	101	-5.6	7.9	1	-23.0	2.9	10.0	2.8	425.4	1682	NA
Corning Glass Works	1599	4.5	9.6	97	2.1	91.3	16.0	5.7	93.7	3054	-0.5
Crane	1611	5.5	9.7	54	-2.2	10.8	4.9	0.7	20.1	697	NA
Data Packaging	37	-0.5	11.7	0	-3.5	0.8	37.9	2.2	519.9	885	3.6
Dayco	787	9.8	7.5	9	-14.1	15.6	13.3	2.0	172.9	1489	-3.6
Dennison Mfg.	570	15.7	11.9	30	10.9	10.5	19.2	1.9	35.1	1172	2.4
Dual-Lite	41	10.3	21.7	0	NA	0.8	-23.1	1.9	-163.5	1245	NA
Eldon Industries	50	8.3	14.5	3	5.2	0.8	35.5	1.6	31.5	1147	-1.9
Emhart	1747	-3.1	11.0	76	5.6	32.5	-0.3	1.9	43.0	1005	0.2
Fedders	157	13.7	14.8	-5	NA	2.6	4.0	1.7	-48.2	1048	NA
GCA	218	14.4	42.0	22	81.4	18.9	66.3	8.6	86.2	NA	NA
General Refractories	410	-12.3	5.6	-19	NA	6.3	-16.0	1.5	-33.4	1055	-6.8
Hexcel	150	2.8	20.0	1	-22.9	5.3	17.8	3.5	853.5	2524	5.4
Hi-Shear Industries	90	12.5	32.7	10	45.0	1.8	16.0	2.0	17.9	1264	NA
Hillenbrand Industries	368	12.6	23.9	29	20.8	2.4	33.1	0.6	8.3	415	11.8
Hon Industries	281	39.0	15.6	19	11.9	1.7	45.0	0.6	8.9	384	9.2
Illinois Tool Works	456	13.4	10.9	44	13.1	7.0	15.0	1.5	15.7	966	-0.4
International Game Technology	62	55.7	114.8	14	168.5	2.4	65.8	3.9	17.1	4600	NA
Jamesbury	112	15.1	18.4	7	8.5	3.0	5.4	2.7	42.3	2080	10.9
Keystone International	149	13.7	27.2	21	27.6	1.3	13.7	0.9	6.3	828	9.6
Kroehler Mfg.	42	-7.9	-31.1	-9	NA	0.8	6.0	2.0	-9.0	705	-33.2
La-Z-Boy Chair	156	-1.6	5.7	10	-1.5	1.2	26.2	0.8	12.8	357	-0.5
Leggett & Platt	263	14.6	13.6	12	12.0	2.0	33.3	0.8	16.7	377	4.0
Libbey-Owens-Ford	1227	5.7	5.1	12	-33.2	24.4	5.9	2.0	206.4	1404	-4.9
Liqui-Box	42	-3.1	13.1	2	15.3	0.6	44.9	1.5	40.6	1500	-0.5
Lydall	107	9.3	15.2	4	1.1	3.0	-12.6	2.8	75.8	1733	5.5
McQuay-Perfex	238	6.8	7.1	10	8.1	1.3	-21.0	0.6	13.9	374	-4.9
Miller (Herman)	253	9.7	34.0	14	37.9	7.0	21.0	2.8	50.3	2125	17.5
Minnesota Mining & Mfg.	6508	7.0	13.3	673	12.5	306.0	8.1	4.7	45.5	3347	2.6
Mite	63	-4.4	12.5	6	15.7	0.9	13.3	1.3	13.5	796	2.6
Mohasco	640	-14.1	0.0	15	7.5	6.2	-6.4	1.0	40.7	487	-6.5
Monogram Industries	263	-3.4	8.8	13	10.5	1.2	19.0	0.5	9.4	311	NA
National-Standard	309	-1.2	3.7	1	-42.5	3.5	2.6	1.1	314.0	925	-7.1
Nibco	201	6.9	10.0	9	9.7	1.3	36.8	0.6	14.6	413	-1.0
Norton	1335	4.1	12.7	95	22.2	21.1	10.7	1.6	22.2	865	1.9
Omark Industries	280	11.5	19.9	23	25.6	5.9	8.8	2.1	25.6	1280	9.4
Overhead Door	254	8.1	8.6	3	-29.1	2.1	NR	0.8	68.5	568	3.1
PPG Industries	3354	6.2	7.3	211	23.7	118.5	15.6	3.5	56.1	3238	0.0
Pantasote	150	0.8	5.6	0	NA	2.3	0.0	1.5	-3650.8	1438	-12.4
Parker-Hannifin	1106	8.2	16.3	64	16.7	14.0	11.1	1.3	21.9	1630	6.1
Parker Pen	723	8.9	22.2	38	29.0	3.2	13.6	0.4	8.6	464	4.0
Penn Central	3349	66.3	63.1	169	44.3	13.9	826.7	0.4	8.2	NA	NA
Premier Industrial	317	-0.1	17.1	32	27.4	1.9	0.0	0.6	5.9	613	6.9
Raymond Industries	47	6.2	13.3	3	30.0	0.5	7.5	1.0	15.0	570	-1.6
Robertson (H.H.)	644	12.8	18.9	28	34.8	4.1	8.9	0.6	14.7	518	3.4
Rogers	103	16.9	13.3	3	-7.2	4.0	19.4	3.8	150.5	1600	9.7
Rubbermaid	357	15.6	16.3	26	10.4	4.3	16.7	1.2	16.8	1221	2.5
SPS Technologies	319	-6.5	19.2	22	31.7	4.2	8.2	1.3	19.0	738	5.0
Scovill	818	3.1	9.9	30	1.1	9.1	15.2	1.1	30.3	519	NA
Sealed Air	97	9.4	23.5	8	29.9	2.3	27.3	2.4	30.1	2728	10.2
Sega Enterprises	151	7.9	57.7	9	130.8	2.9	74.5	1.9	31.4	1568	NA
Signode	700	0.7	7.3	30	-0.6	8.5	2.8	1.2	27.8	1262	NA

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Snap-On Tools	442	9.9	14.6	40	14.4	5.6	15.1	1.3	13.9	911	4.1
Stanadyne	439	11.9	9.8	25	8.1	5.1	10.2	1.2	20.3	826	-1.0
Stanley Works	1009	7.4	11.0	55	10.1	5.9	3.5	0.6	10.7	336	1.3
Starrett (L.S.)	122	11.0	17.1	14	24.5	1.1	17.8	0.9	8.3	454	5.5
Tecumseh Products	816	8.3	4.4	59	6.5	7.1	1.4	0.9	12.0	964	-8.4
Tennant	109	9.2	12.0	10	9.8	5.9	38.4	5.4	61.8	3654	4.3
Tokheim	133	-1.4	18.4	9	14.3	3.9	14.1	2.9	45.0	2011	6.2
Trane	807	5.6	15.3	37	12.6	15.6	19.3	1.9	41.9	1458	-0.2
Tyco Laboratories	361	12.7	25.1	23	37.3	1.6	18.2	0.4	6.9	287	11.7
UMC Industries	336	[illegible]	13.4	9	-3.3	2.5	6.7	0.8	28.7	436	NA
Vermont American	204	[illegible]	10.8	13	5.2	2.9	33.5	1.4	22.9	803	1.7
Vulcan Materials	783	3.9	10.5	78	18.2	5.1	58.1	0.7	6.6	866	0.7
Welbilt	49	22.9	21.8	2	33.6	0.7	NA	1.5	33.4	1384	4.5
West	171	15.3	14.7	14	20.2	4.1	14.0	2.4	29.7	1173	NA
Wheelabrator-Frye	1548	32.8	25.0	90	30.1	19.9	82.9	1.3	22.0	993	NA
Williams Electronics	148	85.5	49.0	18	167.1	2.1	94.0	1.4	11.4	2507	NA
Wyman-Gordon	610	10.9	20.9	57	23.6	3.5	0.7	0.6	6.1	797	-0.1
INDUSTRY COMPOSITE	57028	9.6	13.1	3240	13.0	1166.9	14.2	2.0	36.0	1395	1.8
OIL SERVICE & SUPPLY											
Baker International	2140	38.3	31.4	225	37.9	29.1	33.4	1.4	12.9	1135	16.6
CBI Industries	920	34.8	11.8	84	11.9	5.3	11.2	0.6	6.2	398	6.7
Cameron Iron Works	929	33.2	21.3	110	35.8	15.0	76.5	1.6	13.6	1337	7.7
Crutcher Resources	256	41.3	29.0	25	40.7	1.1	19.9	0.4	4.4	306	17.1
Digicon	108	101.2	44.1	5	199.4	4.1	185.7	3.8	76.0	2029	33.6
Dreco Energy Services	243	223.4	141.8	12	141.8	1.8	NA	0.8	14.7	789	NA
Dresser Industries	4615	14.9	15.8	317	14.1	69.8	19.7	1.5	22.0	1225	1.0
Gearhart Industries	345	44.1	44.8	32	34.8	12.5	136.8	3.6	39.3	2165	NA
Geosource	729	35.6	29.1	59	33.5	17.6	40.6	2.4	30.0	1831	12.6
Halliburton	8435	20.0	17.5	674	16.3	75.3	17.6	0.9	11.2	689	4.9
Hughes Tool	1759	45.8	37.1	255	50.2	25.3	34.9	1.4	9.9	1309	NA
McDermott	3600	9.7	36.2	107	-16.1	42.3	34.7	1.2	39.6	717	24.8
NL Industries	2464	36.0	23.5	310	50.2	36.8	33.8	1.5	11.9	1586	NA
Pengo Industries	182	100.5	NA	16	NA	3.5	133.6	1.9	22.4	958	NA
Schlumberger	5783	18.4	29.6	1266	34.8	240.3	27.7	4.2	19.0	2827	NA
Seiscom Delta	106	68.7	33.8	7	65.6	1.4	24.8	1.3	19.2	365	0.6
Smith International	1194	52.3	34.7	133	33.0	28.4	73.8	2.4	21.3	2211	22.4
Varco International	192	77.3	61.5	22	83.1	6.7	103.5	3.5	29.8	4044	31.2
Weatherford International	230	27.6	29.1	24	50.9	1.3	-1.7	0.6	5.2	395	NA
Western Co. of North America	716	58.6	44.1	101	64.6	6.3	48.6	0.9	6.2	843	30.3
INDUSTRY COMPOSITE	34945	25.2	24.5	3785	26.0	623.6	32.0	1.8	16.5	1360	8.9
PAPER											
Bemis	719	8.5	8.6	16	8.9	11.5	-4.1	1.6	72.6	1321	-11.7
Boise Cascade	3107	2.9	7.8	120	0.9	5.5	10.0	0.2	4.6	186	-5.5
Consolidated Papers	537	5.2	13.1	55	17.7	3.8	12.9	0.7	7.0	727	1.1
Crown Zellerbach	3172	2.7	8.5	75	-8.8	11.7	-7.1	0.4	15.5	412	NA
Fort Howard Paper	471	18.6	16.4	83	16.1	1.8	23.9	0.4	2.2	468	6.1
Hammermill Paper	1400	13.9	13.9	47	24.5	3.6	44.0	0.3	7.7	281	NA
Kimberly-Clark	2886	11.0	14.3	205	11.6	38.4	21.9	1.3	18.8	1223	2.4
Masonite	538	5.3	2.4	27	-6.2	7.0	17.3	1.3	25.9	969	NA
Mead	2900	7.1	11.4	107	2.4	37.0	19.4	1.3	34.6	1555	-4.3
Rexham	190	12.4	13.4	9	7.6	2.0	-5.2	1.1	21.2	734	NA
St. Regis Paper	2819	3.9	8.9	179	15.5	12.0	17.6	0.4	6.7	432	-2.8
Scott Paper	2309	10.9	10.8	133	20.9	31.3	0.3	1.4	23.5	1544	-0.9
Sorg Paper	89	16.2	12.7	2	43.9	1.2	35.4	1.4	57.6	2007	-0.6
Union Camp	1666	5.8	12.1	169	11.3	18.0	11.5	1.1	10.7	1201	0.6
Westvaco	1551	10.0	11.5	101	13.7	16.7	17.3	1.1	16.5	1109	-1.3
Weyerhaeuser	4502	-0.8	8.4	234	-7.2	54.3	4.1	1.2	23.2	1269	-1.5
INDUSTRY COMPOSITE	28854	5.7	10.1	1563	5.6	255.9	10.1	0.9	16.4	930	-2.2
PERSONAL & HOME CARE PRODUCTS											
Avon Products	2614	1.7	11.2	220	2.7	30.9	3.0	1.2	14.1	917	4.2
Block Drug	184	10.4	9.9	18	11.3	4.3	11.4	2.3	23.2	2092	4.0
Carter-Wallace	237	13.8	10.1	12	23.9	13.8	13.0	5.8	119.4	4182	2.6
Chemed	353	14.4	13.5	36	19.4	3.9	18.1	1.1	10.6	699	NA

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Chesebrough-Pond's	1530	10.8	17.6	115	18.0	12.5	8.4	0.8	10.9	587	NA
Clorox	714	12.0	14.6	38	4.3	14.2	19.8	2.0	37.3	2731	NA
Colgate-Palmolive	5261	2.6	10.9	208	6.6	53.8	16.3	1.0	25.8	1152	1.5
Del Laboratories	63	13.8	10.8	3	-0.3	1.1	76.0	1.7	40.3	1260	4.7
Economics Laboratory	629	14.8	15.5	30	7.0	13.5	15.6	2.2	45.5	1851	7.7
Faberge	262	5.9	2.7	6	-14.0	1.6	46.9	0.6	27.6	563	-4.2
Gillette	2334	0.8	11.3	124	12.3	53.2	4.2	2.3	42.8	1646	1.1
Helene Curtis Industries	195	19.1	11.8	5	14.8	2.8	11.1	1.4	57.8	NA	NA
Intl. Flavors & Fragrances	451	0.6	9.7	66	8.9	29.7	3.5	6.6	45.0	8298	1.8
Johnson Products	47	33.5	6.1	0	-33.9	0.9	11.3	1.9	226.0	1532	4.0
La Maur	67	34.2	21.6	3	43.7	0.7	13.9	1.1	29.5	1359	NA
Noxell	233	14.2	14.1	17	16.3	3.2	23.2	1.4	19.3	2437	6.0
Oakite Products	74	8.7	9.5	5	11.0	1.1	-3.7	1.6	22.7	1232	1.2
Procter & Gamble	11416	6.0	12.6	668	10.2	253.0	11.0	2.2	37.9	4217	NA
Purex Industries	650	13.0	13.1	28	15.0	2.3	4.2	0.3	8.0	359	NA
Redken Laboratories	74	12.7	9.1	5	5.7	1.7	2.5	2.3	35.8	2254	-1.1
Revlon	2366	7.4	20.4	175	16.7	91.3	31.5	3.9	52.2	2593	8.7
West Chemical Products	58	6.8	-7.5	1	NA	0.6	-9.1	1.1	125.4	1011	NA
INDUSTRY COMPOSITE	**29811**	**5.7**	**12.7**	**1782**	**9.7**	**590.1**	**13.1**	**2.0**	**33.1**	**2168**	**3.5**
SEMICONDUCTORS											
Advanced Micro Devices	309	37.1	50.8	25	64.0	35.1	24.1	11.4	142.3	3544	34.9
Intel	789	-7.7	32.5	27	5.0	116.5	20.8	14.8	425.8	6934	20.2
International Rectifier	126	-7.6	15.5	3	94.2	3.5	1.7	2.8	108.6	1802	NA
Monolithic Memories	76	-0.9	38.1	7	81.7	5.9	47.2	7.7	84.5	2628	NA
Motorola	3336	8.1	16.3	175	14.8	229.0	14.5	6.9	130.9	3001	5.5
National Semiconductor	1110	22.0	36.4	53	38.1	96.0	19.9	8.7	181.3	2690	15.1
Siltec	40	-21.8	29.2	0	-26.4	2.7	30.8	6.7	1970.4	NA	NA
Texas Instruments	4206	3.2	21.0	109	2.7	219.4	16.4	5.2	202.2	2621	5.5
Unitrode	112	8.5	32.0	11	35.2	5.4	73.7	4.8	48.0	2607	13.3
INDUSTRY COMPOSITE	**10105**	**6.1**	**22.1**	**410**	**13.8**	**713.5**	**17.8**	**7.1**	**174.0**	**3109**	**8.6**
STEEL											
Armco	6906	21.6	17.3	295	19.1	35.8	59.1	0.5	12.2	529	6.5
Bethlehem Steel	7298	8.2	7.3	211	-9.7	50.4	11.8	0.7	23.[illegible]	601	-4.0
Bundy	172	11.8	10.7	7	-31.2	1.5	-20.3	0.9	19.7	499	2.3
Carpenter Technology	571	2.1	16.1	45	11.9	13.5	0.7	2.4	30.2	2788	0.8
Interlake	1017	-3.7	7.3	47	23.3	3.3	13.8	0.3	7.1	334	NA
U.S. Steel	13941	11.6	9.1	1077	60.8	74.4	32.6	0.5	6.9	525	-4.2
Westran	51	-3.7	15.4	2	19.9	0.8	38.6	1.6	41.6	1257	NA
INDUSTRY COMPOSITE	**29954**	**12.0**	**10.3**	**1683**	**46.2**	**179.7**	**26.2**	**0.6**	**10.7**	**577**	**-2.1**
TELECOMMUNICATIONS											
AT&T	58214	14.5	12.2	6888	10.6	507.2	21.1	0.9	7.4	594	2.7
Communications Satellite	334	11.4	16.2	28	-0.7	15.2	10.8	4.5	53.7	5157	NA
General Datacomm Industries	58	7.4	30.5	2	14.5	4.6	4.6	8.0	251.1	4497	28.0
GTE	11026	10.5	12.9	722	7.6	215.0	9.7	2.0	29.8	1054	3.3
Harris	1552	19.3	20.8	104	22.7	83.0	45.6	5.4	79.8	3217	NA
Inter-Tel	43	159.8	NA	4	NA	0.7	195.5	1.5	16.8	1809	NA
Lynch Communication Systems	47	19.9	15.4	1	-24.9	2.5	-34.0	5.3	476.2	2265	3.4
Magnetic Controls	62	10.0	31.5	4	49.4	4.9	27.2	7.9	138.0	3230	15.5
Plantronics	95	13.5	18.1	8	9.1	7.3	10.0	7.7	87.8	4611	9.6
Rolm	295	46.8	74.1	24	90.5	20.1	49.9	6.8	84.4	4544	58.8
TIE/Communications	131	118.9	59.6	11	120.4	2.7	81.7	2.1	26.0	3921	NA
Tellabs	49	11.2	57.4	7	58.4	2.6	12.8	5.3	36.9	3709	NA
United Telecommunications	2255	17.7	15.2	206	8.0	7.6	47.4	0.3	3.7	257	2.7
Western Union	907	14.2	10.3	59	5.2	5.3	3.9	0.6	9.0	390	-1.7
INDUSTRY COMPOSITE	**75067**	**14.2**	**12.7**	**8067**	**10.4**	**878.7**	**20.1**	**1.2**	**10.9**	**770**	**2.9**
TEXTILES, APPAREL											
Burlington Industries	3263	12.5	8.4	115	6.6	14.7	22.5	0.5	12.7	230	-1.6
Compo Industries	134	5.9	14.7	4	54.5	1.9	-7.4	1.4	53.3	1639	NA
Dan River	635	4.5	6.3	15	9.7	1.5	3.1	0.2	10.4	104	NA
Fieldcrest Mills	526	-0.2	6.1	10	-13.6	8.0	9.7	1.5	84.1	682	-1.9

COMPANY	SALES 1981 millions of dollars	SALES Percent change from 1980	SALES Percent annual change (1977-81)	PROFITS 1981 millions of dollars	PROFITS Percent annual change (1977-81)	R&D EXPENSE 1981 millions of dollars	R&D EXPENSE Percent change from 1980	R&D EXPENSE Percent of sales	R&D EXPENSE Percent of profits	R&D EXPENSE Dollars per employee	EMPLOYM'T Percent annual change (1977-81)
Guilford Mills	253	4.4	21.9	21	51.0	1.2	20.0	0.5	5.8	558	NA
Lowenstein (M.)	601	-3.1	1.4	17	NA	2.5	25.0	0.4	14.4	203	NA
Martin Processing	68	1.6	-16.0	-4	NA	0.9	12.6	1.3	-22.6	1048	-14.8
Nike	458	69.7	98.8	26	98.4	4.1	NA	0.9	15.8	1519	NA
Reeves Bros.	353	9.7	5.8	19	16.5	1.6	10.4	0.5	8.6	234	NA
Riegel Textile	455	5.0	9.7	17	6.3	1.6	8.1	0.3	9.4	177	NA
Seton	55	23.7	-2.3	2	-16.9	1.3	77.8	2.4	75.3	1960	-5.2
Stevens (J.P.)	2031	6.0	7.3	-23	NA	4.7	10.9	0.2	-20.6	125	-3.5
Texfi Industries	155	6.9	-5.0	0	NA	1.6	3.2	1.0	504.7	925	-19.5
United Merchants & Mfrs.	670	7.7	0.0	-7	NA	1.0	14.8	0.2	-13.9	73	NA
West Point-Pepperell	1222	-1.9	12.2	41	11.9	1.2	12.3	0.1	3.0	55	NA
INDUSTRY COMPOSITE	**10678**	**7.6**	**8.0**	**252**	**11.1**	**47.8**	**15.0**	**0.4**	**19.0**	**237**	**NA**
TIRES, RUBBER											
Armstrong Rubber	560	39.6	9.5	17	5.2	7.6	32.9	1.4	47.2	1423	NA
Bandag	313	10.9	19.5	34	18.2	2.6	36.5	0.8	7.7	1290	5.4
Carlisle	406	6.7	22.3	35	40.7	2.9	65.6	0.7	8.1	594	2.4
Cooper Tire & Rubber	394	21.6	12.2	17	29.0	4.3	10.3	1.1	24.9	1111	-1.1
Firestone Tire & Rubber	4361	-7.0	0.1	79	NA	78.0	0.0	1.8	98.7	1069	-11.4
General Tire & Rubber	2175	16.6	4.6	66	-18.7	52.6	20.3	2.4	79.9	1935	NA
Goodrich (B.F.)	3185	3.4	8.0	92	7.5	54.8	10.9	1.7	59.9	1626	-5.9
Goodyear Tire & Rubber	9153	8.4	8.0	244	2.5	210.0	20.2	2.3	86.1	1522	-2.7
Mohawk Rubber	211	16.8	-1.2	8	18.0	1.2	10.1	0.6	14.0	732	-13.5
Uniroyal	2260	-1.7	-4.3	45	NA	37.0	2.8	1.6	81.7	1503	-18.2
INDUSTRY COMPOSITE	**23018**	**4.9**	**4.7**	**637**	**1.8**	**451.2**	**13.8**	**2.0**	**70.9**	**1435**	**-4.8**
TOBACCO											
American Brands	4039	-3.9	10.2	386	24.5	20.8	-2.4	0.5	5.4	399	NA
U.S. Tobacco	278	12.1	14.3	46	18.2	1.6	16.9	0.6	3.5	462	NA
INDUSTRY COMPOSITE	**4317**	**-3.3**	**10.3**	**432**	**23.8**	**22.4**	**-1.2**	**0.5**	**5.2**	**403**	**NA**
ALL-INDUSTRY COMPOSITE	**1585799**	**10.1**	**14.5**	**81757**	**14.6**	**32106.5**	**15.1**	**2.0**	**39.3**	**2161**	**2.1**

APPENDIX B

Questionnaire and Cover Letter
From the Joint Economic Committee of Congress
To High Technology Companies

October 21, 1981

THE LOCATION OF HIGH TECHNOLOGY COMPANIES

The Joint Economic Committee has selected your business for voluntary participation in a questionnaire survey on matters of importance to public policy and the business community. The enclosed questionnaire is designed to provide information on factors that influence business location choices. Summary information from the survey will be used by the Joint Economic Committee to evaluate Federal, State and local policies that influence business expansion plans.

Knowing why businesses locate where they do will enable Congress to design policies which encourage business expansion rather than thwart it. Improved public policies could mean less uncertainty and more investment for business.

Your participation in this study is vital to its success. Please assign the task of completing this questionnaire to the person(s) in your organization most knowledgeable on plant or office expansion and location plans. We are keenly aware of the value of your time and have tried to construct the questionnaire in such a way as to minimize your time and effort.

Thank you for your assistance, and be assured that all information on your response will be held strictly confidential. Only the aggregate results will be made available.

Sincerely,

Roger W Jepsen

Roger W. Jepsen, Vice Chairman

Clarence J Brown

Clarence J. Brown, Ranking House Republican Member

JOINT ECONOMIC COMMITTEE
Industry Location Survey

Confidential

Name of Person Completing Survey ____________________

Position ____________________

Level of involvement with plant locations within the corporation:

_____ Closely involved _____ Somewhat involved _____ Only slightly involved, if at all

PART I. CORPORATION IDENTITY AND CHARACTERISTICS

1. Name of Company ____________________

2. Address: State ____________________ County ____________________

   City ____________________

3. How would you describe your plant or office facility?

   _____ Headquarters for a multiplant operation
   _____ Branch of a multiplant operation
   _____ A subsidiary
   _____ Multiplant operation
   _____ Single plant operation

4. Address of Headquarters or Parent Company if different than Question 2:

   State ____________________ County ____________________

   City ____________________

5. Year of incorporation ____________________

6. How would you describe the major business activities of your company? (More than one response may be appropriate.)

   _____ Semiconductor/computer
   _____ Telecommunications
   _____ Research
   _____ Aerospace
   _____ Chemical
   _____ Medical instruments
   _____ Other

   6a. List the major product (service) lines of your corporation:

   ____

   ____

7. How would you characterize the market for your major product (service)?

   _____ Predominantly international
   _____ Predominantly national
   _____ Predominantly regional (For example, Midwest or Southwest)
   _____ Predominantly within State

8. Have the geographical markets for the corporation's major products changed substantially over the past five years? _____ Yes _____ No

   8a. If yes, briefly how? ____________________

9. Roughly, total corporation employment ______________________

10. Roughly, total calendar 1980 corporation revenues ______________________

11. How many plants or permanent offices does the corporation operate? ______________

12. How many of those plants or offices are located in each of these regions of the country? (See attached list of states by region.)

______ New England
______ Midwest
______ Mideast
______ South
______ Southwest
______ Mountain & Plains
______ Far West
______ Overseas
______ Canada
______ Latin America
______ South America

PART II. PLANT EXPANSION AND LOCATIONAL PREFERENCES

13. How many new plants (or sales offices) does your corporation plan to add over the next five years? ______________

14. If possible, list how many of these ~~facilities will be~~ added in the ~~following~~ regions:

______ New England
______ Midwest
______ Mideast
______ South
______ Southwest
______ Mountain & Plains
______ Far West
______ Overseas
______ Canada
______ Latin America
______ South America

15. To what extent do you consider each of the ~~following~~ attributes as a factor in determining your regional preference for a location. (Circle 1-Very Significant; 2-Significant; 3-Some Significance; 4-No Significance):

(See attached list of states by region.)

Attribute	Impact on Locational Preferences			
Tax climate within the region	1	2	3	4
Regional regulatory practices	1	2	3	4
Access to markets	1	2	3	4
Labor costs	1	2	3	4
Labor skills/availability	1	2	3	4
Access to raw materials	1	2	3	4
Cost of living	1	2	3	4
Transportation	1	2	3	4
Energy costs/availability	1	2	3	4
Climate	1	2	3	4
Cultural amenities	1	2	3	4
Academic institutions	1	2	3	4
Other ______________	1	2	3	4

16. Based upon your perceptions, rate each region by attribute using the following scale: 1-Excellent; 2-Good; 3-Adequate; 4-Poor:

Attribute	New England	Midwest	Mideast	South	Southwest	Mt. & Plain States	Far West
Tax climate within the region							
Regional regulatory practices							
Access to market							
Labor cost/availability							
Labor productivity							
Access to raw materials							
Cost of living							
Transportation							
Energy costs/availability							
Climate							
Cultural amenities							
Academic institutions							

17. What impact would each of the following attributes have on your company's choice of a location <u>within a region?</u> (1-Very Significant, 2-Significant; 3-Some Significance; 4-No Significance):

______Good transportation facilities for materials and products
______Good transportation for people
______Cost of property and construction
______Proximity to customers
______Ample area for expansion
______Community attitudes towards business
______Availability of workers:
    ______Skilled
    ______Unskilled
    ______Technical
    ______Professional
______Proximity to raw materials and component supplies
______Availability of energy supplies
______Adequate waste treatment facilities
______State and/or local government tax structure
______Water supply
______Proximity to good schools
______Proximity to recreational and cultural opportunities

17a. In general, these attributes can best be obtained in an ______urban; ______rural; ______other environment

17b. If other, please specify: ______________________________

18. The following are actions that State and local governments can undertake to encourage business expansion within their jurisdictions. How would you rate each action in terms of its likely success? (Circle 1-Very Significant; 2-Significant; 3-Some Significance; 4-No Significance):

Train labor	1	2	3	4
Offer financial incentives	1	2	3	4
Procure resources from local business	1	2	3	4
Reduce taxes	1	2	3	4
Cut red tape	1	2	3	4
Reduce lost time during inspections	1	2	3	4
Improve community attitude	1	2	3	4
Improve cultural amenities	1	2	3	4
Improve recreational facilities	1	2	3	4
Other ____________	1	2	3	4

19. To what extent does your company interact with other firms in the area in the course of daily business activities? _____Significant interaction; _____Moderate interaction; _____Very little interaction; _____No interaction

19a. If significant or moderate, describe the nature of this interaction:

____

____

19b. Was the possibility of this contact with other firms a factor in your company's location decision? _____Yes _____No

20. Roughly, what percentage of your business activity is conducted under contract to the Federal Government?____________

20a. How does this percentage compare with the percentage of your company's business activity conducted for the Federal Government five years ago? _____Higher today; _____About the same; _____Lower today

20b. How important would you rate location near a Federal facility (military or other) as a factor in your ability to obtain Federal grants? _____Very significant; _____Significant; _____Some significance; _____No significance

21. Do you consider the proximity to a university system a factor in your location choice? _____Yes _____No

21a. If yes, which of the following university attributes do you consider important? (Circle 1-Important; 2-Somewhat important; 3-Not important)

Attribute	Impact on Locational Choice		
Degree programs for employees	1	2	3
Part-time teaching opportunities for employees	1	2	3
Faculty research activity	1	2	3
Faculty consultants	1	2	3
Access to laboratories	1	2	3
Access to libraries & information systems	1	2	3
College graduates	1	2	3
Cultural activities	1	2	3
Other ____________	1	2	3

21b. Rate each of the following in terms of importance to the transfer of scientific knowledge from the university to your business enterprise. (1-Very important; 2-Important; 3-Some importance; 4-No importance)

University publications (books, articles, etc.)	1	2	3	4
University services	1	2	3	4
Student recruiting	1	2	3	4
Faculty consulting	1	2	3	4
Corporate support for basic research at universities	1	2	3	4
Government dissimenation of the results of basic research	1	2	3	4

21c.-- In your opinion, what can be done to improve the transfer of scientific knowledge from the university to the community?

____

____

PART III. GOVERNMENT REGULATIONS, TAXES AND EXPANSION ACTIVITY

22. To what extent does Federal Government regulation affect the expansion plans of your business? Large impact; Moderate impact; Insignificant impact

23. With which of the following government agencies has your business had contact within the last two years? (Circle all items that apply to your company).

Agency	Degree of Contact: No contact	Inspected or investigated by	File routine reports to	Rec'd. contract from	Ordered to comply by	Impact on Business: Little	Moderate	Great
Environmental Protection Agency	1	2	3	4	5	1	2	3
Department of Labor	1	2	3	4	5	1	2	3
Department of Defense	1	2	3	4	5	1	2	3
Ofc. of Federal Contract Compliance Programs	1	2	3	4	5	1	2	3
Department of Energy	1	2	3	4	5	1	2	3
Consumer Product Safety Commission	1	2	3	4	5	1	2	3
Food and Drug Administration	1	2	3	4	5	1	2	3
Federal Trade Commission	1	2	3	4	5	1	2	3
Occupational Safety & Health Admin.	1	2	3	4	5	1	2	3
Equal Employment Opportunity Comm.	1	2	3	4	5	1	2	3
Interstate Commerce Commission	1	2	3	4	5	1	2	3
Census Bureau	1	2	3	4	5	1	2	3
Department of Transportation	1	2	3	4	5	1	2	3
Dept. of Health & Human Services	1	2	3	4	5	1	2	3
Dept. of Housing & Urban Develop.	1	2	3	4	5	1	2	3
Small Business Administration	1	2	3	4	5	1	2	3
Securities and Exchange Commission	1	2	3	4	5	1	2	3
Other	1	2	3	4	5	1	2	3

24. Which of the federal agencies listed above have the most impact on the way you operate your business?

1. ____

2. ____

3. ____

25. What has been the impact of State and local regulatory requirements on your business location plans? _____Very significant; _____Significant; _____Some significance; _____Insignificant

25a. If significant or very significant, rate the importance of the following: (Circle 1-Very significant; 2-Significant; 3-Some significance; 4-Insignificant)

Zoning Practices	1	2	3	4
Building permit procedures	1	2	3	4
Building codes	1	2	3	4
Filing and inspection procedures	1	2	3	4
Environmental Restrictions	1	2	3	4
Other__________	1	2	3	4
__________	1	2	3	4
__________	1	2	3	4

26. What has been the impact of State and local government financial incentives on your business location plans?

_____Very significant; _____Significant; _____Some Significance; _____Insignificant

26a. Which of the incentive programs do you consider to be effective local development tools? (Circle 1-Very significant; 2-Significant; 3-Some Significance; 4-Insignificant)

Loan guarantees	1	2	3	4
Low interest loans	1	2	3	4
Industrial development bonds	1	2	3	4
Property tax abatement	1	2	3	4
Research subsidies	1	2	3	4
Investment tax credits	1	2	3	4
Other__________	1	2	3	4
__________	1	2	3	4

27. Approximately what percent of your workforce is unionized? _____%

27a. What impact have unions had on your choice of a location?

___ Very Significant; ___ Significant; ___ Some impact; ___ No impact

Please return in the enclosed postage free envelope to:

Senator Roger W. Jepsen, Vice Chairman
Joint Economic Committee
House Annex 2, Room 359
3rd & D Streets, S.W.
Washington, D.C. 20515
Attn: Dr. Robert Premus, Economist

APPENDIX C

List of States by Region
As Identified by the J.E.C. Report

LIST OF STATES BY REGION

NEW ENGLAND

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

MIDEAST

Delaware
District of Columbia
Maryland
New Jersey
New York
Pennsylvania
Virginia

MIDWEST

Illinois
Indiana
Michigan
Minnesota
Ohio
Wisconsin

FAR WEST

California
Nevada
Oregon
Washington
Alaska
Hawaii

MOUNTAIN AND PLAINS

Colorado
Idaho
Iowa
Kansas
Missouri
Montana
Nebraska
North Dakota
South Dakota
Utah
Wyoming

SOUTH

Alabama
Arkansas
Florida
Georgia
Kentucky
Louisiana
Mississippi
North Carolina
South Carolina
Tennessee
West Virginia

SOUTHWEST

Arizona
New Mexico
Oklahoma
Texas

APPENDIX D

An Excerpt From

"Industry and the Universities:
Developing Cooperative Research Relationships
In the National Interest"

COOPERATIVE RESEARCH RELATIONSHIPS: BENEFITS, HAZARDS, ROLES

	Benefits of the Cooperative Research Relationship	Hazards of the Cooperative Research Relationship	Roles and Responsibilities of the Partners
Universities	1. Acquaintance with the marketplace and innovation process 2. Access to additional technical and physical resources 3. Enrichment of the curriculum 4. Income from patent licenses 5. Additional funding sources for research 6. Less paperwork and administrative burdens compared to direct government funding 7. Enhanced public credibility for service to society	1. Inhibition of unfettered choice of research direction 2. Temptation for more applied and development programs 3. Suspicion of use of university resources for private benefit 4. Polarization of opinion of special interest groups against universities	1. Protect the academic environment 2. Development of cooperative research framework 3. Insure industrial contributions as part of relationship 4. Inform university community of need and character of proprietary protections 5. Provide legal and policy guidance to participating faculty and students
Industry	1. Acquaint research students with industrial research environment 2. Influence future research directions 3. Source of new skills and techniques for research 4. Experiment more efficiently with new directions in research 5. Increase access to peer review 6. Generation of excitement and enthusiasm 7. Enhancement of public credibility	1. Loss of some control over a proprietary position 2. Lack of relevance of university research to industrial problems 3. Suspicion of use of university resources for private benefit	1. Provision of goods and services to meet public needs 2. Develop mechanisms for transfer of research into the innovation process 3. Commitment to develop research ideas, sharing benefits with university 4. Provision of long-term research support 5. Provision of access to industry equipment and processes for participating university research personnel
Government (Public Interest)	1. Improved innovation leads to long-term stable growth of the economy 2. More efficient flow of research knowledge into industry 3. Improvement of the science base for regulation	1. Potential for monopolistic action or restraint of trade 2. Co-mingling of public funds for research with privately supported programs	1. Lessen barriers and provide incentives for university-industry cooperative research 2. Support studies of potential problems in the relationship, and develop models 3. Support cooperative research where public payoff is high 4. Develop long-term perspective for cooperative research programs 5. Provision of financial incentives for industry support of research in universities

Source: National Commission on Research: Industry and the Universities: Developing Cooperative Research Relationships in the National Interest, p. 16.

APPENDIX E

A Letter of Resignation

LETTER OF RESIGNATION
PROFESSOR HENRY O. STONE

THE UNIVERSITY OF KANSAS

Department of Microbiology
735 Haworth Hall
Lawrence, Kansas 66045
(913) 864-4311

June 15, 1982

Professor James M. Akagi
Department of Microbiology
The University of Kansas
Lawrence, KS 66045

Dear Jim:

I have received an offer for a position as an Associate Professor in the Department of Microbiology at the new medical school in Greenville, North Carolina (East Carolina University School of Medicine). After careful deliberation, I have decided to accept their offer and therefore plan to leave the University of Kansas on August 15, 1982.

The decision to leave the University of Kansas was a difficult decision to make. Within the Microbiology Department, I have been treated extremely well by you and by David Paretsky. I shall always cherish the encouragement and support which you gave me during the period when I lacked an external research grant. My colleagues within the Department of Microbiology have been generous with their time and expertise. The success of my graduate students is a direct result of the efforts of my colleagues.

One of the finest characteristics of the University of Kansas is the cooperative attitude which exists across departmental lines. I have enjoyed the finest cooperation from my colleagues in Biochemistry, especially Robert Weaver, Ronald Borchardt and Paul Kitos. Earl Huyser in Chemistry and Mat Mertes in Medicinal Chemistry have generously loaned me equipment without charge. My queries for information always received immediate and concerned responses from Lou Houston and Dick Himes in Biochemistry, Dick Schowen in Chemistry, Les Mitscher in Medicinal Chemistry, and Charles Decedue, Director of the Enzyme Laboratory.

Another valuable characteristic at the University of Kansas is the openness of the administration to faculty input. During the past year, my service on the College Committee on the Budget and the committee's interaction with Bob Adams and Bob Lineberry have demonstrated that cooperative efforts toward problem solving between administrators and faculty members is an active and ongoing process at KU. Indeed, I have felt that I can express my concerns openly to any administrator without fear of retribution. I have found Vice Chancellors Frances Horowitz, Deanell Tacha, Bob Cobb, and Chancellor Gene Budig attentive to my concerns.

Main Campus, Lawrence
College of Health Sciences and Hospital, Kansas City and Wichita

I appreciate the opportunities to obtain administrative experience as your Associate Chairman for a number of years and as Acting Chairman in the Fall semester. These experiences were extremely valuable to me. I discovered that I obtained more satisfaction from the pursuit of science than from administrative endeavors. In addition, administrative responsibilities make it extremely difficult to be physically involved in scientific experiments. I honestly do not know why anyone in the sciences would want to be Chairman at a school like KU. It is essential that decisions at the departmental level which affect the research and graduate missions of a department be made by someone with a distinguished record and an active research program. However, anyone who takes a chairmanship at KU is sacrificing their own scientific career.

The position in Greenville, North Carolina offers me a great opportunity for professional advancement.

1. I will have a higher percentage of my personal time to devote to research. My teaching load will consist of one fourth of the Microbiology course to medical students every third year, and one third of the one semester graduate-level Virology course every two years.

2. An annual budget of about $6,000 per year for travel, research expenditures, and other research-oriented expenses will be provided. This level of support is included in the base budget and will presumably be available indefinitely.

3. Use of glassware cleaning and sterilization facilities, media preparation services, cell culture facility, animal facility, and radioisotope facilities are provided by the University without charge.

4. Approximately 570 square feet of laboratory space and 150 square feet of office space has been assigned to me. The laboratory space is one third P3 containment and two thirds P2 containment. Facilities with P4 containment are available upon request. The equipment and facilities will be certified by an external agency before occupancy and re-tested annually without charge to faculty members.

For "new" faculty members, these additional inducements are added:

5. Technical support in the form of a research assistant will be provided for two to five years (two years in writing and five years verbal). This is in addition to the support which I have on my research grant.

6. With the technical support, a budget is provided for expenses of a research program. As with the technical support, this is promised in writing for two years and verbally for five years.

7. An allocation of $40,000 for capital equipment was assured in writing and a verbal promise of an additional allocation next year.

As a package, these guarantees offer me a tremendous opportunity to pursue a research career. They clearly reflect an administrative and a legislative understanding of the needs of a professional scientist.

The financial aspects of the position are as follows:

1. The position is a twelve month appointment with an annual salary of $46,000. Since the North Carolina legislature votes a true cost of living

increase, as well as a "merit salary" increase annually, the rate of salary increases in North Carolina will exceed those in Kansas. In addition to these normal increases, I will receive a substantial increment upon promotion to full Professor.

2. The clinical faculty of the Medical School will pay health insurance coverage for my wife and dependents, as well as the premium for a $100,000 term life insurance policy.

3. A reimbursement of $4,000 is included to defray moving expenses.

Kansas University is academically superior to East Carolina University. A move away from KU is clearly a gamble--but a calculated one. The new physical facilities for Microbiology in Greenville are first-rate. The construction of a large facility with biological containment through P4 is a substantial commitment by the State of North Carolina to research in infectious diseases and in recombinant DNA technology. The acquisition of new equipment for the facility will provide investigators with excellent capabilities for competitive research. The current level of research support from the State of North Carolina is excellent. The provisions for support services such as media facilities, cell culture facilities, and radioisotope facilities all supported from state funds permit a larger research effort from external funds. The support for higher education in North Carolina has historically been exceptional.

Perhaps the most attractive aspect of the offer from Greenville is that research is accepted as a primary role for the academic faculty. Research is not treated as an adjunct to the teaching role but is instead a full partner. As evidence of their commitment to the research mission, the State of North Carolina has invested in facilities, equipment, supply and travel budgets, support services, research assistants, and a competitive salary structure to insure that North Carolina is highly competitive in the research arena. Even though the State of Kansas could easily afford to support higher education (Kansas is 16th in per capita income, while North Carolina is 42nd!), I do not believe that the State of Kansas will ever support higher education in a manner comparable to North Carolina. Thus, any investigator will be a more competitive scientist in North Carolina than in Kansas. I do not sever relationships with my friends and colleagues at the University of Kansas, for a portion of my heart and intellect will assuredly linger here. Rather, I leave the State of Kansas which has failed to provide the financial support to insure its young people a quality education.

For all these reasons, I therefore reluctantly submit this letter of resignation to the University of Kansas effective August 15, 1982.

Sincerely,

Henry

Henry O. Stone, Jr.
Associate Professor

HOS:sw

APPENDIX F

Industry and University Participants
At A Technology Transfer Conference

July, 1982

Industry/University Technology Transfer Conference
July 14-15, 1982 Tulsa, Oklahoma

LIST OF PARTICIPANTS

T. Ariman	University of Tulsa
Bill Barr	University of Kansas
John Bessler	Aladdin Industries
Ron Borchardt	University of Kansas
Walker Bowman	Standard Oil of Indiana
Ronald Chalfant	Emerson Electric Company
Tom Collins	University of Missouri
Theodore W. Craig	Foremost-McKesson, Inc.
Donald Crain	Phillips Petroleum Company
Ralph Daniels	University of Oklahoma
Anthony J. Del Vecchio	The Pillsbury Company
R. S. Detrick	Koppers Company, Inc.
Mark Elder	University of Oklahoma
Peter Etzkorn	University of Missouri
Tom Faucett	University of Missouri
A. L. Frye	Aladdin Industries, Inc.
Harmon Garfinkle	Corning Glass Works
Preston Grounds	Procter & Gamble Corporation
James Halligan	University of Arkansas
Robert Hartman	Oral Roberts University
Donald Hoeg	Borg-Warner Corporation
William Honstead	Kansas State University
Kenneth Hoving	University of Oklahoma
Ronald Johnson	Oklahoma State University
Lee Jones	Ohio Medical Anesthetics
Nat Kessler	Staley Mfg. Company
Bill Kimel	University of Missouri

Tom King	Ohio Medical Anesthetics
Duke Leahey	Washington University
Dean Leslie	Conoco, Inc.
Peter Levin	University of Oklahoma
Frank Long	ARCO Technology
Micheal Losee	Monsanto Company
Terry Loucks	The Norton Company
Kenneth McCollom	Oklahoma State University
Max Minor	Oklahoma State University
Cecil Miskel	University of Kansas
Joe Mize	Oklahoma State University
Lowell E. Netherton	BASF Wyandotte Corporation
William Nusbaum	Emerson Electric Company
Eli Perry	Monsanto Company
Thomas Protzman	Staley Mfg. Company
Dale H. Reed	ARCO Exploration Company
David Rowley	Christensen & Diamond Technology Center
S. F. Sapaki	General Mills, Inc.
Neil Schmitt	University of Arkansas
E. P. Segner	Memphis State University
Joe Selden	Aladdin Industries
William A. Sibley	Oklahoma State University
Allen Soltow	University of Tulsa
Johnnie Stokes	University of Arkansas
Steve Stone	Oklahoma State University
Robert Tuite	Eastman Kodak
John Van De Castle	ARCO Technology
Jack Ward	University of Missouri

APPENDIX G

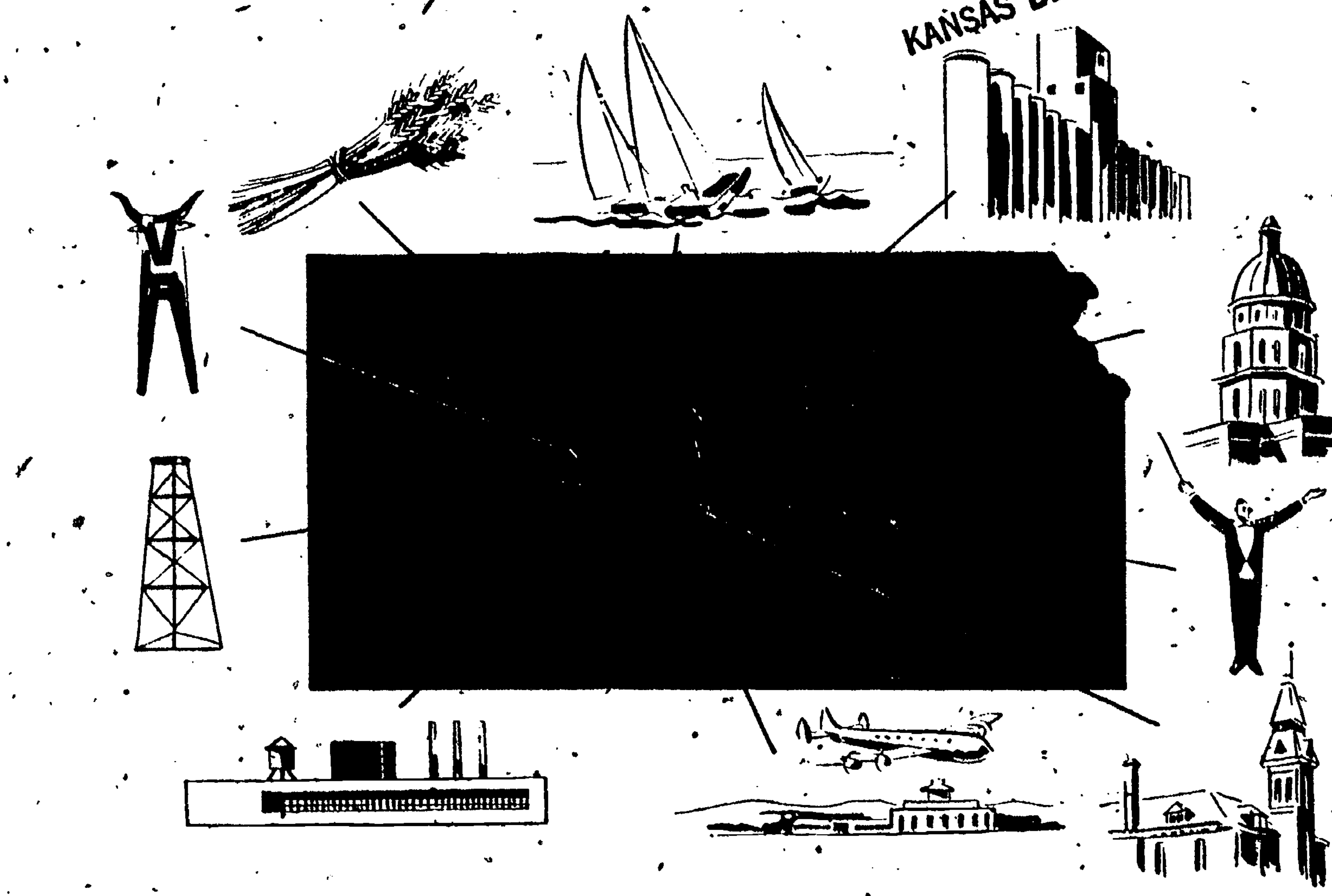
An Excerpt From

"Economic Development For Kansas:
An Action Program"

1962

ECONOMIC DEVELOPMENT FOR KANSAS

...AN ACTION PROGRAM



Prepared By

GOVERNOR'S ECONOMIC DEVELOPMENT COMMITTEE

1962

4. Existing facilities for use.
5. Population composition and trends.
6. Job opportunities in the area, and a résumé covering history of unemployment and specific needs for such a program.

Training provided by each area school should be correlated with the needs of the area and with those of other schools in the state to assure diversified training opportunities commensurate with manpower needs. Co-operation between the State Board of Vocational Education, and the local school boards should be encouraged, and area schools should be administered locally.

Finally, the Committee believes the economy of Kansas will suffer if such educational opportunities are not supported with sufficient funds to build and equip modern shops and training facilities. Furthermore, in a restricted situation there are not enough potential students to offer a variety of courses of study, and to warrant specialized teachers, supervisory personnel, counseling services, or vocationally-trained administrators.

The proposed area vocational education program offers a constructive approach to the solution of this problem. Programs which serve the youth and adults of a wide geographical region possess the enlarged student bodies and necessary expanded financial resources needed to provide the facilities, the special personnel, and the broad curricula required for sound vocational education.

The area program also offers an effective solution to the problem of maintaining a proper balance between supply and demand in the labor force for specific occupations in which vocational-technical training is needed. When there is a need for a certain number of trained workers in a particular occupation, the present tendency is to establish training programs in many different schools throughout the state. Such a program results, oftentimes, in too many workers who are inadequately trained because the school where the training was received was not able to supply the proper equipment and trained personnel. Technical training requires expensive equipment which can only be justified by a large number of students. The area school concept overcomes this problem and increases respect for the vocational program from industry, labor, school officials, and the public.

Scientific Research

Economic growth in excess of population growth stems, among other things, from:

1. More and better capital utilization.
2. More and better technology.

Kansas has lagged behind the more progressive states in the development and utilization of research as a stimulus to economic growth. Unfortunately, too many Kansas people and industries are either unaware of the research resources in the state or unappreciative of their importance to economic development of the state. Likewise, very little has been done to publicize the availability of the state's research resources and therefore no concerted movement to utilize them has been forthcoming.

The Committee considers it essential to economic progress in Kansas that an immediate effort be made to vitalize existing research resources, and to encourage additional developments in this field by increasing research volume in the universities and expanding into more areas.

An article in the Spring, 1962, issue of *State Government* entitled "Research as an Aid to Industrial Development" expresses the Committee's concern:

> . . . The more research within a state, the more likely that the state will benefit by expansion of existing industry and the creation of new industry.
>
> . . . .
>
> . . . there may be a high degree of correlation between growth rates of individual states and the percentage of state revenues they put into research.

There is conclusive evidence to show that manufacturing facilities for the newer products in electronics and "space age" requirements are locating in states with growing research facilities. Kansas has not been considered as a logical location for such production facilities. Does this omission result from lack of recognizing the importance of advanced research facilities by the people of Kansas, and from the absence of a program to publicize the existing quality research resources available in Kansas?

Heretofore the Committee recommended that the proposed Department of Economic Development have the responsibility for co-ordinating the scientific research co-ordination functions in the state. This provision establishes a means for better co-operation between industry, agriculture and the research resources of the state. It also provides assurance that Kansas will not overlook future possibilities in the scientific field as a stimulus to economic development.

To supplement the effort expected from the proposed Department of Economic Development, the Committee believes Kansas industry and business should lend its support for university research programs by:

1. Providing consulting opportunities for research personnel.

2. Making contributions of funds specifically for salary supplements and the employment of research assistants.
3. Contributing funds for purchase of scientific equipment or library materials.
4. Assisting in expanding the volume of university contract research.

The Committee recommends the Kansas Legislature increase its appropriations in support of research in the universities in order to raise faculty salaries, expand laboratory space and equipment, and finance additional research capabilities. Analysis by the Committee of the actions of other states, including those nearby, shows that these states recognize the growing role of research in economic growth and development, and have accordingly provided additional financial support to the universities to attain an even greater status in this field. If science is to flourish in Kansas, state government's endorsement of scientific endeavor will have to become more substantive than in the past. The attraction of outstanding scientific personnel to a state requires recognition and appreciation of intellectual achievement. A report covering an appraisal of scientific effort in Missouri notes, "Science needs status in Missouri." The same thing can be said about Kansas.

There is a definite relationship between universities with outstanding research complexes and private research facilities. The private facilities, particularly those owned by industry, choose to locate in an area where scholars and equipment of universities can be utilized on a consulting basis. In turn, the production facilities of these companies for the newer products are usually located nearby their research facility. In effect, then, the presence of advanced university research facilities act as a magnet in the sense of location of private research and production plants.

The Committee encountered a serious problem relating to university research programs, in that at present all funds received for this purpose, whether from private or public sources, are channeled through the budget department of state government, and are subject to normal purchasing procedures. This procedure restricts the latitude of the researcher, and complicates operational procedures so that Kansas has difficulty in attracting outstanding scientific personnel. This procedure should be changed as in other states.

The Committee, therefore, recommends that a nonprofit research foundation be established by statute, for the purpose of receiving and dispensing research funds granted to universities of the state. The foundation should be governed by a Board consisting of representatives of the Board of Regents, universities and a representative group from agriculture and industry. The research foundation would serve to:

1. Encourage and stimulate expansion of existing research and the development of new research in the state universities.
2. Assist the universities in obtaining funds from federal agencies, private foundations, private industry, and other sources of research support.
3. Correlate research programs of the state universities with the proposed Department of Economic Development, and other state agencies as well as industry and agriculture.

The Committee strongly recommends that the Board of Regents establish and seek legislative appropriations for a minimum of six distinguished professorships at salaries necessary to attract scientists or engineers of national or international distinction.

Experience in other parts of the nation has demonstrated convincingly that the availability of such outstanding scholars in a state is a major attraction to scientific-based industry. Also, such scholars act as a nucleus to attract younger scientists who would eventually increase the pool of talent in the state.

Kansas is fortunate in having already a learned society known as the Kansas Academy of Science. The Committee believes this group has not been utilized sufficiently in matters of economic development. The Academy does promote scholarly attainment and provide recognition for service and achievement. However, the research program envisioned by the Committee encompasses making a place for the Academy in the over-all program, including utilization of this group as a means of bringing to the public's attention the value of scientific achievement in Kansas.

The Committee emphasizes its belief that Kansas must immediately exercise great effort to enlarge and improve scientific research in the state if the people of Kansas are to benefit from the transition now taking place. Economic growth and development in formerly nonindustrialized areas of the nation are often the result of research programs. The movement of people to these newly-developing areas, and the increase in personal income resulting therefrom, forecasts a trend that portends a lesser role for these areas which have not recognized this development. The Kansas economy will suffer unless arrangements can be made to attract research and subsequent production developments to the state. The pattern is very clear—research developments must come first.

Although the Committee was not directly charged by the resolution establishing it to propose governmental reorganization as a primary function, the Committee encountered situations which it felt should be studied to determine whether present government organization and operation are *fostering* economic development.

Because of the great importance of *natural resources development* to over-all economic development, the Committee recommends a study of the government structure under which natural resources development operates to determine the overlapping areas, and to ascertain whether certain phases of natural resources development are being given proper attention.

The Committee discovered the great strides being made by neighboring states in bringing barge transportation to the doorsteps of its cities. The development of the channels on the Missouri and Arkansas Rivers to permit barge traffic alerted the Committee to the competitive position in which Kansas will find itself in a few years. The fact that Kansas is a landlocked state—except for the northeast portion—and the fact that Oklahoma, Missouri, Nebraska, and Arkansas will by 1970 have the attraction of waterways transportation for economic development, concerned the Committee. The opening up of the Arkansas River in Oklahoma as far as Tulsa by 1970 indicates the competition Kansas must face. The Committee recommends that a determination of the feasibility be made of waterways transportation on the Kansas (Kaw) River and the Arkansas River, and their tributaries.

The Committee further recommends that the state of Kansas develop a specific procedure for discharging financial commitments that have been or will be made for incorporating additional water supply in federal reservoirs built in Kansas. Thus economic development interests may know all details pertaining to water costs in areas where such facilities are located.

The Committee recommends that the two mill levy for wheat promotion now levied and paid to the Kansas Wheat Commission, with the state charging a 20 percent overhead cost for collecting said levy, be reviewed in the light of the fact that no other state with such a wheat levy charges over 3 percent for overhead collection costs.

The Committee recommends that representatives of the livestock industry take the initiative in developing regulations for feedlots which will be acceptable to operators and the public.

APPENDIX H

An Excerpt From

"State Activities to Encourage Technological Innovation: An Update"

February, 1982

A University/Industry Experimental Center Program for Small Manufacturers, Arkansas

To combine management and financial assistance with the introduction of technology to assist in the growth and viability of small manufacturers.

Arkansas Science Information Exchange

This program disseminates scientific and technological information to the citizens of the State and brings scientists and citizens together to discuss public policy issues.

Implementation Phase - Arkansas State Science Engineering and Technology Program

The objective of this program is to strengthen the policy management capacity of State Government by developing mechanisms that integrate science and technology information and expertise into the policy management process.

Center of Excellence in Engineering, Arizona

In 1980, the high technology industry, Arizona State University, and the State Government joined forces to create a $32 million center for engineering excellence over a five year period. The State funds of $19 million and the industry funds of $9 million will go to six programs: Solid State Electronics, Computers and Computer Science, Computer Aided Processes, Energy Systems, Transportation Systems, and Thermosciences, with dominant input to the electronics and computer areas.

Connecticut Product Development Corporation (CPDC)

Seeks to stimulate new projects by providing grants to finance development costs in existing new firms. In return for the grant, the CPDC receives a limited royalty at first, usually five percent of sales, with the percentage decreasing as payment goals are surpassed. To date, the CPDC has funded more than 57 projects, 33 of which are now in the marketplace. Funding approvals for 1981 were up 281% over 1980.

Connecticut Innovation Development Program

To foster new high technology innovations, small and medium-sized manufacturers can make use of working capital loans (at below market interest rates) to finance the costs of bringing a newly developed product to the marketplace. In addition, the loans may be used in conjunction with development grants available through the Connecticut Product Development Corporation.

Colorado Electronics Institute

The Institute is intended to serve as a mechanism for the development and coordination of education and research programs related to the electronics, semiconductor and computer industries. The Institute will promote programs at single state or private educational or research institutions for multidisciplinary interuniversity, government-university and industry-university for electronic engineering technology, process control, high-speed microelectronics and system design.

Governor's Science and Technology Advisory Council, Colorado

The Science and Technology Advisory Council serves as a linkage between the academic and research communities and state government. The council is exploring methods of stimulating high technology development in Colorado; has assessed incentives and disincentives for universities to conduct research on Colorado's needs; has survey contacts between state agencies and universities; and is planning a symposium on the future of science and technology in Colorado.

Pension Investment Unit, California

The Pension Investment Unit (PIU) of the Governor's Office of Planning and Research is working with investment advisors and fund managers of both public and private employee retirement funds to explore means of investing more capital in businesses and industries engaged in significant technological innovation.

In addition to bringing together California's lenders and borrowers for creative financial packaging, the PIU is working on structural changes such as a State Constitutional Amendment to allow more flexibility in investments by public employee pension funds, and a State insurance or loan guarantee program to enable pension funds to purchase pools of commercial/industrial loans and mortgages.

California Innovation Development Loan Program

This program will provide innovative financing to promising technology-based firms for product development. The recipients of the loans will be small technology-based entrepreneurs and scientific/engineering inventors.

Investment in People, California

Investment in People is a package of new programs and budgetary priorities designed to increase the technical competency of California's labor force at a variety of skill and age levels. Investment in People includes \$19.6 million to upgrade math and science education in K-12, \$7 million to augment engineering, computer science, and related basic science education in the Universities, and \$12.2 million for employment-based training through community colleges; and \$10 million for job training and placement assistance for displaced workers and welfare recipients.

Micro Electronics Innovation & Computer Science

Under MICRO, the University of California, the State Government, and industry work together to facilitate, expand, and enhance basic and applied research in microelectronics and computer science. General policy directions are determined by a policy board consisting of representatives from the University, the State Government, and industry, appointed by the President of the University. The University administers the program and solicits, reviews and approves all research proposals. Core funding is provided by the State. Approved research projects are supported by these funds and by matching funds from industry. State and industry funds can also be used to augment support for superior graduate students and graduate programs of instruction.

California Worksite Education and Training Ace (CWETA)

Under CWETA, employers make a commitment to hire trained workers for permanent jobs, and then training programs are devised in conjunction with local education and training institutions, with much of the training taking place at the worksite and on the job. CWETA is designed for both entry-level jobs and upgrade training for much higher skill levels. Most of the focus of existing training has been in electronics, machine trades, and health fields.

California Commission on Industrial Innovation (CCII)

The overall purpose of the 18-member Commission on Industrial Innovation is to produce a consensus among business, academic and labor leaders on the programs required to maintain California's economic strength through industrial innovation. The Commission is organized through three subcommittees to examine critical issues in financing technological innovation, education and training , and improving human productivity.

Advanced Technology Development Center, Georgia

1. Advanced Technology Entrepreneur Development. The ATDC will help entrepreneurs identify product markets, assist them in locating venture capital and help venture capitalists in locating high-technology opportunities. The ATCD will provide assistance in the areas of administration, marketing, finance, legal aspects and management.

2. Advanced Technology Industrial Recruitment. The ATDC will be sensitive to the needed climate of technology support and will make a positive effort to meet specific needs.

3. Assisting Industry in Developing New High-Technology Products and Alternative Energy Resources. ATDC will help build technologically-based industry by stimulating the development of advanced technology product lines in existing companies. The effort will consist of identifying, investigating and evaluating new ideas through management and technical expertise.

Venture Capital Information Center, Hawaii

The State Legislature in its 1981 Special Session passed Act 8, which authorizes the establishment of the Venture Capital Information Center in this department. The legislature also appropriated State funds to operate the center in the current fiscal biennium and to create the Hawaii Development Fund to provide loans to investors and developers of new products.

NASA/KY Technology Applications Program, Kentucky

Part of nonprofit technical and scientific information dissemination network. The program has access to 60 different data banks.

Kentucky Industrial Training, Out-of-State or United States

A trainee must be designated by a new or expanding industry; and must return to Kentucky to provide training for other employees on similar equipment, procedures, or processes. The tenure of these out-of-state or U.S. training programs do not exceed eight weeks, and the trainee may travel to any location decided upon by the company and approved by the state agencies.

High Technology Task Force, Iowa

The Task Force, appointed by the Governor, will conduct studies and make recommendations in regard to targeting high technology research and development projects in Iowa. These recommendations will be used in State budgeting for the 1983-1985 biennium.

Industrial Training Program, Illinois

The Industrial Training Program is conducted by the Illinois Department of Commerce and Community Affairs. It was designed to encourage high-tech industries to locate and expand in Illinois by meeting the employer's training needs. The Program offers funding and training assistance in cooperation with local education facilities.

In the two years of the Program's existence, its staff has assisted 48 high-tech industries in their decision to locate or expand in Illinois. In addition, vocational education schools are taking greater initiative in creating partnerships with high tech industries to answer industrial training needs.

High Impact Training Services, Illinois

The High Impact Training Services program is operated by the Illinois State Board of Education. Its purpose is to provide funding for local public school districts and community colleges to establish initial "high impact" training programs to meet specific needs of new businesses and industrial establishments locating in Illinois communities. Applications for local businesses or industries which are expanding their Illinois operation are also considered.

Examples of recent training programs which HITS has funded include copper and brass machinists; radiator manufacturing; electronics technology; and data processing.

Workers for Electronics Project, Illinois

This project is funded through the IL Department of Commerce and Community Affairs, and operated by the Rehabilitation Institute of Chicago and the Electronics Industry Foundation. Its purpose is to train disabled workers in the field of electronics, then to market them to Chicago's electronic businesses and industries.

Illinois Solar 80

Illinois Solar 80 is a residential passive solar construction program designed for Illinois vocational schools traditionally involved in residential building projects. The goal of the program is to promote the feasibility and construction of technologically-innovative passive solar holes. An open solicitation process, professional training in passive design and construction, technical assistance, and promotional support comprise the major program components. The Illinois Department of Energy and Natural Resources conducts the program, which has resulted in the instruction of 650 building trades students in 17 vocational schools, and in the construction of 18 solar homes in Illinois.

High Technology Task Force, Illinois

The High Technology Task Force was recently created to attract, nurture, and retain high technology industry in the State of Illinois. Its emphasis centers on electronics, robotics, and biotechnology. Its objectives are to strengthen university-research programs in technology; to offer financing options and incentives for technological industries in Illinois; and to promote the State of Illinois as an area highly receptive to and capable of accommodating high-tech industry.

State Treasurer's Investment Program - Specific Opportunity Program, Illinois

The State of Illinois operates a State "loan system" to provide funds for the location and expansion of high technology industries in Illinois. The State Treasurer is authorized to deposit state funds in a local bank, which are in turn loaned to the high-tech companies.

The Indiana Corporation for Science and Technology

A bill has been introduced in the Indiana General Assembly to create the Indiana Corporation for Science and Technology, a not-for-profit corporation. The mission of the Corporation will be to recommend public policies and to prepare and implement programs which will encourage the further development of science and technology in the educational institutions and the industries of the State of Indiana.

The Board of Directors of the Corporation will consist of a total of 24-members, with eight from the private sector, eight from the public sector, and eight from the education and university sector. The Board will have a Chairman and an Executive Committee, all of whom will serve without compensation. In addition, there will be a fulltime, salaried Executive Director who will coordinate and implement the Board's programs and activities.

Biomedical Electronics Technology, Indiana

This innovative technological-medical approach to biomedical measurement is the only Indiana program at the technology level combining the life science and electrical technology foundations. The program is offered at Indiana University/Purdue University - Indianapolis.

Machine Trades Technology, Indiana

This specialized curriculum at Vincennes University is designed to develop in students the knowledge and manual dexterities essential in the construction of injection mold tooling. Graduates will be prepared to meet the demand in the plastics industry for this exacting mold making skill.

Corporation for Innovation Development, Indiana

The Corporation for Innovation Development (CID), a for-profit entity, provides seed capital to Small Business Investment Companies (SBICs), and will directly finance high-risk new technology ventures that are unlikely to gain SBIC support. Private investors in the CID receive a 30 percent credit on Indiana tax liability for the amount of their investment. Similar credits are available to investors in those SBICs in which the CID is also an investor. The CID itself is exempt from Indiana taxes.

Laser and Electro-Optics Technology, Indiana

Graduates are qualified as skilled technicians in the emerging technology of laser and electro-optics. Students learn to install, maintain, and operate industrial equipment that utilizes lasers, electro-optics, and optics as principal components. Students are trained for jobs in design support, developmental assistance, sales, field service and maintenance. From the manufacturing angle, they will be prepared for assembly, fabrication, and testing.

Laser and Electro-Optics Technology, Indiana

When the State Board of Vocational and Technical Education approved and funded the laser program in 1975 at Vincennes University, the laser was considered an emerging technology, and our program was second in the nation as a government pilot program. Since that time, the laser field has shown phenomenal growth, and the Vincennes program has become one of several, serving as a model for other new programs.

Technological Extension Service, Maryland

Provides technological problem solving to small and medium businesses in the three western counties of Maryland. Faculty resources of the College of Engineering are used as backup to field agent.

Currently funded at $70,000 per year with funds from Appalachian Regional Commission.

University Research Foundation, Maryland

This corporation, owned by the University of Maryland Foundation, serves as a vehicle for the development of new high technology businesses.

Technology Development Corporation, Massachusetts

Assists small high technology-based companies achieve commercial success from their innovation by providing financial assistance. It seeks situations that will trigger additional private investment. Specifically the corporation will:

- Provide debt, equity or royalty agreement capital
- Will only co-invest with private funds
- Arrange for solely private funding

Minnesota Wellspring

Minnesota Wellspring, a nonprofit corporation, is a collaborative project among the State's leaders in business, labor, education, and government. One-third of Wellspring's budget is provided by the State; the rest comes from private sources. Wellspring's goals are to increase the number of new jobs in Minnesota and expand the State's technology-based industries.

Challenge Grant Program, Minnesota

Under this program, the State would match dollar-for-dollar any contributions from the private sector to three new centers at the University of Minnesota: the Microelectronics and Information Services Center, the Productivity Center, and the Biotechnology Center.

Center for Innovation (CFI), Montana

The Center for Innovation (CFI) was established through a grant from the Old West Regional Commission (OWRC), and has been supported by grants from OWRC and the Montana Department of Natural Resources. The CFI provides technical and financial assistance to inventors in Montana, Wyoming, North Dakota, South Dakota, and Nebraska. Any inventor with an idea for a new product that can create jobs in these five States is eligible for CFI's technical and financial assistance.

Technology-based Innovation and Development Fund, Michigan

The program is intended to fund university/private sector joint research and development projects in Michigan.

A scientific review panel made up of technical, financial, business and academic experts will be established to review the whole proposal submitted for funding. Criteria included the technical nature of the project, potential for job creation, need for long-term funding, private sector participation, and overall feasibility of the project.

High-Technology Task Force, Michigan

103

Task force on technology and innovation composed of universities, private sector, financial community, and state government officials. This task force was appointed in January 1981 and has met on a continuous basis since that time to explore and recommend methods of stimulating high technology development in Michigan. The group is privately financed.

Business Development Corporation (MBDC), Michigan

Initial board was appointed by the Governor is early 1981. The MBDC is currently in the organization stage with a goal to be capitalized initially at $20 million. The corporation will provide medium-risk financing, both debt and equity, to small high-technology firms.

Missouri Loan Guarantee Authority

The proposed loan guarantee, designed around the loan loss reserve concept, will stimulate private lending to small businesses, emphasizing high growth, high-technology enterprises. State income tax credits will be offered to encourage private sector contributions to the Authority's fund.

High-Technology Skills for Auto Workers, Missouri

General Motors is planning to build a new auto assembly plant in Wentzville, Missouri which will use the latest in robotics and high technology equipment. In a cooperative effort the state will establish a high technology training center for the region and retrain 6,000 auto workers for the Wentzville plant.

Research Assistance Act, Missouri

The Research Assistance Act will provide State "challenge grants" which Missouri public colleges and universities can use to match corporate and other private-sector grants for research and applied projects. Projects will meet criteria for job creation and for stimulating high growth, high technology industries in Missouri.

University of Missouri - Robotics Training and Research

The University of Missouri - Rolla campus operates the Integrated Computer Aided Manufacturing program (ICAM). The program uses industrial robotics to train personnel in high technology manufacturing design and development. It also researches industrial and manufacturing applications of interactive graphics and develops computer hardware and software for use in computer-aided design.

Office for Promoting Technical Innovation (OPTI) New Jersey

The New Jersey Office for Promoting Technical Innovation (OPTI) provides assistance to inventors, entrepreneurs and small businesses in the development of new products with innovative technical aspects. Services provided by the Office include technical evaluations, marketing guidance, business planning, and license brokering. Staff evaluations of project potential result in determination of services to be provided. Fees are not charged for services.

Limited financing is available through direct loans or royalty financing when OPTI's Board of Directors finds that "gap" financing for testing, development, production or marketing would significantly alter the prospects for success. The participation of third party lenders or investors is typically a condition of financing; however, OPTI's lending activity has been limited to five transactions of an average $20,000 with a four-year term. Given both financial and technical resource constraints there has been some tendency for the Office to encourage licensing arrangements rather than new business financing.

Patent Development Program, Nebraska

The Nebraska Department of Economic Development's Patent Development Program is responsible for the administration and commercialization of patents owned by the State of Nebraska.

The Department contracts for research on a project-by project basis, principally with the University of Nebraska and/or State Colleges. Any successful results of the project research are then commercialized. Monies accruing to the program in the form of royalities and/or licensing fees are reinvested in additional contract research projects.

Technology Innovation Center (TIC), New Mexico

The Technology Innovation Center, established as a private nonprofit corporation, facilitates the development of new, technologically innovative businesses in the State and trains traditional and non-traditional students in entrepreneurship. University students and faculty at the Center assist entrepreneurs with business plans or engineering and production plans, depending on the entrepreneur's needs. As a result of the Center's first year of operation, six to eight new businesses have now incorporated in the State. The Center, in collaboration with the State Departments of Energy and Minerals and Commerce and Industry and the Los Alamos and Sandia laboratories, sponsored a workshop on financing technological innovation in New Mexico which was attended by 100 entrepreneurs and venture capitalists from around the country.

Technology Programs at Albuquerque Technical Vocational Institute and Other technical two-year training programs, New Mexico

The technology program at the Albuquerque Technical Vocational Institute (TVI) prepares about 470 students per year for careers as advanced technicians. Students may receive training in digital circuitry, all phases of advanced electronics; laser electro-optics, fiber optics, advanced computer programming, electromechanical technologies (including robotics), hydraulics, electronic communications (including microwave technologies). TVI works closely with industry to assure that its training matches industry needs. Mean student age is 27, and many students already have other degrees before entering the technology program.

Science and Technology Foundation, New York

The new legislation reconstituting the Foundation was signed by the Governor on June 9, 1981. The following duties were assigned the Foundation which provided a framework for programs already initiated by the foundation.

1. To foster and support scientific and technological research, development and education in the state, through contracts or other means.

2. To sponsor and conduct conferences and studies and issue periodic reports relating to scientific and technological research, development and education in the state.

3. To review the technological development potential of various regions of the state and to cooperate with and make recommendations to the legislature, state agencies, etc.

4. To assist small and emerging science and technology oriented businesses in applying for federal research grants and state or federal procurement contracts.

5. To collect and disseminate information on financial, technical, marketing, management and other services available to small and emerging science and technology oriented business on a free or for hire basis.

6. To identify emerging technologies which provide significant promise for the development of job-creating businesses.

Corporation for Innovation Development, New York

The basis of the CID economic development program is a statewide strategy aimed at improving the economic base of the State as a whole through the advancement and support of those technology-based new business ventures/start-ups judged to have new/increased job development potential. The CID is located with the Science and Technology Foundation and is capitalized with State and Federal funds. Ventures supported may include start-up enterprises or new product/process development in existing businesses. Generally, the CID seeks to provide financial assistance to young enterprises (under 5 years old and typically undercapitalized), small enterprises (with less than 250 employees, preferably in the 1-99 range) and locally-controlled enterprises (with the likelihood of long term commitments to an area).

Corporation for Innovation Development, New York

Investments will generally be in the $50,000-$100,000 range. Foundation CID program assistance may be in the form of debt financing, near-term equity financing (with royalty payback return) or a combination of the above financings. Investment proceeds, when leveraged with conventional financing, may be used for any of the following or combinations thereof, working capital, acquisition of technical apparatus and facilities, and research and development.

Center of Industrial Cooperation, New York

This center is the vehicle for communication between the technological industrial and university sectors. It is instrumental in arranging cooperative research projects with industry, identifying consultants and facilities for industrial firms and organizing technical education programs for special needs in industry.

Improving Science and Mathematics Education,
North Carolina

1. N.C. School of Science and Mathematics
2. Improving Science and Mathematics Instruction in all elementary and secondary schools
3. Community Colleges and Technical Insitutes

1. School of Science and Mathematics. A residential high school for students with very high aptitudes in science and mathematics. Purpose is to (1) train and inspire those students in residence to become future leaders of science, and mathematics instruction in all elementary and secondary schools in the state. Now in its second year, 300 students are enrolled. No more than 900 will be in residence when the school reaches full capacity, with about 15 percent from out-of-state.

2. Improving S & M in All Schools. The Department of Public Instruction, working with the Board of Science and Technology and the School of Science and Mathematics, is devising means of improving science and mathematics instruction in all elementary and secondary schools by improving the qualifications of teachers, by mobilizing community support, and by upgrading the quality of the curriculum.

3. Community College System. The system consists of 58 community colleges and technical insitutes, with approximately 600,000 individuals enrolled each year. The system has been reorganized and its budget strengthened to give greater emphasis to vocational-technical education and to better enable each institution to meet the technical training needs of industrial firms within its area.

1. North Carolina Board of Science and Technology
2. Microelectronics Center of North Carolina
3. North Carolina Biotechnology Center

1. Board of Science and Technology: Consists of 15 scientists, engineers and public and private officials with the Governor serving as Chairman. Functions as a "nerve center" connecting the research institutions and organizations of North Carolina with state and local government agencies and with the private sector. Develop strategy relevant to the entire process of technological innovation and associated relations between state government and research institutions, private industry and local governments.

2. Microelectronics Center: A cooperative program whereby six research institutions share highly extensive, sophisticated microelectronics research equipment for both research and educational purposes. Designed to guide microelectronics program of the state.

3. Biotechnology Center: Designed to assist major research institutions in North Carolina in developing a very strong research and education program in biotechnology, and in developing essential working relationships with industry.

Direct Loan Program for "Future Oriented Industries" Ohio

Along with tax-exempt bond financing, ODFC has a separate direct loan program targeted specifically to "future-oriented industries". In practice, this has meant an emphasis on technology-based firms, with the largest concentration in companies specializing in instrumentation. The loan program finances fixed assets only at an interest rate of 2%. During its three years of existence, the program has made over fifty loans totaling about $50 million.

PENNTAP, Pennyslvania

In 1965, the Pennsylvania Department of Commerce and the Pennsylvania State University jointly created the Pennsylvania Technical Assistance Program (PENNTAP). PENNTAP is primarily a technology transfer group which provides technical specialists to solve problems. PENNTAP helps business and industry in Pennsylvania solve technical problems by supplying technical information and offering suggestions and ideas on ways to improve products and operation. Subject areas include energy, environment, industrial technology, and health and safety. From 1972 through 1979, PENNTAP has responded to almost 13,000 requests for problem assistance.

Governor's School of Science and Technology, Pennsylvania

This special high school will offer exceptional students the opportunity to develop their potential in math and science, and to train for high technology jobs.

Pennsylvania Science and Engineering Foundation

In 1967 the Pennsylvania General Assembly created the Pennsylvania Science and Engineering Foundation (PSEF) within the Department of Commerce. Through grants, PSEF provides "seed money" for new and innovative research programs, finances projects which show promise of benefit to the Commonwealth and its economy and funds research programs emphasizing applied engineering contributions to the solutions of current problems.

MILRITE, Pennsylvania

MILRITE is the acronym for "Make Industry and Labor Right in Today's Economy". The Council is a quasi-public, independent agency of top-level business, labor and government officials. Its objectives are to explore and initiate ways to more communication channels as well as to seek means of eliminating unnecessary present and future obstacles in the path of restoring a sound state-wide economic and job base.

Governor's Task Force for Study of Technology Corridor Development, Tennessee

A special Task Force of selected industrial and business leaders and civicly-active professionals and other citizens has been appointed by the Governor to supply to the State related to the development of a high technology area of Tennessee. This group is served by support personnel from the Department of Economic and Community Development and TVA. With an operational budget provided by the State, the Task Force is studying Tennessee's national competition for such industrial and business growth, existing high technology industrial and business needs, the research role potential of selected state and private universities and the critically important factor of technical training requirements.

Tennessee Comprehensive Education Study Task Force

This effort is an out growth of cooperation between the State's General Assembly and the Executive Branch to study selected basic public educational issues in Tennessee. Of paramount importance to the mission of this body is the organizational structure for development and delivery of vocational/technical education, including governance. Extensive involvement of educators, lay citizens, industrial and business leaders, and legislators is currently employed to assure appropriate relationships between programming and current and emerging industrial and business employment needs. Preliminary report of findings is scheduled for late 1982.

Innovation Center for Enterprise Development, Tennessee

As a 1974-75 product of planning of the Energy Opportunities Consortium, the Center became operational in 1980 through joint funding support of the Appalachian Regional Commission, TVA (non federal sources), private sources and (in 1981) the State's Department of Economic and Community Development. With minimum personnel, the Center assists individuals with innovative ideas throughout a range of services, including, but not restricted to, patent acquisition, business plan development, introduction to venture capital sources, and acquisition of commercial loans. A prime thrust is in the area of high technology.

Center for Nuclear Studies, Tennessee

The Center of Nuclear Studies was approved in 1971 following approval of its concept by the Southern States Nuclear Board. The Center became operational in 1974, and currently delivers employee screening and technical training services to fifteen (15) major utility firms in fifteen (15) states. Its operational budget of $5 million is derived solely from service contracts, with in-kind support provided by Memphis State University. Selected research and technical assistance contracts are also fulfilled in completion of the Center's mission.

High Technology Initiative for In-State Development and Recruitment of Sophisticated Growth Industry, Tennessee

This project represents a major high technology initiative in Tennessee to harness resources for in-state development and the recruitment from outside of sophisticated growth industry. A major focus is on higher wage-paying research and development and manufacturing, to include electronics, computer science, aerospace, medical, energy and national defense. Another specific goal includes the creation of mechanisms for identifying, providing technical evaluation, and helping find venture capital sources.

Task Force on Technological Development, South Carolina

In June of 1981, Governor Riley appointed a Task Force to develop an approach for South Carolina to take in stimulating technological development. The Task Force is composed of university presidents, business leaders, state commissioners, members of the Legislature, and the Governor's staff. It is currently exploring research capabilities of public and private universities and types of industrial research conducted by businesses in South Carolina.

Science, Engineering and Technology Advisory Service, Virginia

The Advisory Service has surveyed Virginia's scientists and engineers with a view to finding ways of mobilizing this pool of talent for state programs.

University-Industry Research Program, Wisconsin

University of Wisconsin scientists and engineers engage in research and development projects funded jointly by industry and government, to advance the frontiers of new technologies and develop new commercial products and production processes.

A related program is Wisconsin for Research, a nonprofit corporation that works with the university and industry to promote entrepreneurship in new technologies and products, and its for-profit subsidiary Research Development Cooperation, which is developing a research/industrial park near the University in Madison. All profits from RDC's activities are given to the University for research programs.

Governor's Committee on High Technology Training and Advancement, Washington

The Governor is forming a Committee on High Technology Training and Advancement. The Committee's responsibilities include:

Evaluation of the state's current high technology education, training and technical assistance capabilities.

Identification of workable programs that can be used to encourage high technology growth.

Identify training and technical resource barriers to high technology development.

Submit to the Governor and legislature, recommendations for legislative programs, innovations, etc., for the 1983 session.

Staff support for this effort will be provided through the Washington State Department of Commerce and Economic Development.

Washington Research Foundation

The Foundation, funded primarily by private industry sources, was a direct out growth of the Governor's High Technology Transfer Task Force. The purpose of the Foundation is to finance applied research and development into new technology-based products.

APPENDIX I

Recent Initiatives by Neighboring States to Promote High Technology Industries

Wall Street Journal
Tuesday Sept 7, 1982
p. 34

American Sterilizer Company

2424 West 23rd St. Erie, PA. 16512

An Equal Opportunity Employer M/F

of Omaha.

An Equal Opportunity Employer

CONSTRUCTION PROJECT MANAGER

Saint Vincent Health Center, a 572-bed short-term advanced teaching hospital, has an immediate opening for an experienced Construction Project Manager to accept full responsibility for a major construction project.

The Project Manager will coordinate all functions in support of the expansion including architectural, engineering, and construction management. Reports directly to CEO. Excellent salary and benefits, including relocation expenses.

Please submit resume, in confidence, to:

Richard C. Linse, Jr.
Director of Personnel
SAINT VINCENT
HEALTH CENTER
P.O. Box 740
Erie, PA 16544
(814) 452-5650
Equal Opportunity Employer M/F

DATA BASE ADMINISTRATOR

The Cleveland Electric Illuminating Company, an electric utility serving Northeast Ohio, is seeking an individual, preferrably with a degree to provide total technical support in the data base administration area. Candidates must have 3-5 years of experience in monitoring and tuning of data bases, physical and logical design, data base back-up and recovery, and documentation and procedural development. IBM data dictionary desirable.

Salary commensurate with experience and qualifications. Excellent benefit package. Will pay relocation expenses.

Interested candidates MUST forward resumes complete with salary history. No telephone calls will be accepted. Please forward resume to:

Doris H. Holland
CLEVELAND ELECTRIC ILLUMINATING COMPANY
P.O. Box 5000
Room 203
Cleveland, Ohio 44101
An Equal Opportunity Employer

COMMERCIAL LENDING

A leading regional bank in the Midwest has a growth opportunity available for an experienced Commercial Lender.

We are seeking an individual with a minimum of 2 years banking experience who has been exposed to formal credit training. A related college degree is required, with a MBA helpful. Supervisory skills and the ability to travel would be considered pluses.

This position offers excellent growth potential and an attractive salary and benefits package. Send resume in confidence to:

Box MO-376
The Wall Street Journal
Equal Opportunity Employer

SCIENCE AND TECHNOLOGY EXECUTIVE

A Midwestern state seeks a strong executive to be the permanent staff director and leader of its newly formed board of science and technology.

This executive will be responsible for the design and management of programs to carry out the mission of the board. He will organize talent and resources from the public, private and education sectors to encourage and implement the development of science and technology in the state; he also will prepare public statements and policy proposals for the board and for the Governor.

The executive will have the challenge of working with a broad array of institutions: federal, state and local government; university faculties, administrators and regents; and chief executives in small or large companies in the private sector, especially technology-related organizations.

A PhD degree, preferably in an engineering science, and experience in the privae business sector are desirable. An attractive salary is offered.

Replies will be held in strict confidence by the Selection and Screening Committee.

Please reply to:

Box MO-372, The Wall Street Journal
An Equal Opportunity Employer

MARKETING AND SALES MANAGER

Opportunity to plan and implement in the field a marketing and sales program for a medium ticket, mechanical product line.

If you have dealt with a field representative network and have knowledge of the hardware, construction and hard good rental markets, our

MIS DIRECTOR

Our Chicago based firm is a three division manufacturer in the primary metals industry. We can offer an exceptional opportunity to a professional data processing manager with a minimum of 10 years experience, 5 years of which has been in a management position. You must possess a BS degree and be able to function with a minimum of direct supervision and be results oriented with proven people management ability.

This challenging position offers a System 34 environment utilizing RPG II programming. You will manage a staff of 11 employees and report directly to the VP of Finance in our growth oriented and dynamic company. Please send resume

on and
es plus
October
Journal
M/F

NT
and plastic
dly expand-
Human Re-
position will
a manage-
al program,
e design of
ductivity.
0 years of
and training
nd conduct-
compensa-
nt benefits.

R

the industrial
l business. We
sive individual
west territory.
ified individual
and experience
heaters and/or
l degree is not
A stable work
necessary.
nt commission
will become an
plicants should
ES PLEASE

ition

Study finds Iowa ripe for technology

DES MOINES, Iowa (AP) — A state task force says Iowa has many of the ingredients necessary to support high technology industries.

David Swanson, director of the Iowa Development Commission and chairman of the task force, says the state already has some high technology industries.

But he says there are changes Iowa can make that can help existing industries make use of new technology and attract new high technology firms to the state.

High technology industries are ones that make practical applications of scientific advances'— a firm that develops practical uses for laser beams, for example.

Some parts of the country have been remarkably successful in attracting large numbers of high technology firms. Many are concentrated in the "Silicon Valley" of Southern California or the "Golden Triangle" near Durham, N.C.

Those areas, Swanson said, have been developed for years and Iowa is just one of many states now trying to get in on the action.

Despite competition from other states, Swanson said Iowa has many strong points that make it a natural location for such industries.

"Every study says the Midwest is a natural for high technology because of our high educational base and our lower cost of doing business. It's a natural attraction for us," he said.

Other parts of the country where such industries are concentrated generally have strong research activities at universities, good air transportation, favorable environments for scientists and available land.

"We think we've got all those," he said.

The task force originally believed that two sites in the state were the most logical ones for high technology industry — the area between Cedar Rapids and Iowa City, home of the University of Iowa, and the area between Des Moines and Ames, home of Iowa State University.

But now, the task force believes no part of the state should be overlooked,, Ssanson says.

"We've had it called to our attention by several communities that due to telecommunications, high technology firms don't have to be near universities," he says.

Not all types of technology will flourish in the state, Swanson said. The task force has singled out two that hold promise for creating jobs in Iowa — biotechnologies, including animal science, plant science, pharmaceuticals and drugs for both animals and people, and applications of microelectronics, such as in the medical equipment field.

BEST COPY

BIBLIOGRAPHY

1. Agriculture Experiment Station, "Agricultural Research in Kansas," December, 1980.

2. Alladin Industries, "Industry/University Technology Transfer Conference," July 14-15, 1982.

3. Ann Arbor Chamber of Commerce Publication, "Summary of the Major Steps in the Development of Greater Ann Arbor Research Park," January 1, 1969.

4. Arnold, William F., "Bay Area Tries to Keep Firms that Outgrow Silicon Valley," Electronic Business, March, 1982.

5. Azaroff, Leonid V., "Industry - University Collaboration: How to Make it Work," Research Management, May, 1982.

6. Biscomb, R.L., "Community Considerations in Corporate Headquarters Locations," Industrial Development, July/August, 1979.

7. Biddle, Wayne, "A Patent on Knowledge," Harpers, July, 1981.

8. Borefsky, Michael, "U.S. Technology Trends and Policy Issues," George Washington University Program of Policy Studies in Science and Technology, Monograph No. 17, October, 1973.

9. Browne, Lynne E., "Regional Investment Patterns," New England Economic Review, July/August, 1980.

10. Business Week, "Biotechnology is Now Survival of the Fittest," April 12, 1982.

11. Business Week, "A Research Spending Surge Defies Recession," July 5, 1982.

12. Business Week, "A Bargain for the United States in High-Tech Engineers," April 20, 1981.

13. Cape, William H., Scientific and Technological Advice for Kansas Governments and Industry, Government Research Center, University of Kansas, 1969.

14. Chapman, Perry, "Land Development Goes to College," Area Development, October, 1981.

15. Committee for Economic Development, "Stimulating Technological Progress: A Statement by the Research and Policy Committee," January, 1980.

16. Cornia, Gary C., William A. Testa, and Frederick D. Stocker, State-Local Fiscal Incentives and Economic Development, Columbus, Ohio: Academy for Contemporary Problems, June, 1978.

17. Dallaire, Gene, "RPIs Mighty Goal: To Help Rejuvenate American Industry," Civil Engineering - ASCE, October, 1981.

18. Dallaire, Gene, "How Stanford University Launched the U.S.'s Most Successful Research Park," Civil Engineering - ASCE, October, 1981.

19. Dallaire, Gene, "How Campus' Incubator Space Helped a Fledgling Firm," Civil Engineering - ASCE, October, 1981.

20. Danilov, D. Victor J., "The Research Park Shake-Out," Industrial Research, May, 1971.

21. Dietrich, J.J., and R.K. Sen, "Making Industry - University - Government Collaboration Work," Research Management, September, 1981.

22. Dolan, Carrie, "Salt Lake City Starts to Boom as Utah Lures New Business," The Wall Street Journal, Tuesday, July 13, 1982.

23. Doody, Eugene J., and Helen B. Munzer, "High Technology Employment in Massachusetts and Selected States," A Report Prepared for the Massachusetts Division of Employment Security, March, 1981.

24. Governor's Economic Development Committee, Economic Development for Kansas: An Action Program, 1962.

25. Industrial Research, "Research Park Directory," May, 1974.

26. Inside Arkansas, "Industry and University of Arkansas - Little Rock," Spring 1982.

27. Jones, Robert R., "High Technology, to Productivity, to Profitability (Editorial), Industrial Research and Development, October, 1980.

28. Jones, Robert R., "Sites for Scientists," Industrial Research, May, 1975.

29. Kansas Department of Human Resources, Research and Analysis Section, Kansas Occupational Staffing Patterns: Manufacturing, November, 1981.

30. Kansas Industrial Development Commission, Outline of Program Applied Industrial Research, February, 1943.

31. Kansas Legislative Research Department, "Number of Graduates Receiving Degrees or Other Recognition at Kansas Institutions of Higher Education, 1977-78 to 1980-81," April, 1982.

32. Kansas State University, College of Engineering, Research Activities 1981-1982.

33. Krzyzowski, Marian, Marian B. Conboy, and Jessie Hall, "Development High-Technology Industry," Michigan's Fiscal and Economic Structure, Harvey E. Braget, Ed. 1982.

34. LaValle, Kenneth P., "Senate Committee Reports on High Tech Parks," Press Release, November 17, 1980.

35. Lochmoeller, Donald C., Industrial Development Handbook, ULI - The Urban Land Institute, 1975.

36. Low, George M., "Rensselaer Polytechnic Institute, "Rensselaer Technology Center, April, 1981.

37. Main, Jeremy, "Why Engineering Deans Worry a Lot," Fortune, January 11, 1981.

38. Main, Jeremy, "One School that's In the Chips," Fortune, January 11, 1982.

39. McCain, Dr. James, "We Can Organize an Industry-Research 'Axis'", Kansas Business News, May, 1982.

40. McInnis, Doug, "Going After High Tech," The New York Times, Sunday, July 19, 1981.

41. Mid-Continent Research and Development Council," 27th Annual Proceedings," October 12-13, 1981.

42. Money, Mark L., "A Model for the Establishment of a University Related Research Park within a Framework of Selected Management Principles," Unpublished Ph.D. Dissertation, University of Utah, 1970.

43. Money, Dr. Mark L., "University-Related Research Parks," Industrial Research, May, 1970.

44. Morning, George I., "Preliminary Study: Attracting and Development High Technology Industries in Kansas," KDED, Spring 1982.

45. Mosbacher, C.J., "Will R & D Funds Be More Than $77 Billion in "82?," Industrial Research & Development, January, 1982.

46. Muchmore, Lynn R., Edward J. Flentje, Irvin Feller, and Thad L. Beyle, Gubernatorial Policy Making Through Science Advice, National Governor's Association, March, 1982.

47. Murray, Thomas J., "Industry's New College Connection," Dun's Review, May, 1981.

48. Murray, Thomas J., "Whither Silicon Valley?," Dun's Business Month, February, 1982.

49. National Commission on Research, "Industry and the Universities: Developing Cooperative Research Relationships in the National Interest," August, 1980.

50. National Science Foundation, "Federal Funds for Research and Development: Fiscal Years 1978, 1979, and 1980, Volume XXVIII," Surveys of Science Resources Series, Final Report.

51. National Science Foundation, "Federal Support to Universities, Colleges, and Selected Non-Profit Institutions, Fiscal Year 1978," 1980.

52. Office of Science and Technology Policy "Annual Science and Technology Report to Congress: 1981," 1982.

53. Pake, George E., "Industry-University Interactions, Physics Today, January, 1981.

54. Pennsylvania Department of Commerce and Governor's Office of Policy and Planning, "Advanced Technology Policies for the Commonwealth of Pennsylvania, August 5, 1982.

55. Pierce, Neal R., "Commentary: High-Tech Boom Carries Political Surprises," Public Administration Times," June 15, 1982.

56. Premus, Robert, Location of High Technology Firms and Regional Economic Development, A Staff Study of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of the Congress of the United States, June 1, 1982.

57. Redwood, Dr. Anthony L., Rich Sexton, Chuck Dehner, Kay Stewart, Bob Glass, and Bob Valk, An Investigation of University Research Parks: Implications for the Lawrence/KU Community, The Institute for Economic and Business Research, University of Kansas, Lawrence, Kansas, April, 1982.

58. Rensselaer Polytechnic Institute, Rensselaer Technology Center, August, 1981.

59. Research Foundation of Kansas, Design for a Study of a Research Resources Inventory for Kansas, September, 1966.

60. Research Foundation of Kansas, Eight Chapters in the Story of Research and Development in Kansas, January, 1968.

61. Research Foundation of Kansas, Five-Year Plan for Technical Services in Kansas, January, 1966.

62. Research Foundation of Kansas, Roster of Facilities in Kansas, June, 1967.

63. Research Foundation of Kansas, Report of Progress, 1965-1966, June, 1967.

64. Research Foundation of Kansas, Report of Progress, 1968, December, 1969.

65. Research Foundation of Kansas, 1967 Report of Progress, March, 1969.

66. Research Foundation of Kansas, Report on Research and Development Inventory, 1965.

67. Research Foundation of Kansas, Research Resources of Kansas, June, 1966.

68. Research Foundation of Kansas, Specialty Tabulation and Guide for the Roster of Research and Development Specialists, June, 1967.

69. Scientific American, "Marketing to the High-Growth, High-Technology Segments of the U.S. Economy," Spring 1982.

70. Shapiro, William, and Charles F. Harking, "Build the Lab Where Its Best for the Company," Industrial Research and Development, December, 1981.

71. Silnor, A. David, "Venture Financing: States Vie for Entrepreneurs," Venture, June, 1981.

72. Stewart, Milton D., "Bringing It All Back Home," Inc., June, 1982.

73. Stone, Henry O., Former Professor of Microbiology, University of Kansas, Letter of Resignation, June, 1982.

74. Task Force on Capital Formation, "Final Report to the Governor," KDED, December 12, 1981.

75. Task Force on Technological Innovation, "State Activities to Encourage Technological Innovation: An Update," National Governors Association, February, 1982.

76. The Gourman Report: A Rating of Graduate and Professional Programs in American and International Universities, 1980.

77. The Wall Street Journal, "The Leapfrog Recession," Monday, July 19, 1982.

78. Tisdell, C.A., Science and Technology: Priorities of Governments, 1981.

79. Townsend, Lew, "WSU Discussed as Site of New Aeronautical Research Complex," The Wichita Eagle-Beacon, Saturday, October 10, 1981.

80. United States Department of Commerce, Bureau of the Census, County Business Patterns (1970 to 1980).

81. University of Kansas, "Research Capabilities that Relate to Industrial Applications," 1982.

82. University of Kansas, Research Equipment Committee, "Instramentation Needs for Research and Training," February, 1982.

83. Washington Report, "Reagan to Sign Research-and-Development Bill" and "Agencies Must Set Aside a Portion of Contracts for Small Businesses," July 13, 1982.

84. Waters, Jerry B., "Industrial Innovation and the University: A Washington Perspective," Unpublished paper/speech, November, 1980.

85. Wichita State University, College of Engineering, "Faculty and Areas of Specialization," 1982.

86. Wichita State University, Office of Research and Sponsored Programs, "Sponsored Research, Training, and Service Programs, Proposals, Grants, and Contracts," July, 1981.

87. Ylvisaker, William T., and Dr. Stanley O. Ikenberry, Co-Chairmen, "Report of the Governor's Task Force on High Technology," Illinios, March, 1982.

INTERVIEWS

A. Bearth, Dan, Editor, Kansas Business News. Telephone interview with Deanne Vieux, July 20, 1982.

B. Bibb, James. University of Kansas, Lawrence. Personal interview with Deanne Vieux, July 28, 1982.

C. Bogdan, Al. Executive Assistant to the Governor of Michigan. Telephone interview with Deanne Vieux, July 16, 1982.

D. Bramlet, Tim. Illinois Manufacturers' Association. Telephone interview with Deanne Vieux, July 22, 1982.

E. Brunkan, Steven R. Kansas Department of Human Resources. Telephone interview with Kevin Carr, September 2, 1982.

F. Christianson, Roger. Kansas Department of Economic Development. Personal interview with Deanne Vieux, Kevin Carr, Stan McAdoo, Bill Gomez, and Ed Riemann, July 9, 1982.

G. Crothers, John. Tennessee Department of Economic and Community Development. Telephone interview with Deanne Vieux, July 16, 1982.

H. Cummins, Robert. Indiana Department of Commerce. Telephone interview with Deanne Vieux, July 23, 1982.

I. Deemis, Kay. Utah Economic and Industrial Development Division. Telephone interview with Deanne Vieux, July 23, 1982.

J. Diehl, Charles. Chairman, Grain Science and Industry Department, Kansas State University. Telephone interview with Kevin Carr, July 27, 1982.

K. Emerson, Jarvin. Kansas State University. Telephone interview with Deanne Vieux, July 15, 1982.

L. Executive Director, Chamber of Commerce, Athens, Georgia. Telephone interview with Stan McAdoo, July 16, 1982.

M. Executive Director, Chamber of Commerce, Princeton, New Jersey. Telephone interview with Stan McAdoo, July 14, 1982.

N. Geoghean, John. California Manufacturers Association. Telephone interview with Deanne Vieux, July 27, 1982.

O. Goode, Don. Chairman, Animal Sciences and Industry Department, Kansas State University. Telephone interview with Kevin Carr, July 27, 1982.

P. Hamm, George. Chairman, Agronomy Department, Kansas State University. Telephone interview with Kevin Carr, July 27, 1982.

Q. Hooks, John. Office of the Governor of South Carolina. Telephone interview with Deanne Vieux, June 19, 1982.

R. Horowitz, Frances Degen. Vice-Chancellor for Research, Graduate Studies, and Public Services; also Dean of Graduate School, University of Kansas, Lawrence. Personal interview with Deanne Vieux and Kevin Carr, July 26, 1982.

S. Katerndahl, Dean. Director, Kansas City, Kansas, Department of Economic Development. Telephone interview with Deanne Vieux, August 11, 1982.

T. Kellum, Nancy. Ohio Development Financing Commission. Telephone interview with Deanne Vieux, July 15, 1982.

U. Kieschnick, Micahel. California Policy Planning and Research Office. Telephone interview with Deanne Vieux, July 21, 1982.

V. Koplik, Stan. Kansas State Board of Regents Executive Officer. Personal interview with Deanne Vieux, August 20, 1982.

W. Kruh, Robert. Dean, Graduate School, Kansas State University, Manhattan. Telephone interview with Deanne Vieux, July 15, 1982

X. Lindsey, Quentin. North Carolina Governor's Office. Telephone interview with Deanne Vieux, July 21, 1982.

Y. Long, Curt. Associated Industries of Missouri. Telephone interview with Deanne Vieux, July 21, 1982.

Z. Maily, Tom. Chamber of Commerce, Ithaca, New York. Telephone interview with Stan McAdoo, July 14, 1982.

AA. Mathers, Richard. Chamber of Commerce, Albuquerque, New Mexico. Telephone interview with Stan McAdoo, July 16, 1982.

BB. McCain, Dr. James. Topeka. Telephone interview with Deanne Vieux, August 4, 1982.

CC. Meyen, Edward. Associate Vice-Chancellor for Research, Graduate Studies, and Public Services. University of Kansas, Lawrence. Telephone interview with Deanne Vieux, July 19, 1982. Personal interview with Kevin Carr, July 22, 1982.

DD. Miller, Rae. Chamber of Commerce, West Lafayette, Indiana. Telephone interview with Stan McAdoo, July 15, 1982.

EE. Money, Dr. Mark. University of Utah Research Park, Salt Lake City. Telephone interview with Deanne Vieux, June 29, 1982.

FF. Moore, J.P. Arkansas Industrial Research and Extension Center. Telephone interview with Deanne Vieux, July 23, 1982.

GG. Muchmore, Carole. Kansas Department of Economic Development. Personal interview with Deanne Vieux, Ed Riemann, Stan McAdoo, Kevin Carr, and Bill Gomez, July 13, 1982.

HH. Muchmore, Lynn. Kansas Department of Administration, Budget Division. Personal interview with Deanne Vieux, July 20, 1982.

II. Nelson, Jane. Missouri Governor's Office. Telephone interview with Deanne Vieux, July 15, 1982.

JJ. Nordstrom, Carl. Executive Vice-President, Kansas Association of Commerce and Industry. Telephone interview with Deanne Vieux, August 24, 1982.

KK. Ozbun, James L. Acting Dean, School of Agriculture, Kansas State University. Telephone interview with Kevin Carr, July 20, 1982.

LL. Peterson, Norm. Illinois Department of Commerce and Community Affairs. Telephone interview with Deanne Vieux, July 15, 1982.

MM. Premus, Robert. Joint Economic Committee of Congress. Telephone interviews with Deanne Vieux, July 12, 1982 and August 5, 1982.

NN. Rathbone, Donald E. Dean, College of Engineering, Kansas State University. Personal interview with Kevin Carr and Bill Gomez, July 23, 1982.

OO. Redwood, Tony. Institute of Economic and Business Research, University of Kansas. Personal interview with Deanne Vieux, Bill Gomez, Stan McAdoo, and Kevin Carr, July 6, 1982.

PP. Roberts, Carol. Executive Assistant to the Greater Ann Arbro, Michigan Chamber of Commerce. Telephone interview with Stan McAdoo, July 15, 1982.

QQ. Schwartz, Charles J. Kansas Department of Economic Development. Personal interview with Deanne Vieux, Stan McAdoo, Kevin Carr, and Bill Gomez, July 14, 1982.

RR. Slosky, Leonard. Assistant to the Governor for Science and Technology, Colorado. Telephone interview with Deanne Vieux, July 15, 1982.

SS. Suderman, Frederick. Director of Research and Sponsored Programs, Wichita State University. Personal interview of Kevin Carr, August 3, 1982.

TT. Tetrault, Rick. Massachusetts Office of Economic Affairs. Telephone interview with Deanne Vieux, July 19, 1982.

UU. Thomas, Allison. California Commission on Industrial Innovation. Telephone interview with Deanne Vieux, July 15, 1982.

VV. Wilhelm, William J. Dean, College of Engineering, Wichita State University. Personal interview with Kevin Carr, August 3, 1982.