

Professor Michael E. Porter, Harvard University
Council on Competitiveness
Monitor Group
ontheFRONTIER

Wichita



CLUSTERS OF INNOVATION INITIATIVE





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CLUSTERS OF INNOVATION INITIATIVE: WICHITA

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Chairman's Foreword

Regional economies are the building blocks of U.S. competitiveness. The nation's ability to produce high-value products and services depends on the creation and strengthening of regional clusters of industries that become hubs of innovation. We are developing a better understanding of how these clusters raise productivity and are able to innovate more rapidly due to the ability to bring together technology, resources, information, and talent among companies, academic institutions, and other organizations. Close proximity, and the accompanying tight linkages, yields better market insights, more refined research agendas, larger pools of specialized talent, and faster deployment of new knowledge.

Utilizing a unique database developed at the Institute for Strategy and Competitiveness at the Harvard Business School, we are able to measure the relative strength of regional clusters and track their economic and innovation performance over time. In addition, professionals at the Council on Competitiveness, Monitor Group and its affiliate ontheFRONTIER, and the Institute conducted surveys, interviews and analyses in order to assess the strengths and challenges of the regional economies and selected clusters in Wichita, Atlanta, Pittsburgh, the Research Triangle in North Carolina, and San Diego.

We are pleased to present this report on Wichita — the second of five reports on pilot regions. The study contains a conceptual framework for assessing the competitiveness of regional economies, an analysis of the Wichita region overall, as well as detailed assessments of two representative clusters— aerospace vehicles and defense and plastics. The report outlines the accomplishments, lessons learned, challenges, and opportunities for Wichita. These findings will be integrated into a national report to inform both the public and private sector of new strategies used for regional economic development and cluster upgrading. The report will be released at the National Clusters of Innovation Conference on December 13, 2001 in Washington, DC.

We wish to acknowledge the tremendous support we received from the Wichita community with particular thanks to our local advisors. Many of you have helped us to create a unique knowledge base about your region, its industries and its organizations. Your thoughts and insights are embedded in this report, and will benefit not only Wichita but other parts of the country.

Sincerely,



F. Duane Ackerman
Co-Chair, Clusters of Innovation Initiative
Chairman & CEO, BellSouth Corporation



Michael E. Porter
Co-Chair, Clusters of Innovation Initiative
Bishop William Lawrence University Professor,
Harvard Business School

INTRODUCTION

About the Clusters of Innovation Initiative

Future U.S. competitiveness will hinge on our capacity to foster clusters of innovation in regions throughout the country. The clusters of innovation concept represents a new way of thinking about the economy and has begun to take hold as communities across the nation look at the successes of California's Silicon Valley and Massachusetts' Route 128. It is regions such as these, containing many vibrant clusters, that drive the U.S. economy. The nation's ability to produce high-value products and services that support high wage jobs depends on the creation and strengthening of many more regional hubs of innovation.

The **Clusters of Innovation Initiative** was launched to help meet this challenge. Under the leadership of Professor Michael Porter, Harvard University, and Duane Ackerman, Chairman and CEO of BellSouth, and guided by a steering committee of national leaders, the Initiative aims to understand how clusters develop within a regional economy, and to use these lessons to inform key decision makers in every part of the country.

The **Initiative** benefits greatly from a partnership of the Cluster Mapping Project at the Institute for Strategy and Competitiveness at Harvard Business School, the Council on Competitiveness, the Monitor Group and its affiliate, ontheFRONTIER. The Cluster Mapping Project has created a detailed statistical analysis of county-level business data that defines 41 types of clusters (e.g., information technology, automotive, business services) that are found in regions throughout the U.S. economy and maps regional economies by cluster and constituent industry. The data also includes detailed metrics on employment, average wages, new establishment formation and patenting, thus enabling rigorous analysis of the comparative economic performance of regions and their clusters.

In addition to the Mapping Project, professionals from the Council, Monitor Group, and ontheFRONTIER are using a broad-reaching survey—the Clusters of Innovation Initiative Regional Survey—and in-depth interviews to study the historical growth and current performance and composition of local economies and selected clusters in regions around the country: Atlanta/Columbus, GA; Pittsburgh, PA; Raleigh/Durham/Chapel Hill, NC (Research Triangle Area); San Diego, CA; and Wichita, KS. In Wichita, 138 executives were surveyed, and another 74 were interviewed. By using a common methodology and drawing on comparable data, we are able to make valid comparisons across regions and clusters to learn what factors drive cluster development and economic performance and draw lessons to inform both public and private action agendas.

Wichita

This report on Wichita is the second of the five regional reports to be released this year. Like San Diego before it, Wichita is an illustrative example from which other similarly sized regions can learn. Wichita has experienced fairly steady economic prosperity during the last 80 years. Wichita lays claim to early innovative entrepreneurs, most markedly in aerospace vehicles and defense, whose innovations contributed to the region's present broad-based manufacturing capacity and economic prosperity. The U.S. government's need for military aircraft fostered the burgeoning aerospace vehicles and defense cluster. Early Wichita innovations extended to other areas including plastics, machinery, and franchised restaurants. But Wichita's economic prosperity is challenged. Established companies are not innovating at a high rate due to weak innovative capacity. Entrepreneurial firms lack the necessary support to start their new businesses.

Innovation, the root of Wichita's modern economic prosperity, needs to be nurtured. This report seeks to explain the roots of Wichita's solid economy, describe the challenges faced by the region, and provide guidance to help Wichita firms and institutions maintain economic prosperity in the future.

Organization of the Report

This report is divided into five sections:

- **Section 1** provides an overview of the determinants of regional competitiveness and innovative capacity.
- **Section 2** outlines a methodology for assessing them.
- **Section 3** applies this model of regional competitiveness to Wichita. It examines the overall performance and composition of the Wichita economy, and describes how Wichita transformed its economy over the course of the 20th century.
- **Section 4** examines the history, competitive position, and performance of selected clusters— aerospace vehicles and defense and plastics—in the region.
- **Section 5** draws from the regional and cluster analyses to identify lessons, challenges, and opportunities that will inform the national Clusters of Innovation Initiative.

The development of specific recommendations and action plans is beyond the scope of this report. Nevertheless, it does provide many high-level recommendations, including several new strategic directions to pursue, challenges to overcome, and opportunities to seize in order for Wichita to sustain its competitive position and performance going forward.

The National Clusters of Innovation Conference

The findings of this report and those from the other pilot regions will be presented at a **National Clusters of Innovation Conference** to be convened this December in Washington, D.C. by the Council on Competitiveness and in conjunction with the National Governors Association. These findings will provide the analytical basis for this conference and other initiatives to create and support high-performing industries and sustain our nation's competitiveness and prosperity.

ACKNOWLEDGMENTS

Underwriting for this report was generously provided by the city of Wichita, Kansas Technology Enterprise Corporation, Sedgwick County, the Coleman Company, Inc., Koch Industries, Inc., Wichita Technology Corporation, Kansas Inc., Bank of America, Western Resources, Wichita State University, Cessna, the Boeing Company, Raytheon, and Bombardier Aerospace.

This report benefits from the leadership of Professor Michael Porter, Harvard Business School; Duane Ackerman, BellSouth Corporation; and the efforts of professionals from the Harvard Business School Cluster Mapping Project, Monitor Group and its affiliate, ontheFRONTIER, and the Council on Competitiveness.

Daniel Vasquez, Christian Ketels, Elizabeth de Fontenay, Weifeng Weng, Veronica Ingham, and Orjan Solvell, from the Harvard Business School Cluster Mapping Project, provided extensive regional and industry cluster data for this report.

Kyle Peterson, ontheFRONTIER, and Kurt Dassel, Monitor Group, were the report's principal authors. Mark Fuller and Jeff Grogan of the Monitor Group provided overall project direction and editorial advice.

John Yochelson and Alan Magazine at the Council on Competitiveness provided project oversight and interface with business and government leaders in Wichita. Michelle Lennihan coordinated the fieldwork, performed data analysis, and gave general project direction. Debra VanOpstal and Jackie Mathewson provided additional national economic data and analysis, as well as ongoing review and critique of the project.

Allen Bell, city of Wichita; Rich Bendis, Kansas Technology Enterprise Corporation; Trish Brasted, Wichita Technology Corporation; and John Rolfe, Wichita Area Chamber of Commerce, reviewed and commented on drafts of this report and served as advisors to the project. Janet Nickel Harrah and Mohamed Gamal of Wichita State University also provided valuable assistance to the project. Mark Dodds, Wichita Technology Corporation, assisted with interviews of community and business leaders.

Lily Rappoli and her colleagues at the Design Studio at Monitor Group illustrated, designed and created the layout of this report.

Over 150 Wichita business and government leaders contributed to this project in some way by providing background information, granting us interviews, completing surveys and offering helpful suggestions. While the report tries to reflect the consensus view of those interviewed and surveyed, it also attempts to be concise. Any errors, omissions or inconsistencies are the responsibility of the report writers and not any one individual or institution.

For additional information on this research, contact Kurt Dassel at Monitor Group (e-mail: Kurt_Dassel@Monitor.com) or Michelle Lennihan at the Council on Competitiveness (e-mail: Lennihan@compete.org).

CLUSTERS OF INNOVATION

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Steve M. Samek, U.S. Managing Partner, *Arthur Andersen L.L.P.*

Julie Meier Wright, President and CEO, *San Diego Regional Economic Dev. Corp.*

Wichita Regional Advisors

Richard Bendis, *Kansas Technology Enterprise Corporation*

Donald Beggs, *Wichita State University*

Michael Biggs, *Klenda, Mitchell, Austerman & Zuercher, L.L.C.*

C.Q. Chandler, IV, *Intrust Bank*

Bill Hanna, *Koch Industries*

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Jeff Turner, *Boeing Wichita*

Tom G. Winters, *Sedgwick County Commissioners*

Jim Ziegler, *Bombardier Learjet*

HIGHLIGHTS OF THE CLUSTERS OF INNOVATION INITIATIVE REPORT ON WICHITA

Regional Competitiveness and Innovative Capacity

- The economic goal for Wichita should be a high and rising standard of living.
- This depends upon creating a high quality business environment which fosters innovation and rising productivity.
- Strong and competitive clusters are a critical component of a good business environment, and are the driving force behind innovation and rising productivity in a region.
- All levels of government can influence the business environment and the productivity of clusters.
- While government can help foster a favorable business environment, companies and industries must ultimately achieve and sustain competitive advantage.
- Formal and informal institutions for collaboration such as regional economic development organizations and alumni of large influential companies are important contributors to cooperation in advanced economies.

Wichita's Successes Over the Past Decade

- Wichita's unemployment and exports per capita exceed national benchmarks.
- The region surpasses the nation and the state in terms of traded employment, which accounts for near national average wages in the region.
- Wichita's aerospace vehicles and defense firms have grown dramatically, particularly since 1998.
- The region's strength in manufacturing has bestowed the region with a good standard of living.

Strengths

- Wichita has a good number of large and fast-growing clusters.
- Modern Wichita is a broad-based manufacturing center.
- Wichita benefits from a central geographic location.
- The region has a pool of skilled, manufacturing-oriented workers.
- Wichita has a culture of vigorous competition, particularly among the aircraft firms in the region.
- World-renowned businesses started and maintain operations in Wichita.
- The region has a heritage of and appreciation for entrepreneurship.

Challenges

- Wichita's low patent activity compared to national benchmarks and low investment in R&D have created a relatively weak innovative capacity.
- While the region's employment in the aerospace vehicles and defense cluster has declined since 1988, Wichita's near national average wages are still dependent on this cluster.
- The region is impacted by a labor shortage yet has only recently developed a workforce development strategy.
- Wichita has a relatively good portfolio of large and growing clusters, but many of these clusters have wages and patent activity below the national average. There is also limited cluster thinking among the top clusters.
- There are relatively few institutions for collaboration that are vital to idea generation and commercialization for Wichita's firms.
- Scarcity of risk capital limits venture capital investments, IPOs and fast growth firms.
- There have been weaknesses in the transportation infrastructure, particularly in regards to air service.
- The region has yet to craft a community-wide economic strategy for the Wichita of the future.

Opportunities

- The region can focus on broadening the dominant aerospace vehicles and defense cluster.
- The relatively undeveloped plastics cluster offers real opportunities for development and expansion.
- Economic development leaders stress the larger, higher profile clusters such as aerospace vehicles and defense. The region actually has a good position in 13 clusters which offer economic development potential.
- There are many linkages among the region's manufacturing-oriented clusters. Research and training are only two examples of these unexploited linkages. Wichita State University (WSU) and the National Institute for Aviation Research (NIAR) have an opportunity to expand their research capacity.
- Medical services, aviation tourism, and call centers also offer opportunities for expansion.

The Need for New Directions

- The challenge for modern Wichita is to focus on innovation. NIAR can be positioned as an innovation partner to industry.
- The region has been the successful incubator of world-renowned firms. Wichita needs to develop the clusters that surround these anchor companies.
- Building on its heritage of entrepreneurship, the region should seek out and support new entrepreneurs who can help improve regional innovative capacity.
- Economic development plans can change from a defensive to offensive position.
- Wichita was founded on boldness and big thinking. Regional leaders should come together and assemble a new, bold economic development strategy for the Wichita of tomorrow.

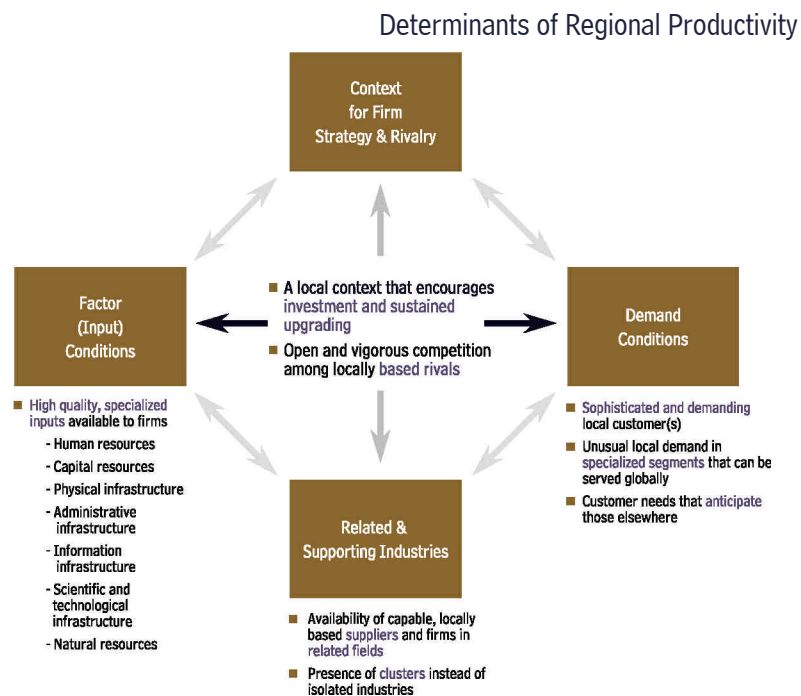
EXECUTIVE SUMMARY

The Determinants of Regional Competitiveness and Innovative Capacity

The central economic goal for Wichita should be to attain and sustain a high and rising **standard of living** for its citizens. The ability to earn a high and rising standard of living depends on increasing **productivity**, which in turn depends on innovation. The central challenge then in enhancing prosperity is to create the conditions for **sustained innovation output**.

A critical driver of innovation output is the quality of the regional **business environment** in which firms operate. This environment is embodied in four broad areas that affect the productivity that can be achieved as well as the rate of innovation.

- **Factor conditions.** Achieving high levels of innovation and productivity growth depends on the presence of high quality and specialized pools of human resources, applied technology, infrastructure, and even sources of capital that are tailored to the needs of particular industries.
- **Demand conditions.** The quality of demand at home has a strong influence on the process of creating and improving products and services. Sophisticated customers in the region press firms to improve and offer insights into existing and future customer needs.
- **Context for firm strategy and rivalry.** The rules, incentives, and pressures governing the type and intensity of local rivalry have a fundamental influence on productivity policies that encourage investment, protect intellectual property, and foster productivity growth.
- **Related and supporting industries.** Local sourcing from capable suppliers based in the region can enhance productivity and improve the capacity for innovation through allowing quicker and less costly communication, fostering the flow of ideas and enhancing flexibility through outsourcing.



These four areas of the diamond shown above are self-reinforcing and act as a system. Regional rivalry, for example, stimulates the development of unique pools of specialized skills and the formation or attraction of specialized suppliers. Active local rivalry also upgrades regional demand by creating more demanding customers.

Clusters and Productivity

The workings of these attributes lead to the formation of **clusters**, or geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by customer, supplier, or other relationships.

Once a cluster forms, the industries that compose it become mutually reinforcing. Information flows freely, and innovation spreads rapidly through the relationships among customers and suppliers. Institutions such as colleges and universities adapt to cluster needs. Rivalry in one industry spreads to other industries in the cluster through spin-offs or related diversification.

Through a cumulative process that often occurs over several decades, the region becomes a repository of specialized expertise, technology, and institutions for competing in a given field.

Clusters innovate faster because they draw on local networks that link technology, resources, information, and talent. Strong competitive local pressures increase incentives for a cluster participant to innovate. Clusters build the basis for **specialized** skills and capabilities and enable competitive advantage in world markets.

The Role of Government on Competitiveness

Government at all levels has an influence on the business environment and the innovative potential of clusters. Government's proper role is to improve the business environment rather than to intervene directly in the competitive process.

Government has four fundamental roles:

- Improve the quality of basic inputs that firms draw upon, such as human resources, physical and technological infrastructure, and capital;
- Create rules, regulations, and incentives that encourage innovation and upgrading. Through regulations, tax policy, and antitrust enforcement, government policies influence the climate in which firms compete;
- Build upon and reinforce the formation of local clusters; and

- Raise the sights of local firms and the region's citizens — helping to educate about the imperative of international competition, articulating an economic vision for the region, signalling the future, and so forth.

Institutions for Collaboration

Companies can invest to upgrade the local environment individually and through industry associations and other institutions for collaboration. These are formal and informal organizations and networks that (1) facilitate the exchange of information and technology; and (2) foster various kinds of coordination and collaboration that can improve the business environment in a cluster or in the overall economy.

Private Sector	Joint Private/Public
<ul style="list-style-type: none"> ■ Wichita Area Chamber of Commerce ■ Cluster Specific Organizations ■ Wichita Manufacturers' Association ■ SCORE — Wichita Chapter 143 ■ Wichita Independent Business Association ■ South Central Kansas Economic Development District (SCKEDD) 	<ul style="list-style-type: none"> ■ Kansas Technology Enterprise Corporation ■ Economic Development Advisory Group ■ Kansas World Trade Center ■ Wichita Technology Corporation ■ National Institute for Aviation Research
Informal Networks	Public Sector
<ul style="list-style-type: none"> ■ Wichita State University Alumni ■ Angel investor community ■ Wichita Technology Council 	<ul style="list-style-type: none"> ■ Small Business Administration ■ Center for Economic Development and Business Research ■ Small Business Development Center ■ Bureau of Community Development, Sedgwick County ■ Kansas Minority Business Development Council ■ Regional Economic Area Partnership (REAP) ■ Mid-America Manufacturing Technology Center (MAMTC) ■ Center for Entrepreneurship (WSU)

Selected Institutions of Collaboration in Wichita

The Composition of Regional Economies

Regional economies are composed of four main types of activities:

- **Local clusters.** These clusters are found everywhere and produce goods and services which are needed by the local population (e.g., retail trade).
- **Traded clusters.** Traded clusters produce goods and services in a particular locale, and then distribute that product across the nation or globe (e.g., automotive, medical devices). These clusters are concentrated only in a handful of regions.
- **Natural resource clusters.** Natural resource clusters are found in locations where a particular natural resource is abundant; they are there to extract and distribute that resource.
- **Local operations of clusters based elsewhere.** These are not research, manufacturing, or other knowledge-intensive activities, but those involved in marketing and distribution.

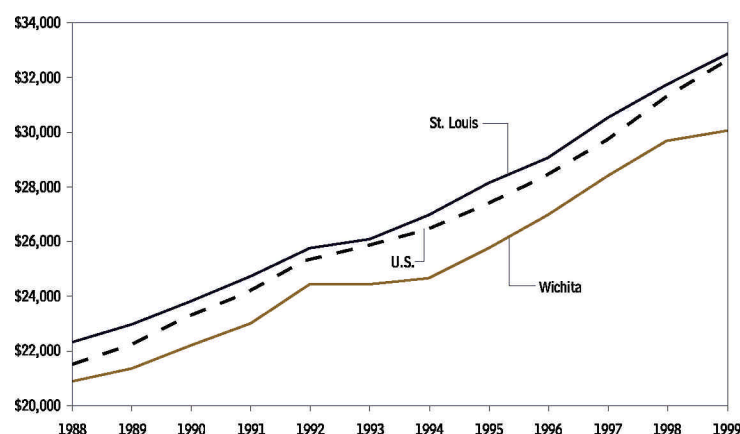
Traded clusters drive regional prosperity. While local clusters account for roughly two-thirds of employment in an average region, traded clusters heavily drive the prosperity and growth of a region; average wages in traded clusters are roughly \$13,000 a year higher than wages in local clusters. This is because traded clusters can achieve higher productivity, their growth is unconstrained by the size of the local markets, and their success creates much of the demand for local clusters.

PERFORMANCE AND COMPOSITION OF THE WICHITA ECONOMY

Overall Economic Performance Indicators

- **Employment.** The compound annual rate of growth of employment in Wichita was 1.2%, below the Kansas rate at 1.3% growth and the U.S. rate at 1.7%.
- **Unemployment.** Unemployment in Wichita dropped from a high of 6.6% in 1994, to 3.3% in 2000.
- **Wages.** Average wages are above the state average but below national and benchmark averages. Recent wage growth has trailed both the state and the nation.

Average Wages in Select Geographic Areas



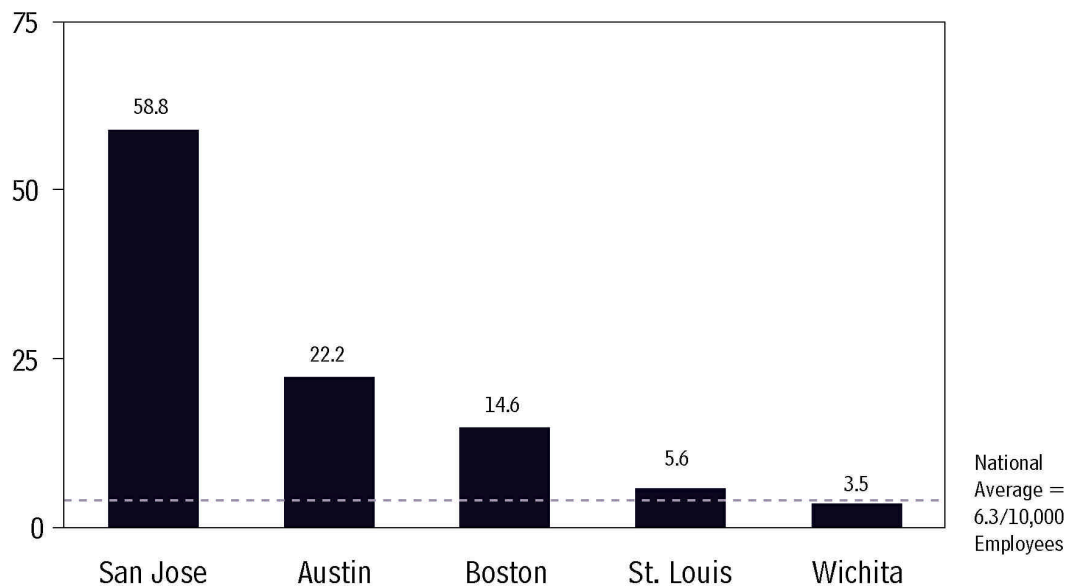
Note: Average wages are nominal
Source: Bureau of Economic Analysis

- **Cost of Living.** Wichita has a composite cost of living index of .98 compared to a national average of 100.
- **Productivity.** The productivity of Wichita overall trails the nation.
- **Exports.** Wichita exports almost 52% more per worker than the national average and annual export growth is about even with the nation.

Innovative Capacity Indicators

- **Patents.** Wichita had 3.5 patents per 10,000 workers compared to the national average of 6.29 per 10,000 workers. Wichita's per worker patent rates are well below benchmark regions and growing slowly at 3% compared to the national growth rate of 6.5%.
- **Venture Capital.** Wichita's venture capital funding per worker is \$20 compared to \$266 for the nation. Data limitations prevent venture capital growth rate analysis.
- **Fast Growth Firms.** With the exception of 1991 and 1996, the Wichita MSA had .2% of Inc. 500 firms as compared to its .24% share of national employment.

Patents per Employee for Selected Metropolitan Statistical Areas

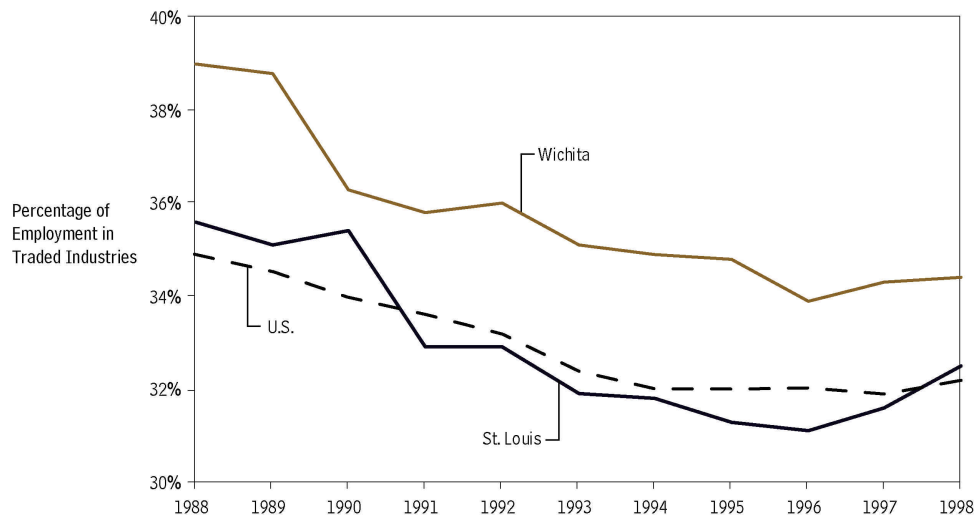


Source: U.S. Patent and Trademark Office

Composition of the Wichita Regional Economy

- **Traded industry versus local industry employment.** In 1998, 34% of Wichita's employment was in traded clusters such as aerospace vehicles and defense and plastics; 65% of Wichita's employment was in local clusters such as personal services, local construction, and real estate development. Employment in traded industries in the Wichita Economic Area was greater than Kansas, St. Louis and the U.S. overall.

Traded Versus Non-Traded Employment, Selected Geographic Areas, 1998



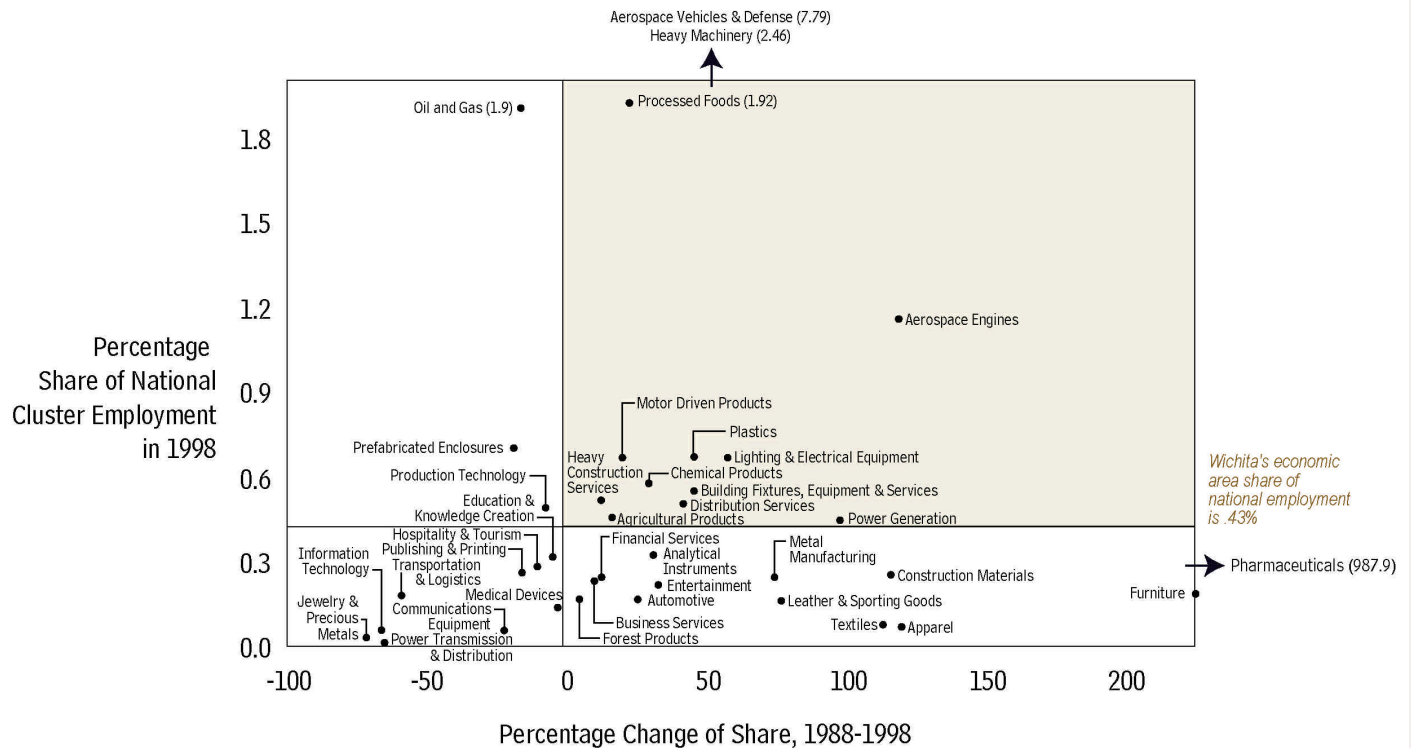
Source: Cluster Mapping Project, Institute of Strategy & Competitiveness, Harvard Business School

- **Good positions in numerous clusters.** The Wichita Economic Area had thirteen clusters that were large and fast-growing in 1998: aerospace vehicles and defense, aerospace engines; heavy machinery; processed foods; motor driven products; plastics; lighting and electrical equipment; chemical products; heavy construction services; building fixtures, equipment and services; distribution services; agricultural products; and power generation.
- **Certain clusters contribute to near national average wages in the region.** Among the region's largest 11 clusters, aerospace vehicles and defense, business services, distribution services, financial services, and plastics all contribute to a traded cluster average wage that is considerably higher than the regional average wage.

Assessment of Overall Innovative Capacity

- **Strengths**
 - Moderate cost of living.
 - Strong positions in a series of manufacturing-related clusters and subclusters.
 - Central geographic location.
 - Pool of skilled workers.
 - Culture of vigorous competition.
 - Supportive local government.
 - Entrepreneurial culture.

Traded Clusters by Size and Relative Growth Rate EA, Narrow Industries, 1998

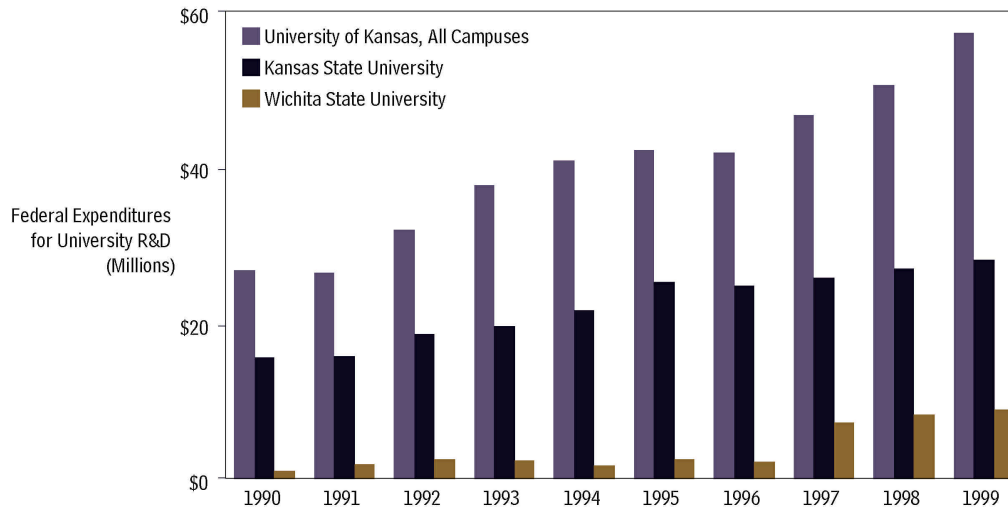


Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

• Challenges

- Dependency on the employment and wages of the aircraft subcluster.
- Labor constraints.
- Low rate of innovation.
- Lack of cluster thinking.
- Few institutions for collaboration.
- Scarcity of risk capital.
- Weaknesses in transportation infrastructure.
- Lack of consensus on community-wide economic strategy.

Federal Expenditures for University R&D per Employee, Wichita MSA and the U.S.



Source: NSF WebCASPARD Database System, U.S. Bureau of Labor Statistics
Adjustments to 97/98 data from Office of Research Administration, WSU

ASSESSMENT OF THE AEROSPACE VEHICLES AND DEFENSE CLUSTER

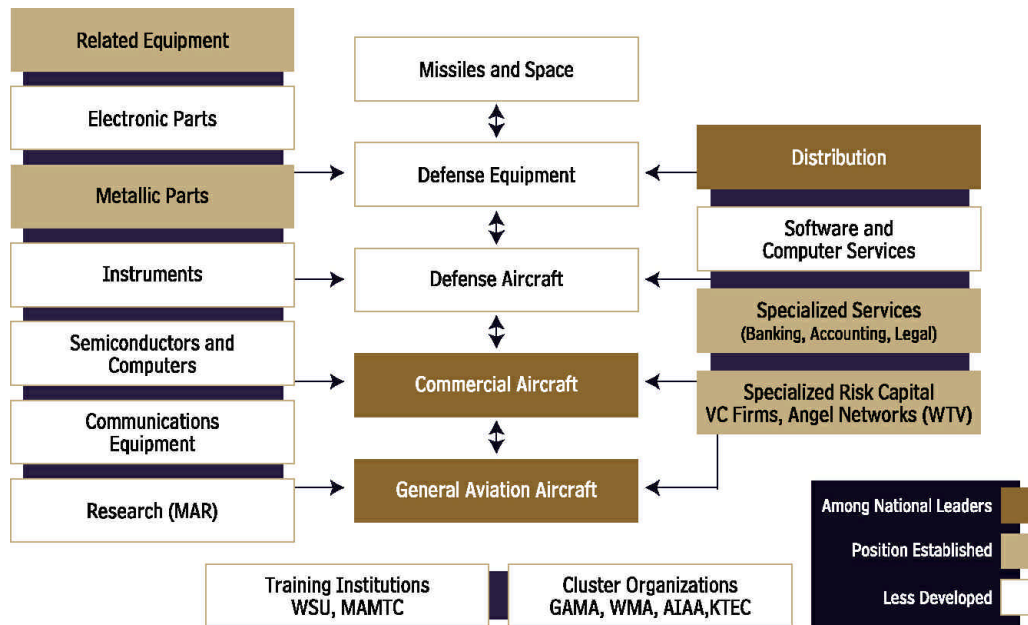
Economic Performance

- **Employment.** The Wichita cluster was the fifth largest aerospace vehicles and defense cluster in the nation by Economic Area and was the third most concentrated of the 20 largest clusters, as measured by location quotient for broad industries. The Wichita cluster was the seventh fastest growing cluster among the 20 largest aerospace vehicles and defense clusters by Economic Area.
- **Wages.** Wages were below the national average in 1998 for the cluster and rose more slowly than the national growth rate.
- **Patent Registration.** With 7.8% of national cluster employment, the aerospace vehicles and defense cluster had only .5% of the national cluster patent share in 1998. The region claimed two patents in 1998 and created .05 patents per 1,000 workers, about 5.8% of the national average for the aerospace vehicles and defense cluster. Wichita ranked 18th out of the 20 largest aerospace vehicles and defense clusters in terms of patents in 1998.

Composition

- The Wichita aerospace vehicles and defense cluster is focused on manufacturing/assembly and highly concentrated in the aircraft subcluster. Wichita ranks 18th for industry breadth out of the 20 largest aerospace vehicles and defense clusters in the country.
- The cluster is competitive in the commercial and general aviation aircraft, distribution, related equipment, and metallic parts subclusters. At an industry level, the region has a heavy concentration of employment in aircraft and aircraft parts and equipment, transportation equipment and supplies-wholesale, plating and polishing, computer storage devices, instruments to measure electricity, and facilities support services. The cluster's weaknesses lie in the following subclusters: missiles and space, defense equipment, electronic parts, instruments, communications equipment, software and computer services, and research.

Wichita Aerospace Vehicles and Defense Cluster



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Innovative Capacity

• Strengths

- Trained and skilled workers.
- National Institute for Aviation Research (NIAR).
- Vigorous competition among regionally-based rivals.
- Four global aircraft manufacturers in region acting as anchors to the cluster.
- Regional business support firms (legal, accounting, banking) developed to support specialized needs of the aerospace cluster.
- Abundant local machine shops making quality parts.
- Local aircraft companies considered to be sophisticated, to have special needs and to be demanding buyers.
- Local government considered to be responsive to the cluster.

• Challenges

- Low levels of federal and state funding for basic and applied research.
- NIAR requiring more funding, with a limited commercialization track record, not focusing on break-through technology, and conducting little technology transfer to aerospace entrepreneurs.
- Tight labor supply for trained and skilled workers.
- Wichita State University (WSU) not on the Year 2001 list of the U.S. News and World Report's 50 best engineering graduate schools or the 101 best undergraduate engineering programs with PhD programs.
- Aerospace vehicles and defense cluster employment is concentrated within one subcluster.
- Few suppliers of sophisticated parts and components.
- Limited contribution by suppliers in the innovation process.
- Lack of a cluster umbrella organization.
- Limited number of institutions for collaboration.

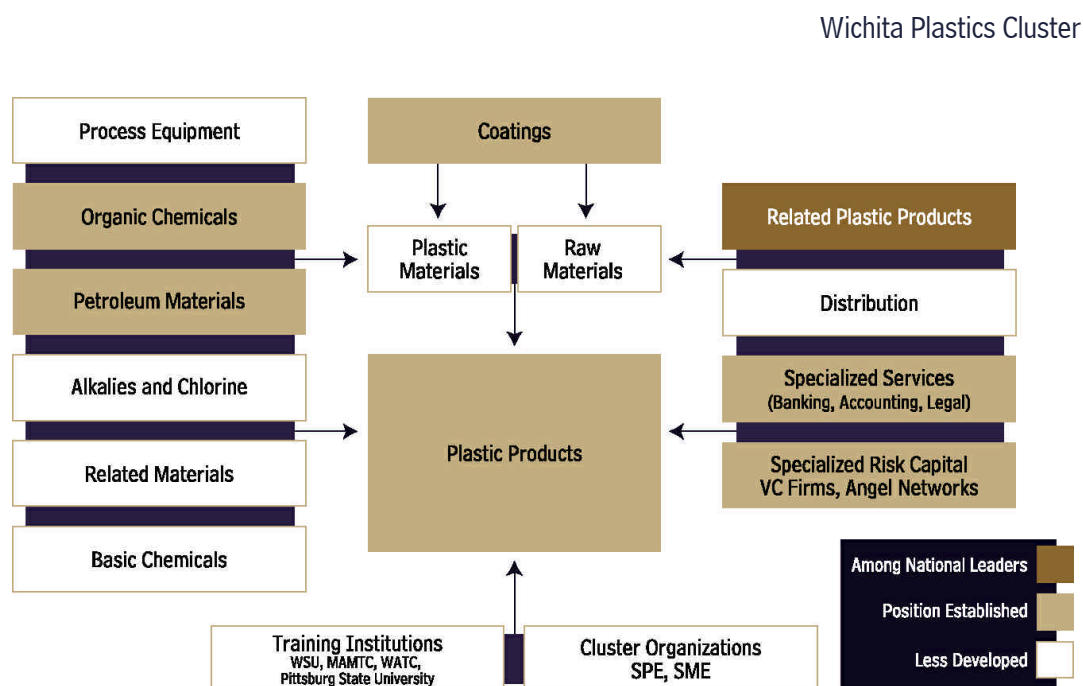
ASSESSMENT OF THE PLASTICS CLUSTER

Economic Performance

- **Employment:** In 1998, the Wichita plastics cluster was the 41st largest by Economic Area. Plastics products (37th) and petroleum materials (15th), two subclusters within the plastics cluster, performed better than the overall cluster ranking when compared to other large plastic clusters in the nation.
- **Wages:** Average wages in the cluster are relatively high and are growing faster than national average wages for the plastics cluster.
- **Patent Registration:** Patents for the Wichita plastics cluster in 1998 represented .2% of the total plastics patents in the country or about a third of what would be expected, given Wichita's share of national employment. The Wichita plastics cluster's one patent per 1,000 employees is 28% of the national average per 1,000 workers for the cluster.

Composition

- The focus of the Wichita plastics cluster is on manufacturing of plastics products and related products to businesses and consumers. The region is home to a number of petroleum producers and chemical companies, which explains the competitive position of the organic chemicals and petroleum materials subclusters. Wichita is also competitive in coatings. The cluster is less developed in raw material inputs, distribution, plastic materials, basic chemicals, related materials, alkalies and chlorine, and process equipment.



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School Interviews, Clusters of Innovation Initiative Regional Opinion Survey

Innovative Capacity

• Strengths

- Two nationally recognized plastic firms located in the region (the Coleman Company and Rubbermaid).
- Plastics curriculum at Pittsburgh State University.
- Polymer research institute at Pittsburgh State University.
- Competition among regionally based rivals, particularly among injection molding companies.
- Suppliers of satisfactory quality.
- Sophisticated and demanding local buyers.
- Composite lab at WSU.

• Challenges

- Low levels of R&D investment, and limited use of existing local research.
- Narrow cluster, relying on only one industry for bulk of employment.
- For the most part, relatively simple products manufactured.
- Little feedback from local suppliers on innovation.
- Limited supplier base.
- Potential of local demand not fully realized.
- Low levels of federal and state government funding for basic research.
- Few institutions for collaboration.
- Cluster awareness low.
- Local assets not well linked or utilized.

SUSTAINING COMPETITIVE ADVANTAGE: LESSONS, CHALLENGES, AND OPPORTUNITIES FOR WICHITA

Lessons

The development of the Wichita region offers eight important lessons for other regions.

- **Successful economic development leverages a region's national and other distinctive assets.** Wichita's economic development leaders have built upon a number of assets to create the manufacturing center that exists today.
- **Entrepreneurial leadership is at the core of economic growth.** Wichita's success is built on the risky decisions and hard work of aerospace vehicles and defense entrepreneurs and their successors in plastics, restaurant franchising, chemicals, oil and gas and others.
- **Innovation underpins competitive advantage.** innovation is critical in an advanced economy, and Wichita has demonstrated innovation in aerospace, plastics, and franchise services.
- **Anchor firms have a disproportionate influence on an economy.** Wichita's key clusters are composed of a few large and powerful anchor firms.
- **Clustering creates unique labor pools and other assets.** Wichita has a pool of specialized labor with strong manufacturing skills.
- **Cluster breadth and depth is essential to sustained vitality.** Although no region can have a relative strong presence in all 41 clusters found throughout the U.S. economy, it is important to have a strong presence in several of them. Wichita has a strong position in 13 manufacturing-oriented

clusters which all require nurturing.

- **Spillovers across clusters spur new business formations and economic development.** Clusters beget other clusters, as interactions across disciplines seed new lines of business. The aerospace vehicles and defense cluster aided the development of the plastics cluster in Wichita just as the existence of oil and gas spurred the chemical cluster.
- **Specialized R&D is required for success in a knowledge economy.** The imperative to innovate in Wichita requires best in class expertise in such fields as advanced plastics and materials, aerospace vehicles and defense engineering industrial engineering, applied engineering, and so forth. WSU and NIAR are critical for Wichita's R&D but they have not reached their innovation potential.

Challenges

For the most part, Wichita's near national average wages are not the result of recent innovations but rather the legacy of the region's original entrepreneurs and their successors. Its core challenges are to improve its innovative capacity, strengthen the aerospace vehicles and defense cluster, nurture plastics and deepen the other manufacturing-oriented clusters in the region.

- **Dependency on the Employment and Wages of the Aircraft Subcluster.** Wichita's prosperity is tied to a few firms in a few industries. The aerospace vehicles and defense cluster alone is responsible for close to 20% of narrow cluster employment in the Wichita region.
- **Quality and Quantity of Human Resources.** Out of a list of 15 factors, community and business leaders overwhelmingly chose access to skilled labor as the number one barrier to firm expansion. Of the five regions in the Clusters of Innovation study, Wichita ranked second in terms of citing low availability of labor as a future threat to the region.
- **Low Rate of Innovation.** Wichita's economy is not built on research and development, the source of other regions' competitive advantage.
- **Few Institutions for Collaboration.** Wichita has few crosscutting (e.g., university to private sector, or among the manufacturing-oriented clusters) and cluster specific (e.g., aerospace vehicles and defense, plastics) institutions for collaboration.
- **Weaknesses in Transportation Infrastructure.** Wichita's physical infrastructure cannot adequately serve the future growth of the region.
- **Scarcity of Risk Capital.** Venture capital is scarce in Wichita, but the region has a major asset in its local angel investors.
- **Limited Cluster Thinking.** Wichita has not distinguished itself as a region of model cluster development or cluster mindedness.
- **Lack of Consensus on Community-Wide Economic Strategy.** The region has yet to craft a vision for the Wichita of the future and a follow-on strategy that takes into account increasing international competition, the vital importance of human capital, specialized research and development, advanced educational facilities and innovation.

Opportunities

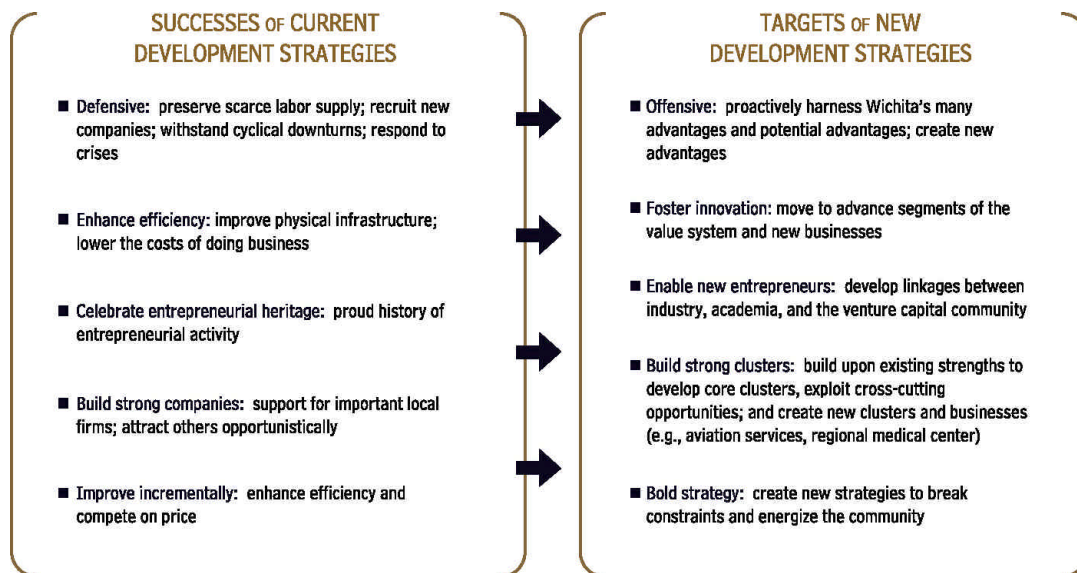
Opportunities include deepening the aerospace vehicles and defense cluster, upgrading the plastics cluster, energizing other clusters, mounting a crosscutting manufacturing strategy, and pursuing less obvious cluster opportunities.

- **Expand Aerospace Cluster Beyond Aircraft Assembly.** The region can focus on improving technology transfer, deepening the local supplier base and improving links with suppliers, addressing workforce issues, connecting to the plastics cluster and branching out into related services.
- **Upgrade the Plastics Cluster.** This cluster seems to be developing on its own without respected steering and strategy-setting mechanisms, significant government support, or research assistance.
- **Develop Specific Clusters.** Wichita has a number of large and growing clusters that have not received a great deal of attention. In addition to aerospace vehicles and defense and plastics discussed in this report, food processing, metal manufacturing, production technology, heavy machinery, prefabricated enclosures and the large but declining oil and gas industry, could all benefit from targeted support.
- **Mount a Crosscutting Manufacturing Strategy.** The common link among large and fast growing clusters in Wichita is the large skilled labor pool. Other linkages among these clusters, such as research, training, supporting industries, specialized service providers, customers, and so forth are not well developed in the region. Given Wichita's dependence on the aircraft industry, local leaders should create programs to strengthen these other linkages and build up more manufacturing-related clusters.
- **Pursue New Opportunities.** There are a number of interesting but less obvious business strengths in Wichita beyond the large and growing clusters mentioned above, such as medical services, aviation tourism and call centers.

The Need for New Directions

To stay competitive, the region needs to strengthen its innovation infrastructure, encourage new business start-ups, and spur cluster development. Most importantly, the region needs to chart a bold course focused on innovation.

- **Pursue Bold Strategies.** The region must be careful not to trade on its' comparative advantage of lower wages and essentially compete on price, a losing proposition today when other locations can produce the same product at even lower wage rates. Wichita cannot afford to improve incrementally — it must gather the appropriate stakeholders, focus on innovation, and chart a bold course forward.
- **Build Clusters.** The region has fostered a number of world-renowned companies during the last 80 years. Wichita should now turn to developing the clusters around these anchor companies.
- **Enable New Entrepreneurs.** The region has the right combination of entrepreneurial assets to position itself as one of the entrepreneurship capitals of the U.S.



- **Take the offensive.** The region's economic development plans have tended to adopt defensive goals, such as preserving a scarce labor supply, withstanding cyclical downturns, and responding to crises. The alternative offensive strategy is to proactively harness the many existing and potential advantages in Wichita and create new advantages.
- **Upgrade the Sophistication of Wichita manufacturing Economy.** Wichita has more than twice the national percentage of workers in the manufacturing sector. The region can be a center of advantaged manufacturing in the United States.

1

REGIONAL COMPETITIVENESS AND INNOVATIVE CAPACITY: CONCEPTUAL FRAMEWORK

DETERMINANTS OF REGIONAL PROSPERITY

A nation or region's standard of living is determined by the **productivity** of its economy. Productivity, the value of goods and services produced per unit of the nation's labor and capital, sets the wages that can be sustained and the returns earned by holders of capital—the two principal components of a nation's or region's per capita income. Productivity determines prosperity at all geographic levels, whether it is a nation, a region (metropolitan area), or an inner city (see Exhibit 1). In this report, our focus will be on the **regional** level.

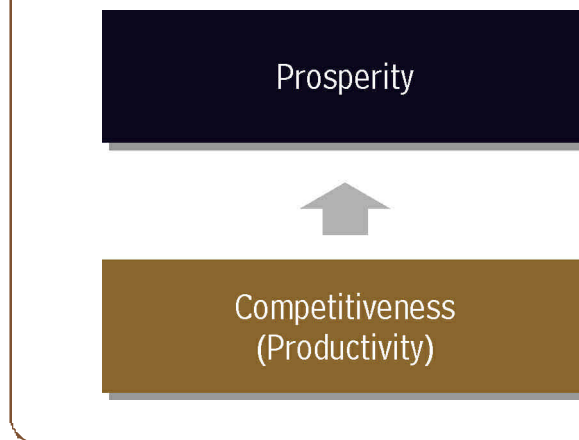
Productivity, contrary to popular usage, is more than just efficiency. Competitiveness, then, is set by productivity. It also depends on the **value** of the products or services that a region's firms can produce as measured by the prices they can command. In advanced economies, productivity growth depends heavily

on creating higher value for products, services, and features as well as improving the efficiency of processes.

The central challenge in enhancing the prosperity of a region is to create the conditions for sustained productivity growth.

Productivity does not depend on what industries a region competes in, but on how it competes. There are no industries that are inherently the most productive and thus more attractive in generating prosperity. In shoes, for example, Northern Italy supports high wages and profits because of the high value that consumers place on its products because of their design, materials, brand recognition, and distribution channels.

Exhibit 1. Prosperity and Productivity



Regions should not attempt to pick “winners,” or try to create new industries where there are no pre-existing advantages to build upon. Instead, the challenge is to upgrade the sophistication and productivity of all the region's industries. Not all industries and companies will be equally successful, but success should be determined by the marketplace rather than intervention by government.

The most important sources of prosperity are *created*, not *inherited*. Inherited competitive advantages such as natural resources, location, or a supply of labor are becoming less important in determining prosperity. Globalization has expanded the supply of natural resources, and technology has created new substitutes for them and brought distant locations into the economy. A supply of labor is no longer an advantage in a world where low-skilled workers are plentiful. Prosperity depends not on inherited inputs themselves, but on creating the conditions that allow firms operating in the region to be highly productive in the use of inputs.

A good example is the oil and gas cluster in Houston. A modest quantity of oil and gas is still produced in Texas. However, Houston has become the world's center of technology and knowledge in oil and gas exploration and production, as well as the source of most of the sophisticated equipment and services required. This supports high wages and a large base of thriving companies. The most prosperous regions do not export natural resources or only physical products, but intellectual capital in various forms.

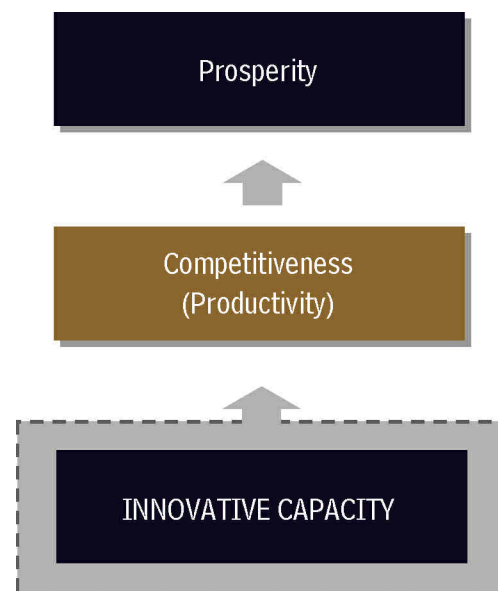
The prosperity of a region depends on the productivity of *all* its industries. The productivity of a regional economy depends on the average productivity of all its companies and industries, not just those that sell outside the region. For example, research on Japan¹ has shown that poor productivity of local industries such as transportation, construction, and wholesaling raised the cost of doing business and the cost of living and thus became a drag on the prosperity of the country despite the existence of some very productive exporting industries. Regional competitiveness, then, depends on competitive local companies in fields such as utilities, transportation, and other local services.

Innovation and the Growth of Productivity

Maintaining, much less increasing, a region's standard of living requires the steady growth of productivity. No region in an advanced economy can maintain high wages, and hold its own in global markets, by producing standard products using standard methods. Lower-wage countries and regions are improving their skills and can rapidly access modern technology. In advanced regions, prosperity rests heavily on the **capacity for continuous innovation** (see Exhibit 2).

Innovation is more than just scientific discovery. Innovation stretches beyond science and technology, and includes all the activities involving the discerning of needs and the transformation of knowledge into commercial products, processes, and services. Indeed, some of the most important innovations today occur in sales, services and distribution. Just think of the revolution in the small-package delivery business that occurred in the last 15 years and resulted in U.S. global preeminence in this industry.

Exhibit 2. Innovation and the Standard of Living



There are no low-tech industries, only low-tech firms. Today, innovation can drive productivity improvement in virtually every industry. Although industries producing enabling technologies such as computers, software, and communications have received much attention, opportunities to apply advanced technology are present in fields as disparate as textiles, machinery, and financial services. Hence, there are no “low-tech” industries, only low technology companies that fail to incorporate new ideas and methods into their products and services.

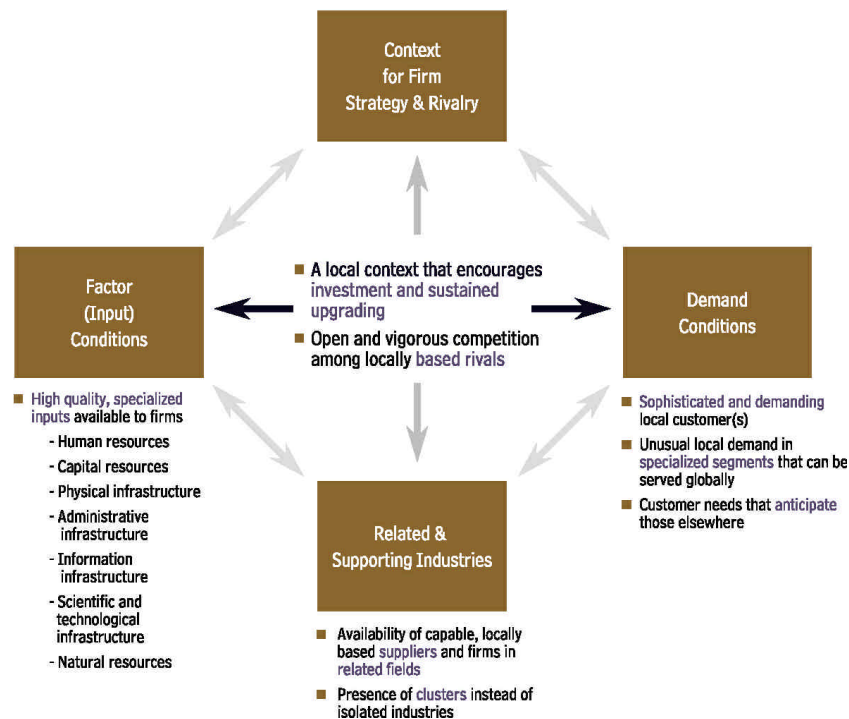
The Microeconomic Foundations of Productivity and Productivity Growth

The productivity and innovativeness of a regional economy benefit from overall conditions such as a sound fiscal policy, an effective political decision making process, and sound legal institutions. However, broad regional attributes such as these are increasingly preconditions, not sources of competitive advantage.

Prosperity in a region is actually created by the microeconomic foundations of competitiveness, rooted in the sophistication with which individuals, firms, and industries based there compete. Competitiveness requires ongoing improvement in corporate management and in the sophistication of company strategies and operating practices. However, the sophistication with which firms compete rests heavily on the quality of the regional business environment in which firms operate. For example, the productivity of companies is affected by such things as the quality of employees they can attract, the efficiency of the local logistics and transportation, and the costs of dealing with regulation.

The quality of a region’s business environment is embodied in four broad areas (see Exhibit 3) which affect the productivity that can be achieved as well as the rate of innovation.²

Exhibit 3. Determinants of Regional Productivity



Factor conditions: Achieving high levels of productivity depends on the presence of high quality and specialized pools of human resources, applied technology, infrastructure and even sources of capital that are tailored to the needs of particular industries.

Demand conditions: The quality of demand at home has a strong influence on the process of creating and improving products and services. Sophisticated customers in the region press firms to improve and offer insights into existing and future customer needs.

Context for firm strategy and rivalry: The rules, incentives and pressures governing the type and intensity of local rivalry have a fundamental influence on productivity. Policies that encourage investment and protect intellectual property foster productivity growth, for example, as does the presence of on competing local rivals.

Related and supporting industries: Local sourcing from capable suppliers based in the region can enhance productivity and improve the capacity for innovation through allowing quicker and less costly communication, fostering the flow of ideas, and enhancing flexibility through outsourcing.

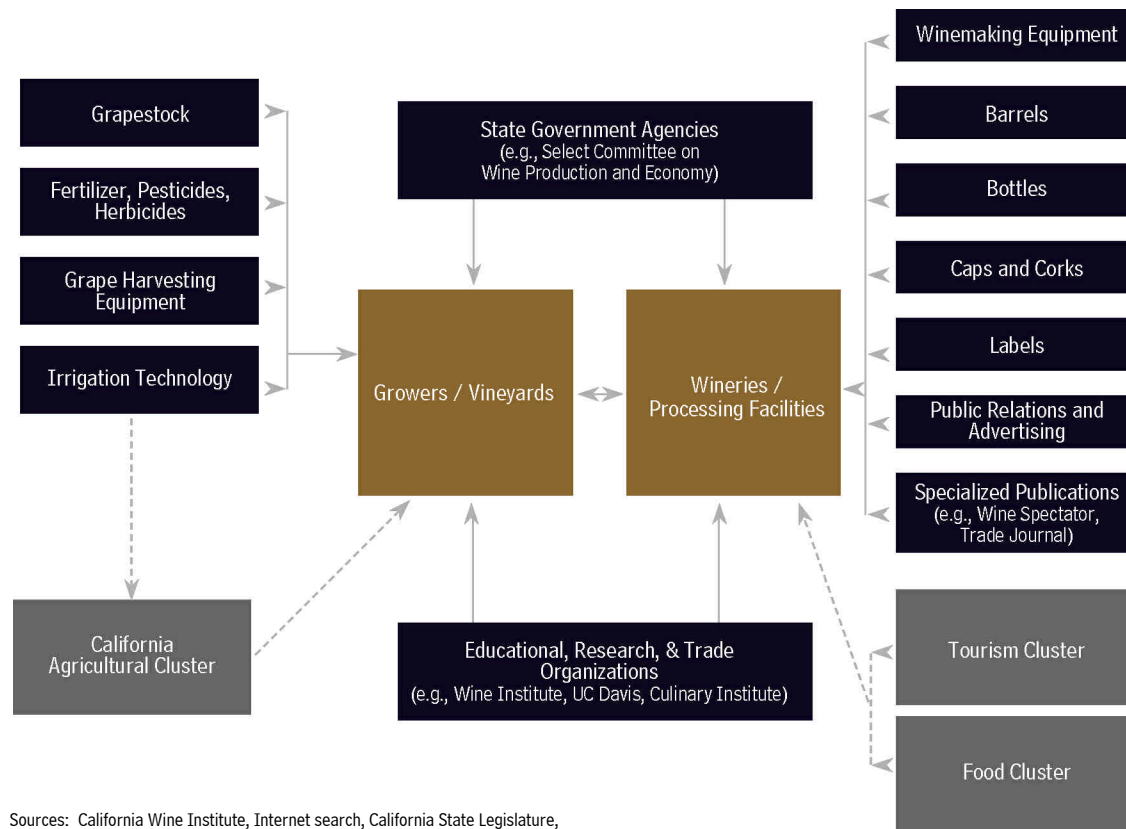
These four areas are self-reinforcing and act as a system. Regional rivalry, for example, stimulates the development of unique pools of specialized skills and the formation or attraction of specialized suppliers. Active local rivalry also upgrades regional demand by creating more demanding customers.

Clusters and Productivity

Clusters are geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. Clusters are normally contained within a geographic area where ease of communication and interaction is possible, and sometimes concentrated in a single town.

Clusters cut across traditional industry classifications. Clusters take various forms, depending on their sophistication, the field of activity, location, and historical roots. Developed clusters, however, normally include end product or service companies; suppliers of specialized inputs, components, machinery, and services; financial institutions; and firms in related industries. Clusters also often include firms in downstream industries; producers of complementary products; specialized infrastructure providers; government and other institutions providing specialized training, education, information, research, and technical support; and standard setting agencies. Finally, many clusters include trade associations and other collective private sector bodies that support cluster members (see Exhibit 4).

Exhibit 4. The California Wine Cluster



Sources: California Wine Institute, Internet search, California State Legislature,
Based on research by MBA 1997 students R. Alexander, R. Amey, N. Black, E. Frost, and A. Shivanda

Clusters enhance competitiveness in three ways.³ First, they improve productivity because firms have ready, efficient access to specialized suppliers, skills, information, training and technical expertise in a demanding competitive environment. Second, clusters foster innovation by creating an enabling business environment. Finally, clusters lead to the creation of new firms through startups and spin-offs and by attracting subsidiaries of firms based elsewhere, reinforcing productivity and innovation. Establishing a business in a cluster is easier than elsewhere, because all the inputs are available there.

Clusters draw on both general and cluster-specific aspects of the business environment. Clusters benefit from national and regional circumstances such as intellectual property laws, transportation infrastructure, and the general education system. The uniqueness of clusters, however, usually owes much to the specialized circumstances of the location.

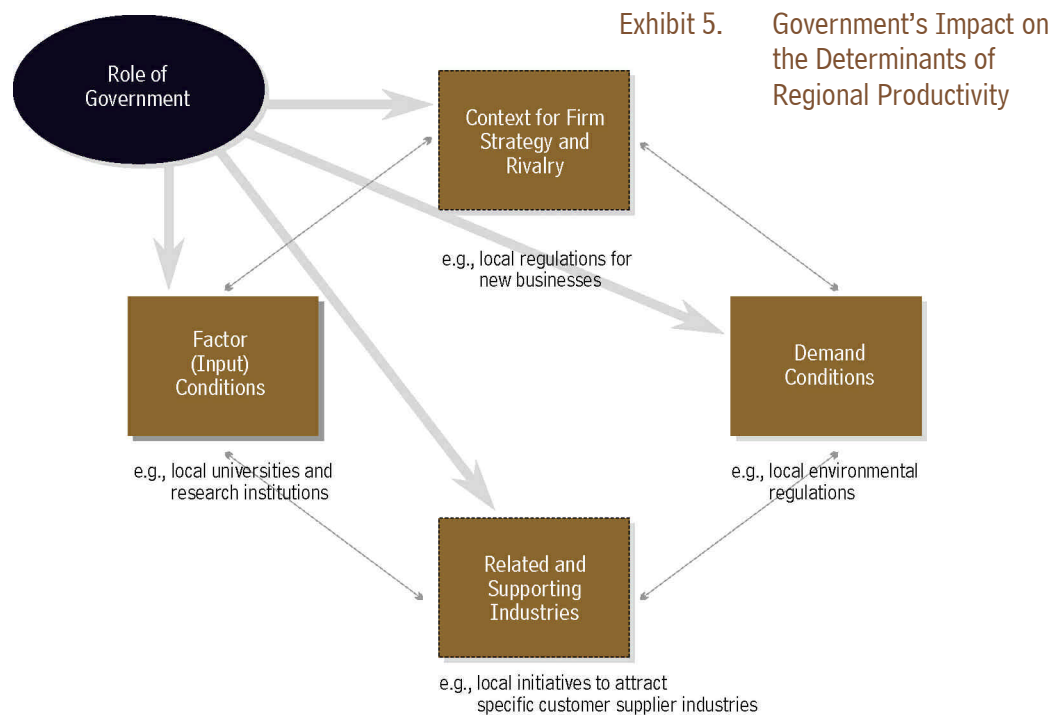
Extensive market, technical, and other specialized information accumulates within a regional cluster. Specialized inputs can be assembled, and relationships are forged among cluster participants. Firms can access trained people and technology at much lower cost than developing these assets internally. The presence of a full range of knowledge, inputs, machinery, and services makes experimentation easier and promotes greater efficiency and flexibility than vertical integration of relationships with distant suppliers.

Other Influences on the Business Environment

The diamond defines the areas of the business environment that have the most important effect on productivity and innovation. Some of the conditions in a region's business environment arise spontaneously, or through the actions of individual firms and organizations such as universities and infrastructure providers. Many parts of the business environment, however, are influenced by government and institutions for collaboration within the region. Finally, attitudes, values, and beliefs held within a region can also shape its competitiveness and rate of progress.

GOVERNMENT

Government affects competition and innovation through policies and services that influence all parts of the diamond (see Exhibit 5). Government at all levels has an influence (positively or negatively) on the business environment and the productive potential of clusters. While the U.S. government is often seen as having the most impact on competitiveness, policies at the regional and even local level are often equally if not more important.



Government's proper role is to improve the business environment rather than to intervene directly in the competitive process. Government should not subsidize individual companies but work to raise the productivity and innovativeness with which companies can operate. Many U.S. regions, for example, have traditionally sought to attract industry through tax incentives and driving down the cost of doing business in terms of payroll taxes, unemployment insurance, utilities and the like. This approach may be necessary in uncompetitive regions, but it is ultimately self-limiting. Pushing down costs can reduce the revenue

necessary to improve education, infrastructure and services. Improving the productivity of the region and boosting its innovative capacity are more effective in increasing the standard of living in the long run.

Institutions for Collaboration. Institutions for collaboration are formal and informal organizations and networks that (1) facilitate the exchange of information and technology; and (2) foster various kinds of coordination and collaboration that can improve the business environment in a cluster or in the overall economy. Institutions for collaboration, then, create and amplify the arrows and feedback loops in the diamond.

Institutions for collaboration unleash productivity and innovation inherent in the business environment in a number of ways. First, they create relationships and enhance the level of trust in these relationships. Second, they encourage the definition of common standards and rules. Third, they facilitate the organization of collective activity. Fourth, they are vehicles to define and communicate beliefs and attitudes (see Exhibit 6). Finally, they can be mechanisms to develop a common economic or cluster agenda.

Economic Attitudes, Values and Beliefs. The final category of influence on competitiveness and innovation is more intangible. Economic attitudes, values and beliefs—which are often termed “culture”—bear on the behavior and aspirations of individuals, organizations, and other institutions in a region. Of particular importance in an advanced economy like the U.S. are the beliefs about the bases for

competitiveness, the importance of entrepreneurs, attitudes toward collaboration, and civic mindedness. Other attributes and beliefs, such as a passion for the environment or sports, can also affect competitiveness.

Determinants of Innovative Capacity

All parts of the diamond affect a region’s productivity and competitiveness. However, a subset of the business environment has particular importance in determining a region’s innovative capacity. As discussed in the Council report

Exhibit 6. Examples of Institutions for Collaboration

General	Cluster-specific
<ul style="list-style-type: none"> ■ Private sector <ul style="list-style-type: none"> - Chambers of Commerce - Professional associations ■ Public sector <ul style="list-style-type: none"> - Economic development agencies ■ Jointly private / public <ul style="list-style-type: none"> - Advisory councils - Competitiveness councils ■ Informal networks <ul style="list-style-type: none"> - School networks - Religious networks 	<ul style="list-style-type: none"> - Industry associations - Specialized professional associations and societies - Alumni groups of core cluster companies - Incubators

The New Challenge to America’s Prosperity: Findings from the Innovation Index,⁴ the sources of innovative capacity in a region can be divided into three categories.

Common innovation infrastructure. These are the elements of the diamond in a region that underpin innovation across all or many fields, including the university system, intellectual property laws, the pool of scientists and engineers, and the region’s venture capital firms. While some common innovation infrastructure is national, most is regional in scope.

Cluster-specific conditions. These are parts of the diamond that foster innovation in particular clusters. This includes the presence of specialized research institutions, individuals with particular technical skills, venture capitalists that specialize in the sector, and so on.

Quality of linkages. The common infrastructure and cluster-specific conditions can be mutually reinforcing. Also, linkages are often present across regional clusters (e.g., information technology and analytical instruments). The quality of linkages within the region affects the potential for innovation. While some linkages are spontaneous, **institutions for collaboration** have as important a role in innovative capacity as they do overall.

THE COMPOSITION OF REGIONAL ECONOMIES

Regional economies are composed of four main types of activities. The first is clusters that produce products and services that compete nationally and internationally. These clusters, which we term **traded clusters**, can be located anywhere. They consist of locally based firms and subsidiaries of firms based elsewhere that have research, manufacturing, and other sophisticated activities in the region and hence become part of that region's cluster as well.

The second type of activity is firms that produce goods and services tied to the local market. These **local clusters** can be found in every region. Third, some regions have **resource-driven** clusters, in locations where natural resources of a particular type are abundant. Finally, a fourth type of activity involves the **local operations of clusters based elsewhere**. They are not research, manufacturing, or other knowledge-intensive activities, but those involved in marketing and distribution. Silicon Valley computer companies, for example, have numerous sales offices, service centers, and distribution facilities located in other regions. These activities, which are part of traded clusters, are difficult to distinguish statistically. This means most regions will have some activity in most traded clusters.

Traded clusters drive regional prosperity. While local clusters account for roughly two-thirds of employment in an average region, the prosperity and growth of a region are heavily driven by traded clusters. This is because traded clusters can achieve higher productivity, their growth is unconstrained by the size of the local markets, and their success creates much of the demand for local clusters.

Exhibit 7 shows the average composition of regional economies in the United States for 1998. Traded clusters accounted for 32.2% of total employment in 1998 with an average wage of \$39,286. Local clusters accounted for 67% of employment and an average wage of \$25,025. The average wages of traded clusters have grown at a compound annual growth rate of 4.8% over the 1988 to 1998 period, compared to 3.7% for local clusters. The higher wages of traded clusters reflect their much higher productivity, shown in Exhibit 7. This, in turn, is due in part to the far higher rate of innovation in traded clusters as measured by patents per 10,000 employees.

Regional economies are highly specialized. The particular mix and evolution of traded clusters vary markedly from region to region, even in regions that are close or next to each other. A detailed analysis of the clusters in each region, their relative wages, and their evolution over time is an important component of our analysis of each region.

Exhibit 7. Composition of Regional Economies in the United States, 1997

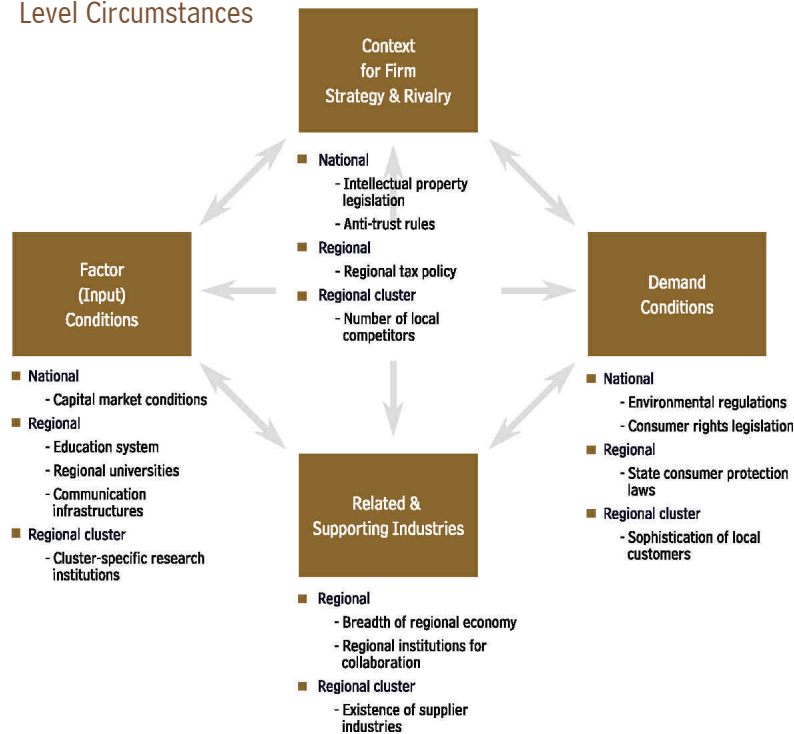
	Wichita	Kansas	United States
Average Wages, 1999	\$30,054	\$27,412	\$32,711
Average Wages, 1988	\$20,872	\$18,545	\$21,527
Compound Annual Growth Rate, 1988-1999	3.37%	3.62%	3.88%
Total Employment, 2000	292,271	1,439,732	140,866,333
Total Employment, 1990	258,750	1,270,851	118,793,000
Compound Annual Growth Rate, 1990-2000	1.23%	1.26%	1.72%
Share of United States Employment (2000)	.21%	1%	100%

Assessing the Regional Competitive Environment

The competitiveness of a region is affected by circumstances at three levels: national, regional and cluster specific.

Exhibit 8 gives examples of the types of influences that must be assessed in the regional analysis that follows.

Exhibit 8. National, Regional and Cluster Level Circumstances



REGIONAL STUDY METHODOLOGY 2

The Clusters of Innovation Project examines five regions: San Diego, Atlanta, Pittsburgh, Raleigh-Durham, and Wichita. For the purposes of this study, a region is defined as a metropolitan statistical area (MSA) using U.S. Department of Commerce boundaries.⁵ The five regions were selected to provide a diversity of size, geography, economic maturity, and perceived economic success. The regions are similar enough to allow interesting comparisons, yet diverse enough to encompass a wide variety of challenges and opportunities in regional economic development.

The focus of the regional analysis is on both overall competitiveness and capacity for innovation, a key enabler of future competitiveness. In each region, we examine five areas:

- Regional economic performance
- The composition and evolution of the regional economy
- Assessment of the region's business and innovation environment
- The competitiveness of selected regional clusters
- Implications for the regional agenda

Data for the study were drawn from a number of sources. Performance indicators were assembled from a variety of sources such as the County Business Patterns, Department of Commerce Trade Statistics, PWC Money Tree, and the Inc. 500 List.

The principal source of quantitative data on the composition and performance of the overall economies and specific clusters was the Cluster Mapping Project of the Institute for Strategy and Competitiveness at Harvard Business School. The Cluster Mapping Project has compiled in-depth data on employment, wages, establishments and patenting activity by cluster at the county level. It provides an objective basis to compare the composition of regional economies and assess the relative position of a region's clusters (see the description below).

To analyze the business and innovation environment, we reviewed previous studies and conducted primary research. To generate new quantitative data, an extensive survey was conducted of business, government, and non-profit leaders in the region. (The full survey is included as Appendix 2). Surveys were completed by 138 executives at companies and institutions throughout the region. Of the total, 71 were companies from the aerospace vehicles and defense and plastics clusters, and 67 were from regional institutions for collaboration, communications cluster firms and other non-cluster organizations (e.g., venture capital firms, banks).

We also conducted in-depth interviews with 74 Wichita leaders. Of these, 52 were cluster representatives and 22 were representative from academia, government, or institutions for collaboration.

REGIONAL ECONOMIC PERFORMANCE

The study examined regional economic performance on two levels. At the broadest level, we compared the region to other regions on various indicators of economic vitality and standard of living such as employment, wages, productivity, and exports. To assess potential future competitiveness, we examined measures of innovative output and entrepreneurship including patents, venture capital investments, the prevalence of fast growing companies, and initial public offerings. Wherever possible, we tracked both the level and the growth rate of each performance indicator (see Exhibit 9).

We compared the performance of the Wichita regional economy to the national economy as a whole, as well as to other technologically intensive regions.

Exhibit 9. Economic Performance Indicators

Overall Economy	Innovation Output
<ul style="list-style-type: none">■ Employment Number of persons employed■ Wages Payroll per employee■ Productivity Value of shipment per person employed■ Exports Value of manufacturing exports	<ul style="list-style-type: none">■ Patents Number of patents and cited patents■ Venture Capital Investments Value of venture capital investment■ Fast Growth Firms Number of companies on Inc. 500 list and Gazelle-type companies■ Initial Public Offerings Number of initial public offerings

The Composition and Evolution of the Regional Economy

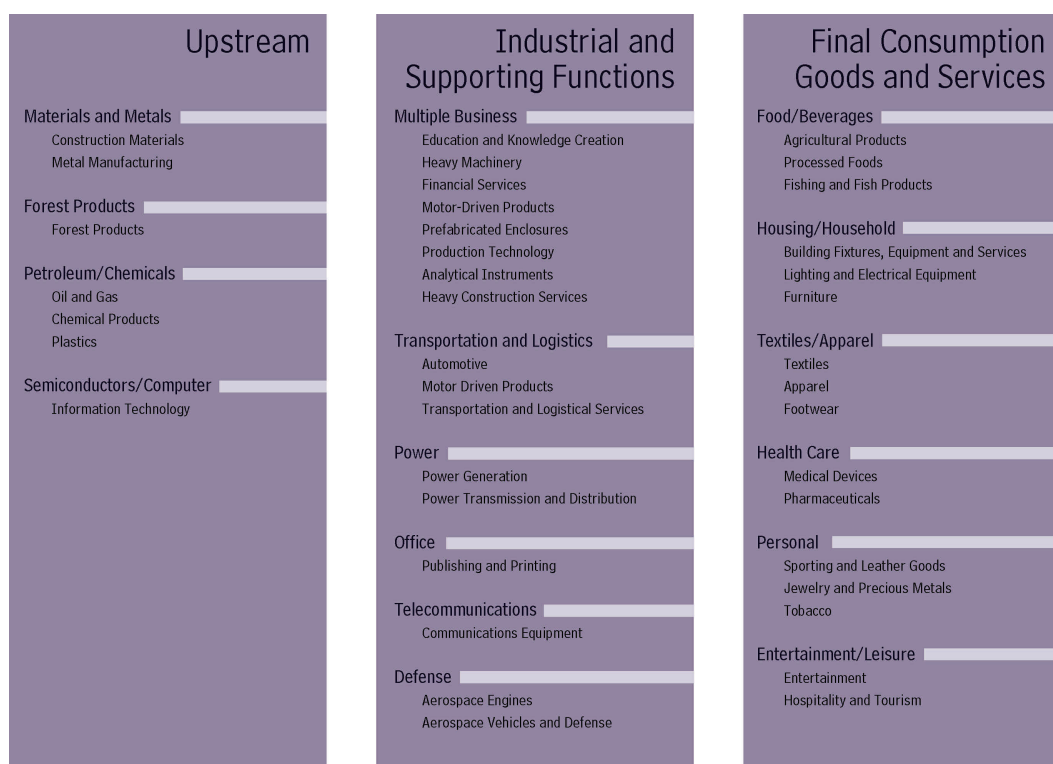
Especially in advanced nations such as the United States, regional economies are specialized, with each region strong in a different mix of industry clusters. Comparing regional economies has been difficult because clusters have not been systematically identified or mapped across all U.S. regions. To address this challenge, Professor Porter and his team at Harvard Business School have defined clusters statistically and assembled detailed data by industry and cluster on employment, wages, establishments, and patenting activity over time for every region in the United States. (See the boxed insert for a summary of the Cluster Mapping Project).⁶

The Cluster Mapping Project provides an objective, quantitative way to profile regional economies, compare them over time, and measure the strength, evolution, and performance of the region's clusters. The cluster mapping data is used to identify the most important clusters in the region's economy, understand the drivers of the region's relative wages, employment growth, and formation of new establishments, assess the region's patenting performance, and examine the region's relative position versus other regions overall as well as in its leading clusters.

CLUSTER MAPPING PROJECT METHODOLOGY

- The purpose of the Cluster Mapping Project is to assemble a detailed picture of the location and performance of industries in the United States, with a special focus on the linkages or externalities across industries that give rise to clusters.
- The raw data for the project are County Business Patterns data (excluding agriculture and government) on employment, establishments, and wages by four-digit Standard Industrial Classification (SIC) code by U.S. county. In addition, U.S. patent data by location of inventor are allocated to industries and clusters using a concordance of technology classifications with SIC codes.
 - Confidentiality limitations mean that actual data are not disclosed for every county and economic area in every industry. Various techniques are used to compensate for missing data.
- Economies are analyzed at various geographic levels, including states, Economic Areas, Metropolitan Statistical Areas (MSAs), and counties.
- All the industries in the economy are separated into “traded” and “local” based on the degree of industry locational dispersion across geographic areas. Local industries are those present in most, if not all, geographic areas and primarily sell locally. Traded industries are those that are concentrated in a subset of geographic areas, and sell to other regions and nations.
- For traded industries, clusters are identified using the correlation of industry employment across geographic areas. The principle is that related industries that are normally located together are linked by external economies, and constitute a cluster.
- Clusters are defined initially using state-level data (n= 50). The robustness of clusters is tested using Economic Areas as the geographical unit.
- Clusters are constructed using two approaches, which are reconciled:
 - Select a “core” industry in a field or activity. Calculate locational correlations of all other industries with the core. Those industries with statistically significant correlations with the core define the extent of the cluster.
 - Calculate locational correlations between all pairs of industries in a field and related fields. Those industries with statistically significant and substantial intercorrelations define the cluster.
- In both cases, industries with “spurious” correlations to the cluster or co-locations due to the presence of several strong clusters in the same geographical area are eliminated using Input-Output tables, industry definitions, and industry knowledge.⁷
- Note that a given industry can be part of more than one cluster. This may reflect overly broad industry definitions. However, it is also the case that there are multiple forms of externalities, and some industries are suppliers or customers of many others. Thus, overlapping clusters are expected and important economically.
- This process resulted in 41 traded clusters in the U.S. economy. These are shown in the figure below, grouped into broad categories.
- Cluster industries are separated into “narrow” and “broad.” Narrow industries are the subset of the industries that are most correlated with a given cluster. Broad industries are those with statistically significant locational correlations that are within the cluster, but with stronger locational correlations with another cluster.

- Analysis using narrow industries eliminates cluster overlaps. An industry is a narrow industry for only **one** cluster. We refer to the narrow industries as the **narrow cluster definition**.
- Analysis using both narrow and broad industries includes the overlap among clusters. This overlap is important to understanding cluster competitiveness, but leads to double counting of employment, which leads to difficulties of interpretation for some analyses. We refer to clusters including both narrow and broad industries as the **broad cluster definition**.
- Subclusters, or subsets of cluster industries that are more strongly correlated with each other, are defined for each cluster. Subclusters are separately defined for narrow and broad industries. There are 244 subclusters of narrow industries and 245 subclusters of broad industries within the 41 traded clusters.
- We also group 241 local industries into clusters using industry knowledge. There are 16 local clusters ranging from local health services to local utilities to local retail clothing and accessories. We did not analyze local clusters extensively in this project, instead focusing on cross-regional competition. Doing so would be meaningful for examining the competition among counties within a metropolitan area.



Assessment of the Business and Innovation Environment

The quality of the overall business and innovation environment includes both common characteristics that affect the entire economy and the particular circumstances in important regional clusters. We first examine overall competitiveness with special emphasis on the environment for innovation. Exhibit 10 below illustrates some of the dimensions of the overall business environment analyzed in each region.

Exhibit 10. Business Environment and Cluster Indicators

	Common	Cluster-Specific
Basic and Specialized Factor Inputs	<ul style="list-style-type: none"> Information and communication infrastructure Skilled workforce Investment in educational capacity Availability of risk capital Quality of life 	<ul style="list-style-type: none"> Presence of specialized research centers Presence of specialized talent base Presence of specialized training and education institutions
Context for Firm Strategy and Rivalry	<ul style="list-style-type: none"> Tax policy (e.g., investment incentives) 	<ul style="list-style-type: none"> Intensity of rivalry among firms in the cluster Degree of cooperation between firms in the cluster
Related and Supporting Industries	<ul style="list-style-type: none"> Regional position in broad based industries such as business services and energy 	<ul style="list-style-type: none"> Extent of related industries inside and outside of the cluster
Sophistication of Demand	<ul style="list-style-type: none"> Overall regional education and per capita income levels 	<ul style="list-style-type: none"> Sophistication of the demand in the region for the clusters' products and services
Government	<ul style="list-style-type: none"> Zoning regulations Coordination between government agencies 	<ul style="list-style-type: none"> Cluster-specific regional policies
Institutions of Collaboration	<ul style="list-style-type: none"> Existence of regional institutions of collaboration 	<ul style="list-style-type: none"> Existence of cluster-specific institutions for collaboration
Attitudes toward Business	<ul style="list-style-type: none"> Regional attitudes toward the sources of economic prosperity 	<ul style="list-style-type: none"> Cluster-specific attitudes toward the sources of economic prosperity

The Competitiveness of Selected Regional Clusters

In each region, two or more clusters were selected for in-depth analysis. All clusters are important to the regional economy, and are worthy of study. However, the limitations of time and resources meant that we utilized studies of a few clusters to gain insight into the region's challenges and opportunities at the cluster level. Exhibit 11 lists the clusters analyzed in each region.

Exhibit 11. Clusters Studied in Each Region

San Diego	Atlanta / Columbus	Pittsburgh	Wichita	Raleigh-Durham
<ul style="list-style-type: none"> Pharmaceuticals / Biotechnology Communications 	<ul style="list-style-type: none"> Financial Services Information Technology Transportation and Logistics 	<ul style="list-style-type: none"> Pharmaceuticals / Biotechnology Information Technology Production Technology (Includes Robotics) 	<ul style="list-style-type: none"> Aerospace Vehicles and Defense Plastics 	<ul style="list-style-type: none"> Pharmaceuticals / Biotechnology Communications Shorter case studies of Chemicals, Fibers and Plastics

Clusters were chosen for analysis based on size, importance to the region, stage of development, and perceived success. We also coordinated the choice of clusters across regions to permit cross-regional comparisons. Overall, eight of the 41 traded clusters in the U.S. economy were analyzed in at least one region. We also examined the same cluster (e.g., pharmaceuticals/biotechnology in San Diego and Raleigh-Durham) in more than one region to investigate differences across regions in the economic and innovation performance of the cluster.

To assess cluster performance, we compared a cluster (e.g., aerospace vehicles and defense in Wichita) to the national averages and to other benchmark regions (e.g., the aerospace vehicles and defense cluster in St. Louis).

In analyzing each cluster, we paid particular attention to its historical evolution, not just its current circumstances and future challenges. The process by which clusters developed was both revealing about the region's competitive circumstances and important to understanding how the region might expand its economic base into new fields.

Implications for the Regional Agenda

The study revealed many implications for local leaders at both the regional and cluster level. Implications cut across government and the private sector, and other institutions such as universities and trade groups. Some of the most important implications arose in the following areas:

- reasons for the region's past successes;
- areas of the business environment that need improvement;
- the issues and opportunities facing particular clusters; and
- opportunities for regional growth that are not being pursued.

INTRODUCTION

Wichita's current economic prosperity can be traced back to a small group of innovative entrepreneurs during the first half of the twentieth century. Individuals bearing now well-known names including Cessna, Beech, Coleman, Koch, and later, Lear, helped the region move away from its traditional reliance on natural resources like oil and gas and agriculture toward steady growth in manufacturing. The area's business and government leaders helped these early entrepreneurs build a broad-based manufacturing center which supports a nationally competitive cluster in aerospace vehicles and defense and smaller but important clusters in plastics, aerospace engines, heavy construction services, motor driven products, processed foods, heavy machinery, chemical products, building fixtures, equipment and services, agricultural products, and distribution services. Due to its strong manufacturing orientation, Wichita has developed a base of both highly and medium skilled manufacturing workers.

Despite its entrepreneurial origins and relatively strong present economy, however, modern Wichita faces challenges. Although the economy has diversified in the last ten years, the aerospace vehicles and defense cluster still strongly influences the average wages in the region. Innovation within established firms, as measured by patent registration, is not particularly strong. Labor is in short supply and will likely become increasingly so during the next twenty years as worker demand increases beyond population growth and the ability to recruit people. The region claims only one research center. Rivalry is intense, limiting collaboration that can lead to innovation. Despite the region's strong entrepreneurial roots, today's start-up infrastructure is not an advantage for local entrepreneurs. Innovation, driven by the region's original, bold entrepreneurs, has contributed to the region's present economic prosperity. In order to sustain similar economic performance in the future, the region will have to focus on improving its innovative capacity.

We begin with a brief historical perspective, which is essential to understanding Wichita's past successes and current challenges. We then evaluate the economic and innovation performance of the region using a variety of metrics. To understand this performance, we describe the composition of the economy and its position vis-à-vis other regions. We then assess the strengths and weaknesses of the region with particular focus on its innovative capacity. The numerous issues and challenges uncovered in the analysis are expanded upon in the final chapter.

The relevant unit of analysis for this region is the Wichita Economic Area (EA), which includes 60 cities in south-central Kansas and three in Oklahoma (Beaver, Cimarron, and Texas). All sections of this report use EA data except for the sections that address Wichita's economic performance and its innovative capacity. Due to data limitations, these sections use data based on the Wichita Metropolitan Statistical Area (MSA), which includes Sedgwick, Butler and Harvey counties.⁸

Historical Perspective on the Wichita Regional Economy

Originally an agricultural economy, Wichita became a commercial center on the Chisholm Trail in the late 1800s. Citizens passed a \$200,000 bond and helped Wichita beat out other cities to attract a railroad. Sedgwick County passed at least three levies to build additional rail lines. Real estate speculation, aggressively promoted by the city's two newspapers, followed the new railroad. The city's economic development organization at the time, the Board of Trade, encouraged manufacturers to come to Wichita with incentives of land titles. Unfortunately, however, most of the out-of-state manufacturing firms went bankrupt due to poor availability of materials. Wichita's agricultural industry protected the nascent economy from early extinction.⁹

The discovery of oil in 1914 attracted a new wave of business growth and real estate speculation. "Wild-eyed entrepreneurs," attracted to a growing boomtown when large oil fields were found, populated turn-of-the-century Wichita. The "El Dorado" oil field on the outskirts of Wichita provided 10% of the nation's output by World War I. Relatively small by national standards, Wichita's oil industry contributed \$783 million in revenues by 1965. At its height, the Wichita industry employed 3,000 workers. Most of the firms that produced the oil were from out of state.

Entrepreneurs in Aviation.¹⁰ Engineering innovation, economic boosterism, and the availability of local capital explain the rise of Wichita's modern aerospace vehicles and defense cluster (see Exhibit 12). Following the success of the cattle trade in 1872, men like Jacob Melvin and "Jake" Moellendick, wealthy from the oil boom, became aviation's first venture capitalists. They funded Wichita's original aircraft, the Laird Swallow.

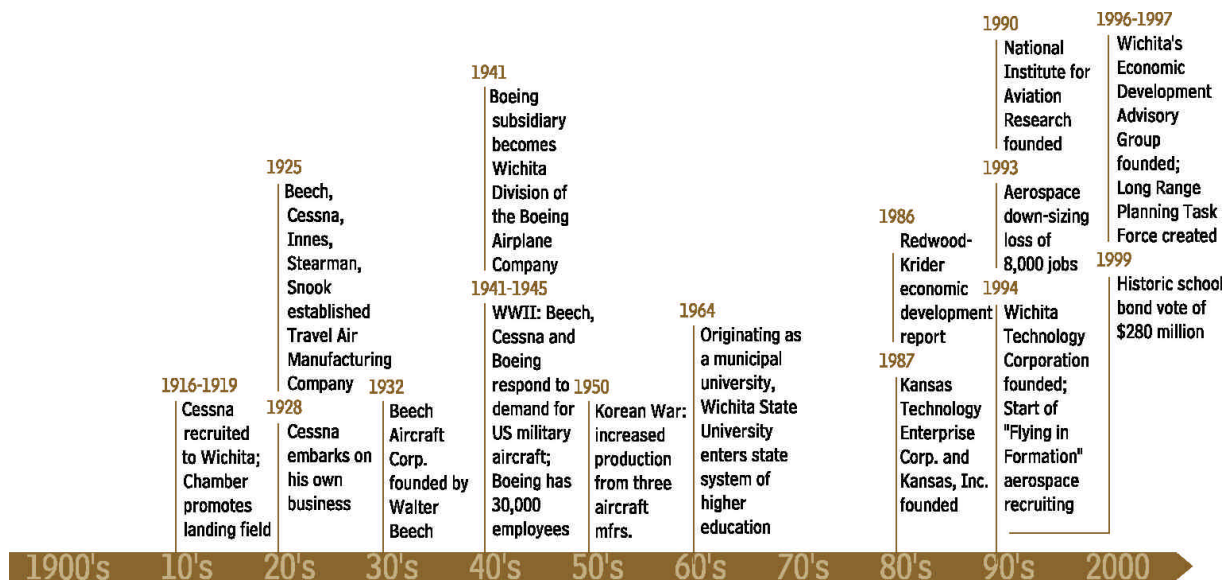
Wichita businessmen attracted Clyde Cessna to build airplanes in Wichita in 1916. The Wichita Chamber of Commerce demonstrated foresightedness as early as 1919 when it promoted a landing field for the country's then growing interest in aviation. In 1924, Wichita hosted the National Air Congress that attracted over 100,000 people. This helped to fuel the aviation spark in Wichita, as did three entrepreneurs — Cessna, Walter Beech, and Lloyd Stearman. Initially forming the Travel Air Manufacturing Company, the partnership broke up and each partner formed his own company: Beech Aircraft, Cessna Aircraft and Stearman Aircraft. Stearman became a subsidiary of Boeing Seattle in 1934 and was named the Wichita Division of the Boeing Airplane Company in 1941.

By 1928, Wichita was already known as the Air Capital of the World. Writing "The Story of Wichita" for *Aviation* magazine in 1930, journalist John Nevill answered the question of why Wichita was responsible for one-fourth of the commercial airplanes built in the U.S.: "One answer is topography. A second is geography. A third is climate. A fourth is air-mindedness, mentally, physically, and financially. A fifth, general 'go-getterism.'"

The 1940s and 1950s were a period of boom and bust cycles for Wichita aviation. The 1940s brought dramatic growth as the government contracted with the region's aviation manufacturers to expand the fleet of military aircraft. At the height of World War II, Boeing, Beech, and Cessna employed 60,000 Wichita

workers, a significant jump from pre-war levels. Labor shortages were so severe that workers had to be imported from Oklahoma. Employment declined sharply at the end of World War II (38,000) and then scaled up again during the Korean War. Layoffs at Wichita's aerospace vehicles and defense manufacturers over the last 50 years helped spawn many of the small aircraft suppliers in Wichita.

Exhibit 12. Evolution of the Regional Economy



Source: Interviews

In the early 1960s, the city of Wichita and the Wichita Area Chamber of Commerce recruited Bill Lear to the region, adding another aviation company led by a brilliant entrepreneur to the cluster. (Lear also invented other items besides aircraft, including the eight-track stereo system.) Lear had experimented with executive aircraft in the 1950s and moved his operation to Switzerland in 1955 to build the Lear Jet. He decided to move his business back to the U.S., mounting a three-city competition, including Grand Rapids, Michigan, and Dayton, Ohio, which Wichita won. The City offered Lear \$1.2 million in industrial revenue bonds to help build his new manufacturing facility near the Wichita airport.

During the early 1980s, Wichita aviation and the region suffered a down cycle when it lost 15,000 workers during the nationwide recession. Boeing sent Lionel Alford, a senior executive, to decide whether to maintain the Wichita plant, which at the time was partially owned by the federal government. Lawford did a careful review of the financial, technical, and human assets of the plant and determined that Wichita offered hardworking people and an accommodating community. About this time, the Beech Company was acquired by Raytheon Aircraft, setting a pattern for the other general aviation companies to follow.

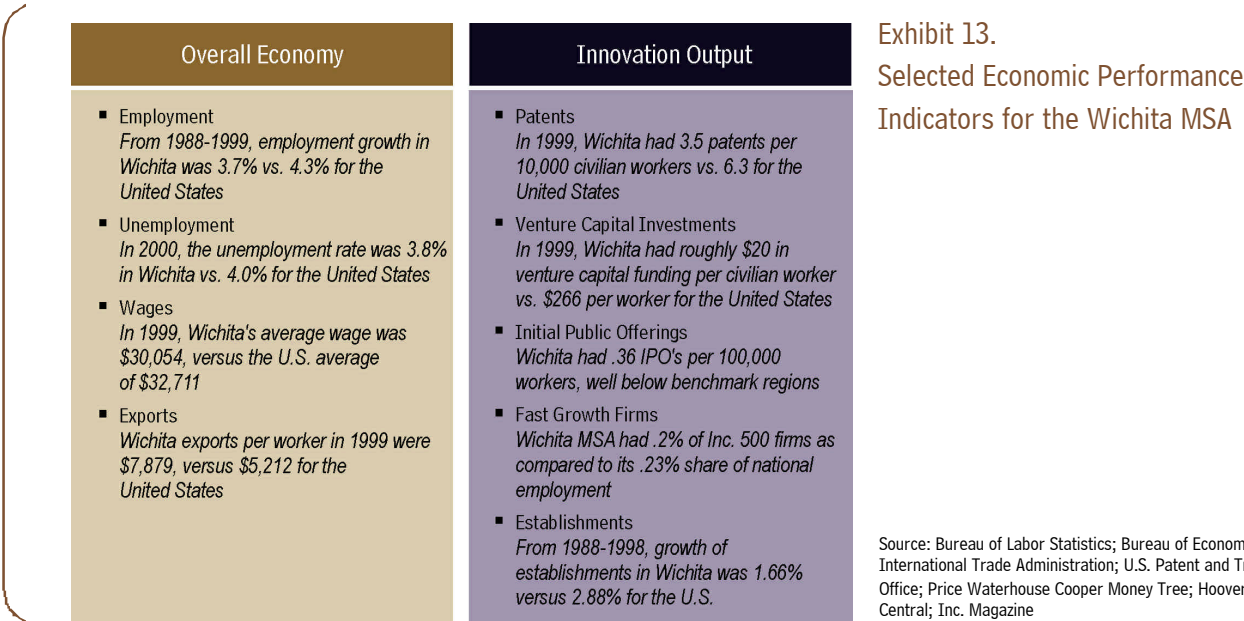
Wichita's aviation cluster suffered another downturn in the early 1990s but re-emerged at the end of the decade with strong sales growth in general aviation fueled by a strong economy. Acquisitions within the aerospace vehicles and defense cluster continued as out-of-state companies purchased Cessna and Lear in the early 1990s.

Beyond Aviation. In addition to aviation entrepreneurs, the region has had a noteworthy number of other, non-aviation entrepreneurs who have helped build Wichita's strong manufacturing base. In 1902, W.C. Coleman started a lamp company in Wichita, laying the foundations for a major consumer products company and later anchor to the plastics cluster. Other prominent, entrepreneur-led firms in Wichita include Koch Industries, Inc., a leading company for chemicals and petroleum products and the second largest private company in the U.S., and Chance Industries, manufacturer of buses, trolleys, and amusement rides. These and other companies serve as anchors to Wichita's manufacturing-oriented clusters: chemical products, motor driven products, heavy construction services, processed foods, heavy machinery, building fixtures, equipment and services, agricultural products, and distribution services. The region has relatively high employment in a number of manufacturing subclusters within these clusters, such as forgings and stampings, wire and springs, process equipment, metal products, components (heavy machinery), automotive components, and precision metal products.

In addition to the accomplishments in the manufacturing sector, Wichita has been the birthplace to innovative service firms, including Pizza Hut, Papa John's, Taco Tico, and Rent-A-Center. Recently, the region has witnessed an influx of telemarketing/call centers during the last five years, attracted by Wichita's strong telecommunications infrastructure, central time zone, work ethic, neutral accents, and recruitment activity by the Chamber of Commerce conducted in the late 1990s. Approximately 20 call centers have added several thousand jobs to the region.

REGIONAL ECONOMIC PERFORMANCE

Wichita has had good economic growth but less impressive innovation results. Unemployment and exports per capita exceed national benchmarks and wages, wage growth, and employment, while below national rates reflect moderate economic performance. However, relative productivity and innovation output measures are below national benchmarks. Low measures in patent registration, venture capital investments, number of Initial Public Offerings (IPOs), number of fast growth firms, and establishment growth all signal weak innovative capacity. Low innovation capacity is a warning sign to the region as poor innovation capacity can erode a region's economic prosperity.



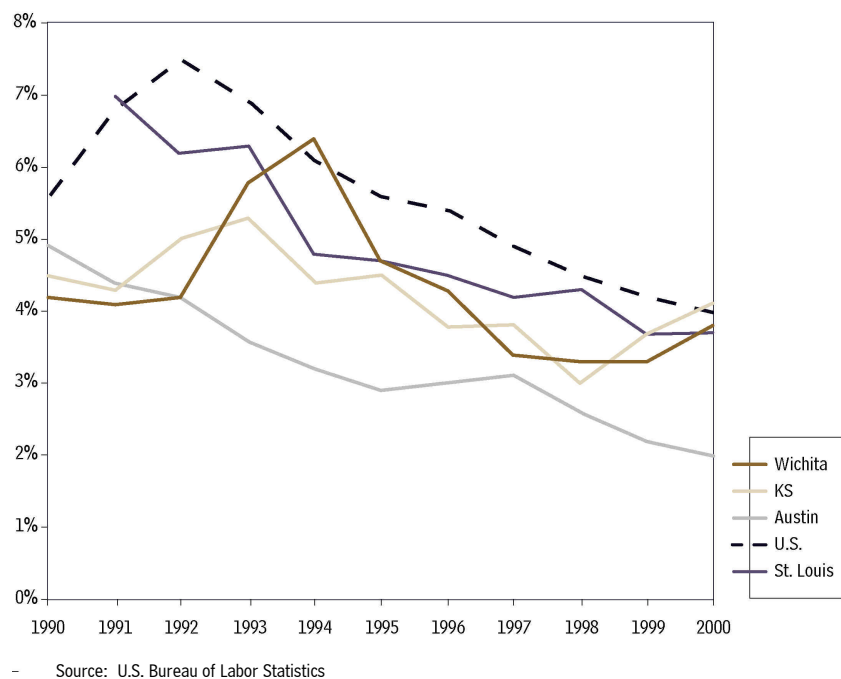
Indicators of Overall Economic Performance

To assess the overall economic performance of the Wichita MSA economy, we compare it to the nation and several benchmark regions in the following metrics: employment, average wages, productivity, and exports (see Exhibit 13).

Employment.¹¹ The Wichita MSA economy has performed well in terms of employment over the last decade, particularly manufacturing employment, which has been declining nationally (19.1 million to 18.5 million over the 1990 to 2000 period.) In 2000, total employment in the region was 292,271, up from 258,750 in 1990.¹² Wichita has registered a lower unemployment rate than the national average for the last ten years.¹³ Unemployment peaked in 1994 at 6.6% (resulting from a downturn in aerospace vehicles and defense) but dropped to 3.3% in 2000¹⁴ (see Exhibit 14). Over the 1990 to 2000 period, the compound annual rate of growth of employment in Wichita was 1.2%, below Kansas at 1.3% and the U.S. at 1.7%.¹⁵

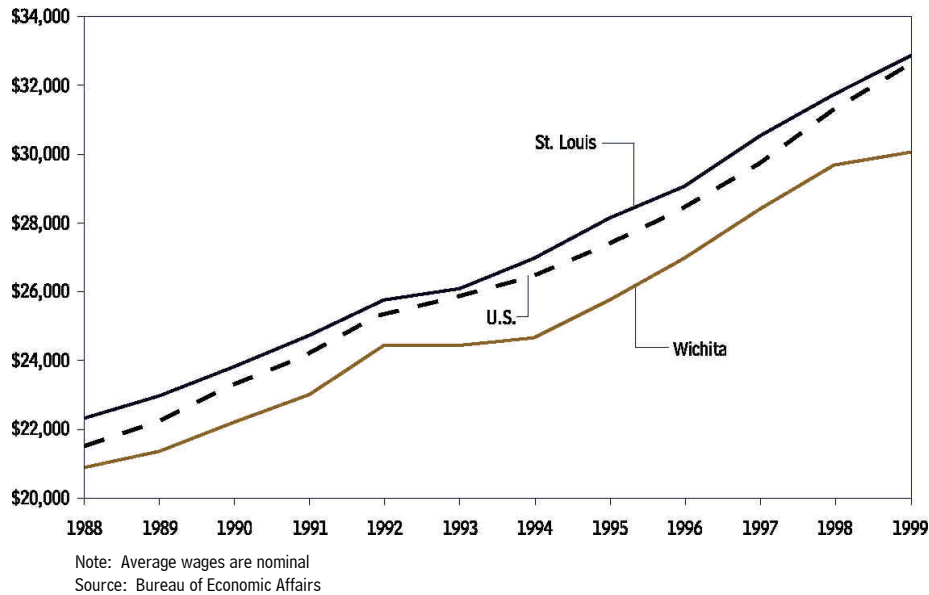
Future employment growth may be constrained by relatively slow population growth. Population growth is expected to slow to .8% during the period 2000 to 2030.¹⁶ This compares to a 1.37% annual growth rate over the 1990 to 1999 period for Wichita and a .99% growth rate for the nation.¹⁷

Exhibit 14. Unemployment Rates in the Wichita MSA and the United States, 1991 to 1999



Average Wages. In 1999, the Wichita MSA average wage of \$ 30,054 was considerably higher than the Kansas average of \$27,412 but below the national average of \$32,711. Average wages in Wichita are lower than those in St. Louis (\$32,835), Austin (\$38,262), Boston (\$40,196), and San Jose (\$60,022). While Wichita's wages have been increasing at an annual rate of 3.37%, this is below the growth of state (3.62%) and national (3.88%) wages (see Exhibit 15).¹⁸

Exhibit 15. Average Wages in the Wichita MSA, 1988 to 1999



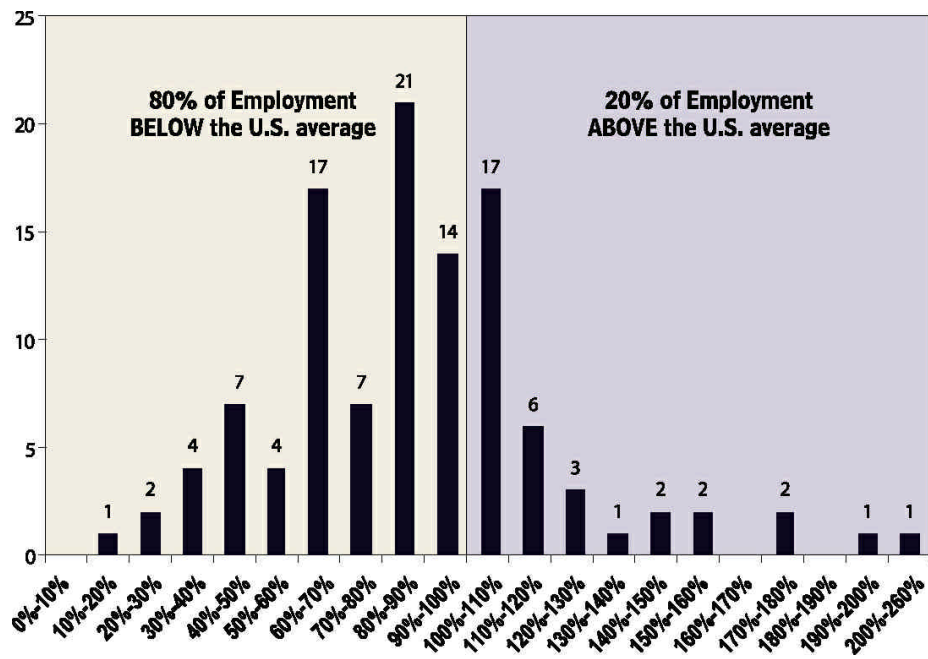
For the 33 traded clusters in the Wichita MSA, the region's index of average wages to U.S. average wages in 1998 was .84, or 16% below the national average.¹⁹ This was up from .76 in 1988. Only five clusters, representing 11% of the traded employment, paid average wages above the national average for that cluster.²⁰

Cost of Living. The Wichita MSA has a composite cost of living index of 98 versus the national average of 100.²¹ The cost of living in the Wichita MSA is nearly at par with the national average for lower income citizens and 1.5 % less than the national average at the highest income level.²² Grocery items, housing, and transportation are lower than the national average. Utilities and health care are slightly higher than the national average. Local and payroll taxes have come down since 1997 and are now on par with the national average. State taxes have gone up since 1998 but they, too, are on par with the nation. Kansas' 5.9% sales tax is less than the 6.43% national average for state sales taxes.²³

Productivity.²⁴ Our measure of productivity indexes the productivity of an industry in a region to the productivity of that same industry nationwide.²⁵ An index of 100 means that a region's productivity in an industry equals the nation's average for that industry. Any region will have a mix of some industries that are more productive than average and others that are less productive. Productivity expressions are also imperfect because of differences in segments served. However, the measure is illuminating as a starting point for more in-depth analysis.

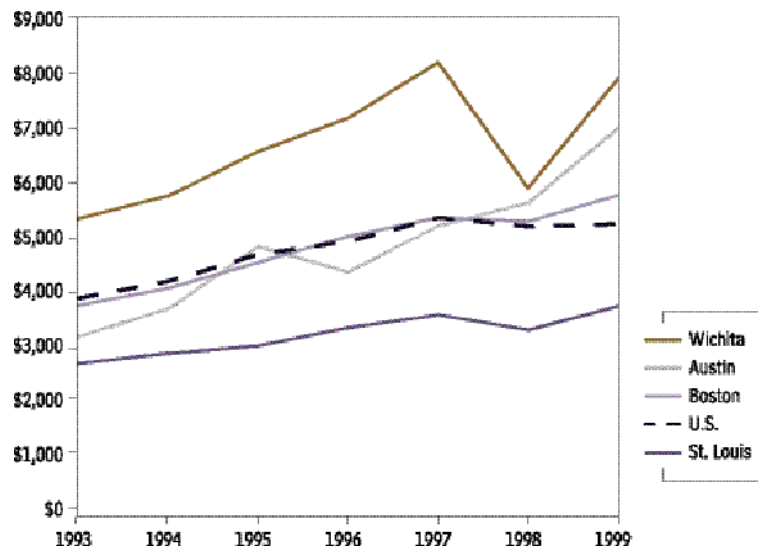
Exhibit 16 shows the Wichita MSA position in 110 industries. The Wichita MSA weighted average productivity index was .86 in 1997, or 14% lower than the national average. The comparable numbers for benchmark regions are 1.13 for Boston and .94 for Austin.²⁶ Only 20% of Wichita's workers were in industries that were more productive than the national average for their industry. It should be noted that data is available for only 110 industries and does not include productivity data for the aircraft parts and equipment industry, which is large and significant to the economy.

Exhibit 16. Relative Productivity of Wichita MSA Industries, 1997



Exports.²⁷ Exhibit 17 shows Wichita's strong export per worker position. Wichita MSA manufacturing exports per worker in 1999 were \$7,879, significantly higher than the United States as a whole (\$5,212), St. Louis (\$3,696), Austin (\$6,905), and Boston (\$5,497). Wichita's MSA annual export growth rate of 7.9% over the 1993 to 1999 period is the same as the U.S. and better than St. Louis (6.2%) but lags other benchmark regions: 8% for San Jose, 19.1% for Austin, and 8.3% for Boston. Wichita ranked 127 on a list of 253 MSAs in terms of percent-age change in exports over the 1993 to 1999 period. During the 1998 to 1999 period, Wichita's ranking improved to 16 on the list of 253 MSAs.²⁸ The surge in aerospace vehicles and defense sales, particularly general aviation aircraft during the later part of the 1990s, undoubtedly explains this dramatic export improvement and underscores the dependence of the Wichita economy on this cluster.

Exhibit 17. Exports per Civilian Worker, Selected MSAs, 1999



Note: Data is for manufactured and commodity exports only
Source: U.S. Department of Commerce, International Trade Administration

Indicators of Innovation Output

To assess potential future competitiveness, we compared Wichita to the nation and benchmark regions in the following measures of innovative output and entrepreneurship: patents, venture capital investments, the prevalence of fast growing companies, and initial public offerings. Patents measure early stage innovation, whereas venture funding, fast growth firms, and IPOs measure innovation at successive stages.

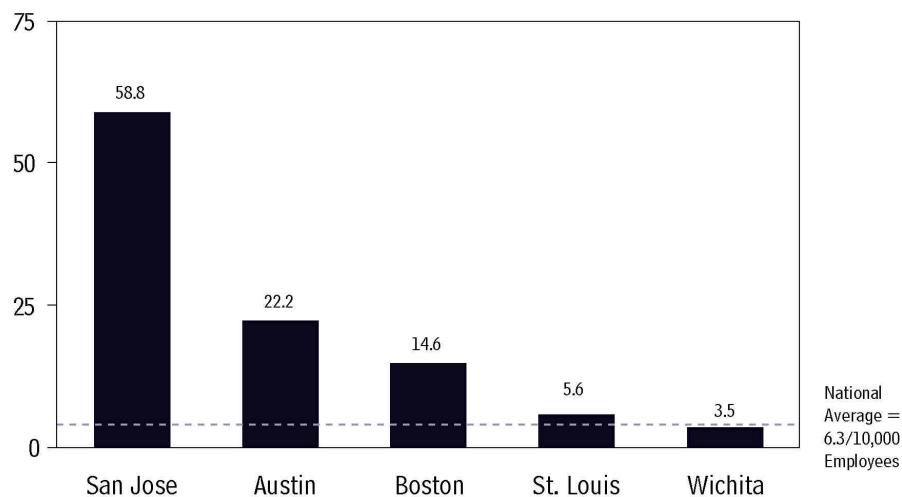
Overall, the Wichita economy has produced a low level of innovation output over the last decade. Patent registration, venture capital investments, number of IPOs, number of fast growth firms, and establishment growth are all low compared to national benchmarks. These innovation measures raise concern about the region's future competitiveness.

Early Stage Innovation: Patent Registration. The Wichita MSA's rate of patent generation is lower than the average region. Exhibit 18 shows that Wichita registered 3.5 patents per 10,000 civilian workers in 1999, about half the national average of 6.29 and well behind competitor regions like St. Louis (5.6), Boston (14.6), San Jose (59), and Austin (22.2). Wichita's annual patent growth rate of 3% over the 1990 to 1999 period falls below the national rate of 6.54%, St. Louis's rate of 6%, Boston's rate of 7.11%, and Austin's rate of 18.01%.²⁹

In 1998, none of the 10 clusters in the Wichita MSA with a share of national cluster employment above its share of national employment (.24 %) had a proportionate or higher patenting rate. Aerospace vehicles and defense, with 1.4% of national cluster employment, had only a .07% national cluster patent share. Among the 20 largest clusters in the Wichita MSA, only the processed foods cluster had a patent per employee index higher than the national average. Twenty-seven of the 41 traded clusters saw a fall in their share of national cluster patents over the 1988 to 1998 period.³⁰

To measure the quality of patents, we look at the number of patents cited in other patents. Wichita clusters have a low percentage of high quality patents (see Exhibit 19) compared to benchmark regions. Ten percent of Wichita patents were cited in other patent applications in 1998, compared to 51% for Boston

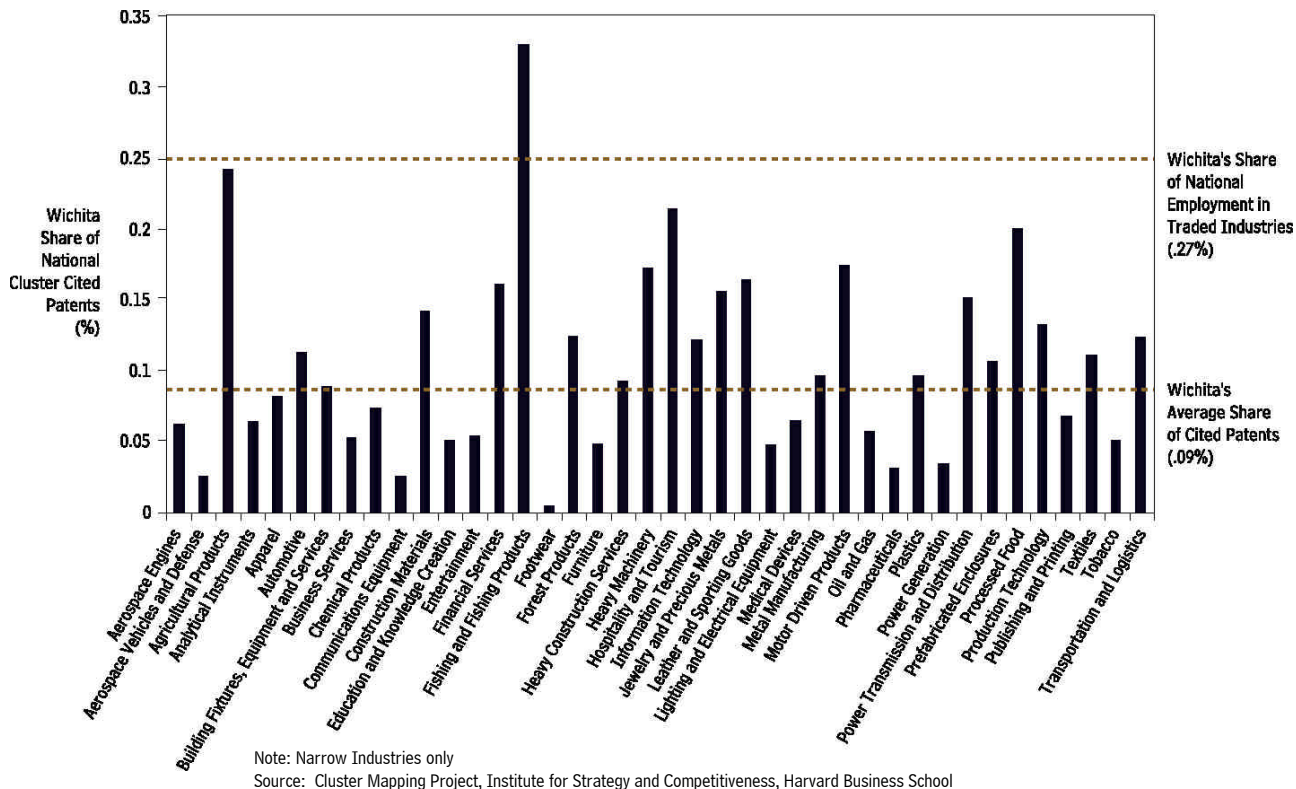
Exhibit 18. Patents Per Employee, Selected MSAs, 1999



Source: U.S. Patent and Trademark Office

and 62% for Austin.³¹ The MSA had .09% of national cluster cited patents in traded industries but .27% of the nation's traded employment in 1998. St. Louis had 1.01% of national cluster cited patents in traded industries. Within the Wichita region, only fishing and fishing products had a share of cited patents above the region's employment share. Agriculture products, processed food, hospitality and tourism and motor driven products were the next best measures of Wichita's share of cited patents.

Exhibit 19. Wichita's National Share of Cited Patents by Narrowly Defined Cluster, 1998

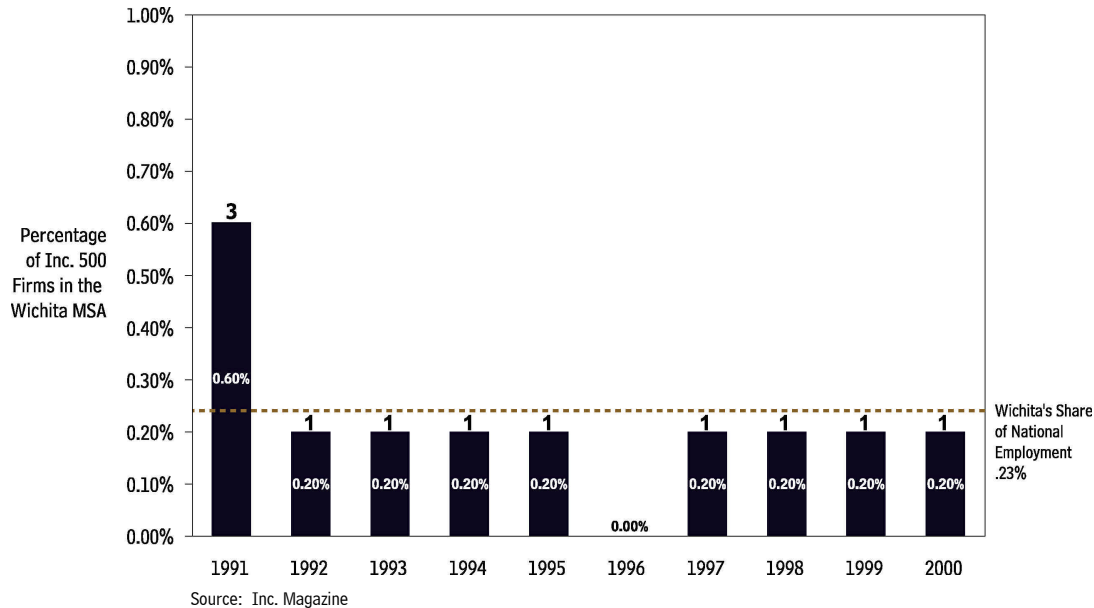


Later Stage Innovation: Venture Capital Funding.³² In 1999, the Wichita MSA had roughly \$20 in venture capital funding per civilian worker compared to \$266 per worker for the nation, \$52 per worker for St. Louis, \$768 per worker for Boston, and \$1,975 per worker for Austin. Between 1998 and 1999, only four venture capital deals worth \$6.59 million were made in the Wichita MSA. Two deals were in computer/peripherals, one was in industrials and another in publishing and broadcasting. Two of the deals went to Interex, a computer peripheral firm, which went bankrupt in 2000. None of the venture capital deals were for early stage companies.³³

Survey findings and interviewee discussions point to a serious shortage of venture capital funding in Wichita, particularly for early stage companies. For many of the small manufacturing-oriented machine shops located in Wichita, debt financing is more relevant than venture capital.³⁴

Fast Growth Firms.³⁵ With the exception of 1991 and 1996, the Wichita MSA had only one Inc. 500 firm, or .20% of all Inc. 500 firms, as compared to its .24% share of national employment. Exhibit 20 shows the percentage of Inc. 500 companies in the Wichita MSA on the vertical axis (exact number at top of bar). Only in 1991 did Wichita have a greater number of Inc. 500 companies than its share of national employment.

Exhibit 20. Percentage and Number of Inc. 500 Firms in the Wichita MSA, 1991 to 2000



IPOs.³⁶ In terms of initial public offerings, the Wichita MSA had just two over the 1996 to 1999 period compared to 17 for Austin, 106 for Boston, and 112 for San Jose. Normalized for population in 1997, Wichita had .36 IPOs per 100,000 workers compared to .62 for Austin, .77 for Boston, and 2.67 for San Jose (see Exhibit 21).

ENTREPRENEURIALISM IN WICHITA

Although Wichita has held the title of “Air Capital of the World” for more than 60 years, Wichita residents are even more proud of the entrepreneurs who gave birth to the aviation companies and other, nationally recognized firms. In addition to Cessna, Lear, and Beech, Wichita has produced the Coleman Company, Koch Industries, Pizza Hut, Papa John’s, Rent-A-Center, Taco Tico, Candlewood Hotel Co., BriteVoice, Inc., and Residence Inns, among others.

Wichita has not actually generated more new business establishments than the national average over the 1988 to 1998 period. During this period, Wichita created 44 new business establishments per 10,000 workers compared to 70 for the nation as a whole, at an annual growth rate of 1% net new businesses versus 1.44% for the U.S.. Nearly all interviewees, however, mentioned that Wichita’s success is attributed to its particular entrepreneurial bent. Four reasons explain Wichita’s entrepreneurial pride.

Wichita entrepreneurial businesses employ the majority of the workforce. The four aerospace vehicles and defense manufacturers, the Coleman Company and Koch together employed approximately 50% of 1998 narrow traded employment in the Wichita MSA. These anchor firms contribute to near national average wages in the Wichita MSA. In addition, approximately 100 small machine shops and tool companies play an important role in airframe production for the aerospace vehicles and defense and plastics anchor firms. Many of the owners/entrepreneurs of these firms worked for one of the manufacturing anchor firms at one time. Some interviewees have mentioned that the region’s boom and bust cycles have fueled these aerospace vehicles and defense entrepreneurs when they have been laid off. “If everything is nice and steady, no one is encouraged to jump and try to do something on their own,” said Tim Witsman, President of the Wichita Chamber of Commerce.³⁷

Interviewees believe that Wichita’s “open mind/open prairie” mentality has fostered entrepreneurial attitudes and people. Fran Jabara,³⁸ legendary entrepreneur, member of the WSU business faculty for 28 years and advisor to Bill Lear, said, “Why does everyone talk about entrepreneurialism in Kansas? The original entrepreneur was the farmer. The farmer work ethic and the honesty of Midwesterners are responsible for the creativity and the entrepreneurialism in Kansas.”³⁹ Tom Devlin, founder of Rent-A-Center, said, “People dream about starting their own business here. Everyone believes that owning his or her own business is the ultimate goal. As soon as you get enough money, you want to start your own business.”⁴⁰

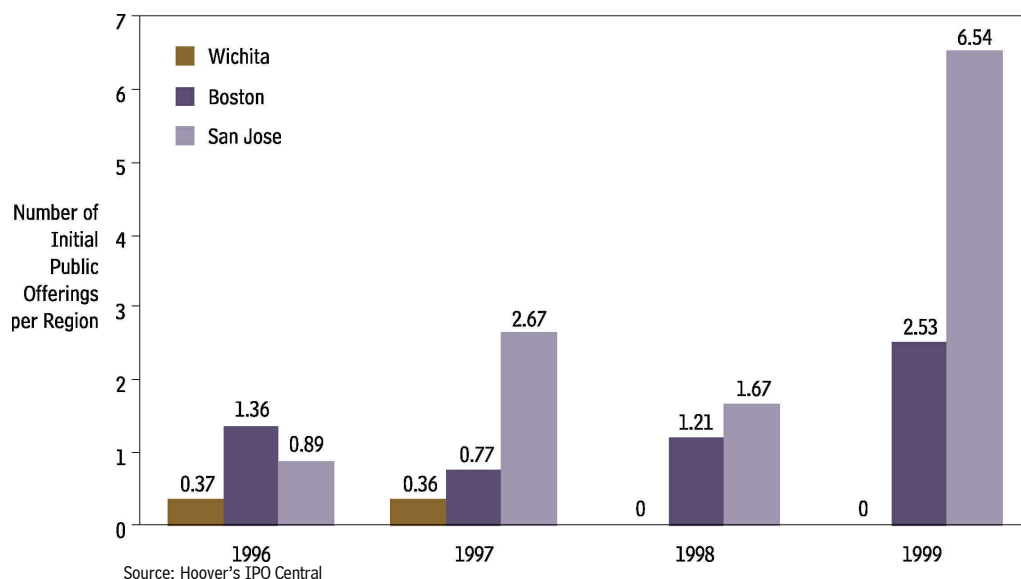
Entrepreneurs are profiled widely, have acted as role models in the community, and have encouraged follow-on entrepreneurs. Koch Industries is an example of an established but highly entrepreneurial, Wichita-based company. Koch employs 11,000 people around the world and approximately 2,000 in Wichita, its world headquarters. The second largest private company in the U.S., Koch started by refining oil products but has broadened to include chemicals, minerals, synthetic textiles, cattle ranching, road materials, and financial services. Koch processes and transports 25% of the total natural gas liquids consumed in the U.S. Koch Ventures, a venture capital firm within Koch, has invested \$175 million in U.S. businesses since 1996.

Pizza Hut is another case study in setting Wichita’s entrepreneurial trends. Allen Bell, Director for Economic Development for the city of Wichita, said that friends and colleagues working together and the presence of oil money spurred Pizza Hut’s development. “What Pizza Hut did was create the Wichita dream. In other cities, if you have a good idea, it may not come to mind to start franchising. Here, people succeeded and created a pattern for others to follow.”⁴¹ “Pizza Hut has done more for the creation of

wealth, entrepreneurialism, and innovation in Wichita than any other company. All of the original founders and franchisees were friends in school. And these guys are still investing in Wichita,” said Jabara.⁴² In terms of spin-offs, Frank Carney, the co-founder of Pizza Hut, started competitor Papa John’s. J&G products, a spice supplier to the Pizza Hut Company, was founded in Wichita. A Wichita Pizza Hut franchisee founded the Lone Star Steakhouse chain.⁴³ The International Pizza Hut Franchise Holders Association, which represents 152 Pizza Hut franchise organizations, has its base in Wichita. Wichita-based Pizza Hut franchise organizations employ 250 executives and operate about 18% of the 4,478 Pizza Hut restaurants in the country.⁴⁴

Wichita has also invested in programs and institutions for collaboration, such as the Center for Entrepreneurship and the associated Kansas Family Business Forum at WSU that teach, nurture, and support the region’s innovators and promote entrepreneurship generally. Jabara started the Center for Entrepreneurship in the late 1980s. Students can receive an undergraduate degree from the Center and a Master of Science in Business with a specialization in entrepreneurship. Tom Devlin, founder of Rent-A-Center, provided funding to create the Center. The Family Business Forum provides seminars for local, family-owned businesses. Jabara also started the Entrepreneur and Executive in Residence Lecture Series and the Business Heritage Book Series, a series of books on local entrepreneurs. The Koch family supports the Young Entrepreneurs of Kansas, an organization that works in Wichita-based schools to teach youth about business and entrepreneurship.

Exhibit 21. Number of Initial Public Offerings, Selected MSAs, 1996 to 1999

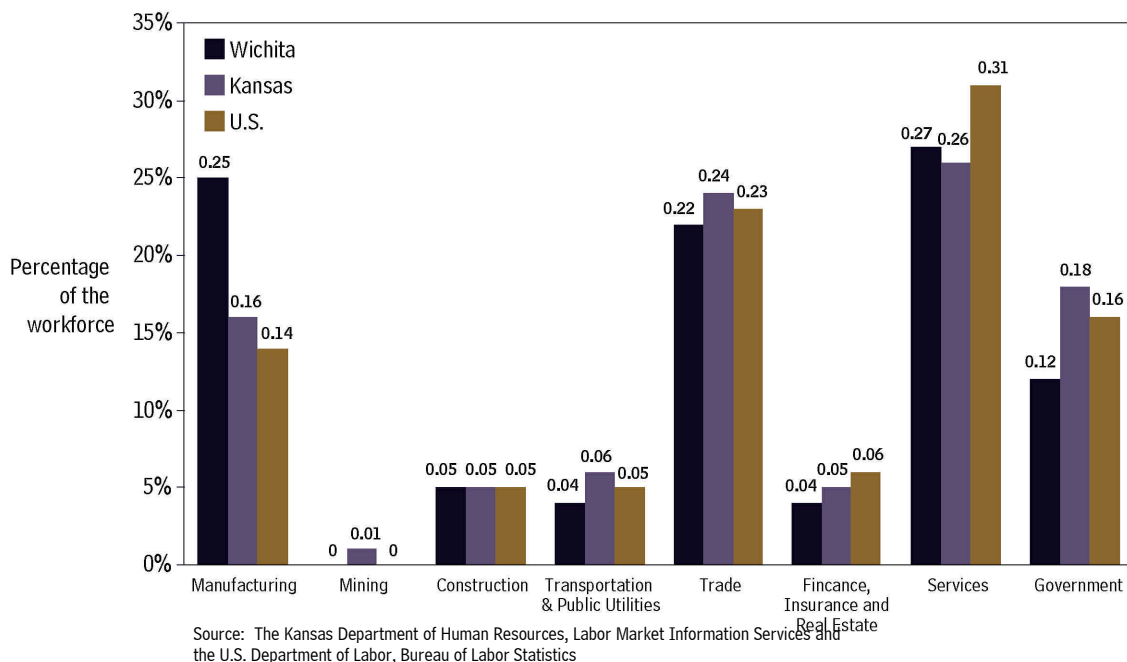


The Composition of the Wichita Regional Economy

Wichita has a greater share of its employment in traded industries than Kansas and the nation as a whole, reflecting Wichita's high percentage of employment in the manufacturing sector and specifically in the aerospace vehicles and defense cluster. Perhaps surprisingly, the region has a good number of other large and growing manufacturing-related clusters. Unfortunately, the economic and innovation performance of many of these clusters is below national benchmarks, which helps to explain the region's lower innovation measures.

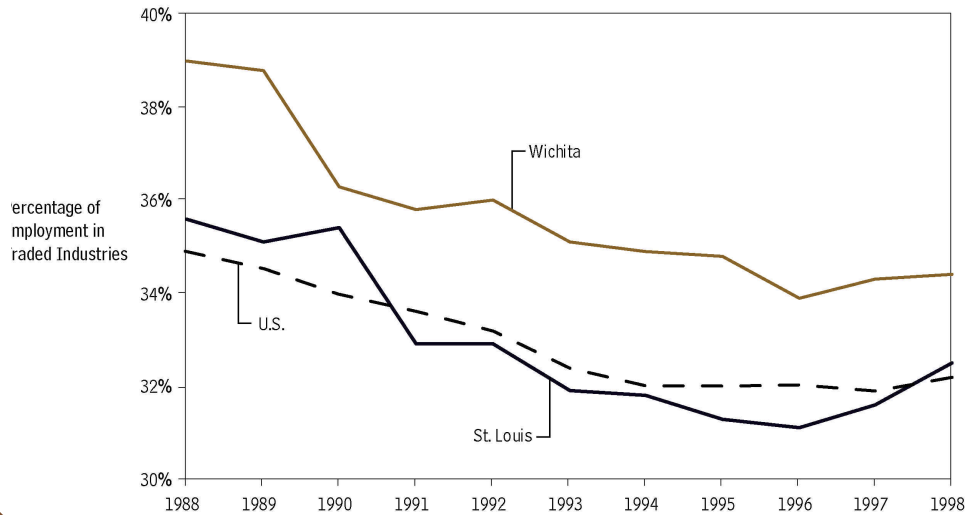
The Wichita MSA had roughly 25% of employment working in the manufacturing sector, as compared to 16% for Kansas and 14% for the nation in 2000 (see Exhibit 22). The service sector claimed 27% of employment, followed by retail trade (22%), government (12%), construction (.05%), transportation (.04%), finance, insurance and real estate (.04%), and mining (.004%). Growing at an annual rate of 4.39%, construction had the fastest growth, followed by services (2.7%), government (1.85%), and manufacturing (1.26%) over the 1990 to 2000 period. Mining declined the most significantly at -3.97% over the period.⁴⁵

Exhibit 22. Wichita Employment by Sectors, MSA, 1990 to 2000



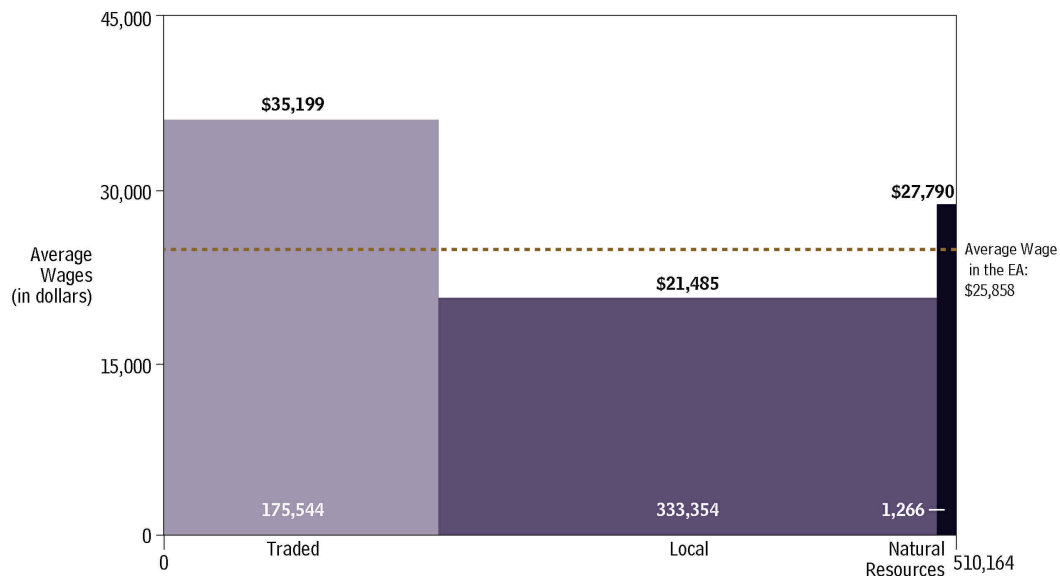
The region's high percentage of employment in the manufacturing sector is due to relative high employment in traded industries. Traded industries are those that can be located anywhere and produce products and services that compete nationally and internationally. They are important because they tend to pay higher wages and thus are critical to a region's prosperity.⁴⁶ Exhibit 23 shows that employment in traded industries in the Wichita Economic Area is greater than in Kansas, St. Louis and the U.S.⁴⁷ Wichita's economic strength and near national average wages are based on this high proportion of employment in traded industries (see Exhibit 24). However, while traded cluster employment is relatively high, the region's largest traded clusters demonstrate relatively low economic performance and innovative capacity as compared to nation-

Exhibit 23. Percentage of Employment in Traded Industries, Economic Area, 1988 to 1998



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 24. Composition of Average Wages in Wichita EA, by Traded, Local and Natural Resource Clusters, 1998



Note: Length of shapes is determined by number of workers (Total 510,164)

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

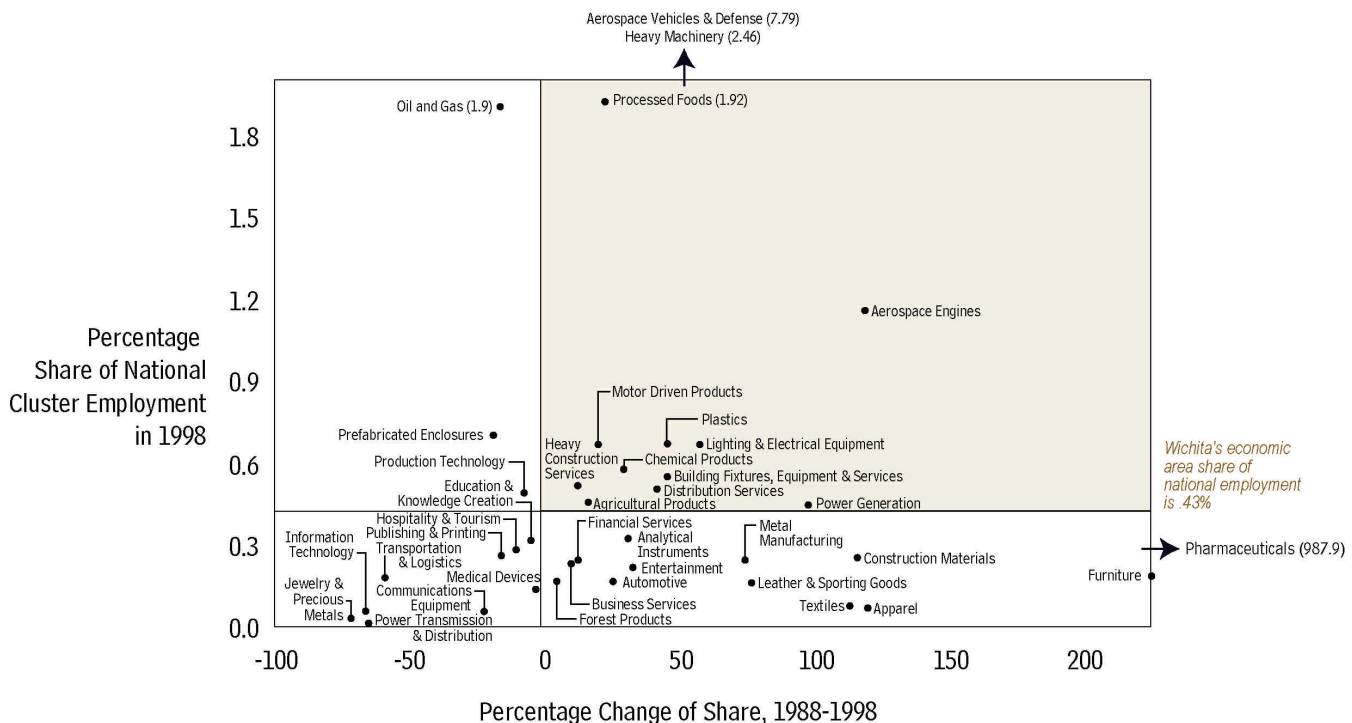
Clusters.⁴⁸ Wichita has several large and growing clusters, including some that are well known and others that have a much lower profile in the region. Particularly among the largest clusters, we detect a number of challenges, which accounts for the low innovative capacity in the region.

Exhibit 25 shows the Wichita Economic Area's employment share and growth in share in the 41 traded clusters in the United States economy. Wichita had .43% of total national employment in the Economic Area. Clusters above the horizontal axis are relatively concentrated in Wichita, and clusters to the right of the vertical axis have grown over the 1988 to 1998 period. The upper right quadrant represents clusters that have a disproportionate share of national employment in Wichita and are growing their share.

In Wichita, 13 clusters are located in the upper right quadrant, representing 70% of the Economic Region's total traded cluster employment. These clusters are aerospace vehicles and defense, aerospace engines, plastics, lighting and electrical equipment, heavy construction services, motor driven products, processed foods, heavy machinery, chemical products, building fixtures, equipment and services, agricultural products, and distribution services, and power generation. While Wichita has a strong portfolio of 13 clusters, albeit some being small, economic development leaders have tended to focus attention on about half this number.

Several of these clusters are responsible for the near national average wages in Wichita. Exhibit 26 shows the disproportionate impact of the aerospace vehicles and defense cluster on the Economic Area average wage and the average wage among all traded clusters in the region. Average wages within the aerospace

Exhibit 25. Composition of the Wichita Economy by Cluster, Economic Area, 1988 to 1998



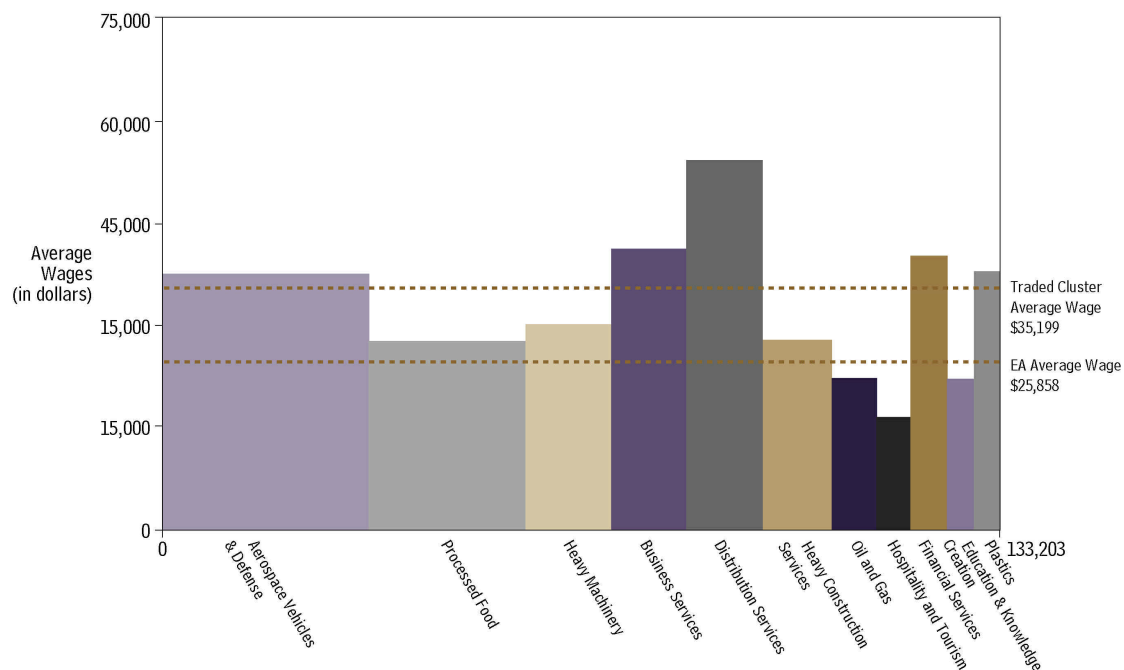
Note: Narrow Industries only

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

vehicles and defense cluster were approximately \$37,731 in 1998, above the Wichita traded cluster average wage of \$35,199 for the EA and the average wage of the EA as a whole (\$25,858). In addition to aerospace vehicles and defense, business services, distribution services, financial services, and plastics all contribute to a traded cluster average wage that is considerably higher than the regional average wage.⁴⁹

Although Wichita has a good number of large and growing traded clusters that contribute to the region's near national average wages, there are challenges detected among the largest ones. Exhibit 27 shows employment, wage and patent data from the narrow industries of the 20 largest clusters in the Wichita Economic Area by national share.⁵⁰ This exhibit reveals extremely high employment within the aerospace vehicles and defense cluster as compared to the other largest clusters in the region. While diversification away from aerospace vehicles and defense has occurred during the study period, 36% of Wichita MSA traded employment in narrow industries still worked in the aerospace vehicles and defense cluster in 1998 (down from 51% in 1988). Further, this exhibit shows relatively low performance in terms of wages, wage growth rates, and patent activity compared to national benchmarks among the top 20 clusters in the region. These indicators of the top clusters explain the region's only moderate economic performance and low innovative capacity measured in terms of patents.

Exhibit 26. Wichita EA Average Wages for 11 Largest Clusters, Narrow Industries, 1998



Following the region's relatively strong employment growth measures, most of Wichita's top clusters were growing during the study period. Fourteen of the 20 largest clusters were growing at or above 1.23%, the annual employment growth rate in the Wichita Economic Area. Relatively fast-growing, large clusters include processed food, heavy machinery, business services, distribution services, heavy construction

services, hospitality and tourism, financial services, education and knowledge creation and plastics. Except for plastics, this list of large and growing clusters was rarely mentioned by interviewees.

Aerospace vehicles and defense, which actually shrank over the 1988 to 1998 period, remains the largest employer in the Wichita EA. It is important to note two caveats about the aerospace vehicles and defense cluster employment data. First, the drop in aerospace vehicles and defense employment is not as large as the data illustrates in Exhibit 27. For some industries, the U.S. Census Bureau uses means within ranges

Exhibit 27. Employment, Wages and Patenting Activity in the 20 Largest Clusters, Narrowly Defined, Wichita Economic Area, 1998

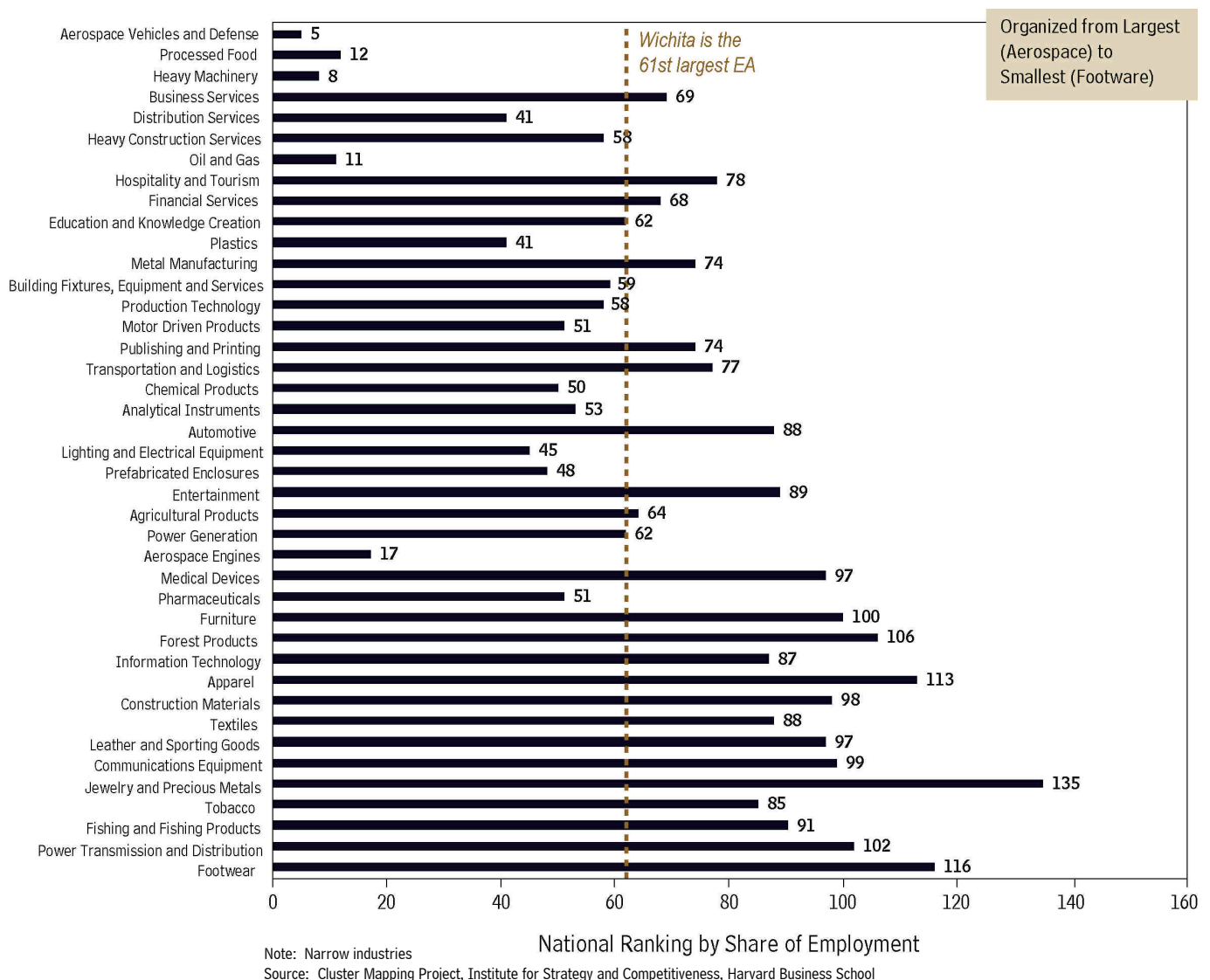
Cluster	Total Employment 1998	Annual Growth Rate in Employment 1988-1998	Average Wages Indexed to Nation 1998	Annual Growth Rate of Average Wage Index 1988-1998	Patents per Employee Indexed to Nation 1998	Annual Growth Rate of Patent Index 1988-1998
Aerospace Vehicles and Defense	34260	-3.50	72.6	-1.50	5.8	0.79
Processed Food	26631	2.10	90.5	0.66	25.9	6.57
Heavy Machinery	10536	3.10	84.0	-0.50	37.9	0.78
Business Services	9410	5.90	84.9	-0.15	52.3	-5.21
Distribution Services	9310	6.60	122.3	2.96	28.3	-13.65
Heavy Construction Services	9001	3.40	80.1	1.08	81.5	2.78
Oil and Gas	7674	-2.60	49.4	-2.78	16.0	3.75
Hospitality and Tourism	7178	1.80	77.4	0.98	70.1	-3.57
Financial Services	6932	3.10	65.6	-1.54	45.9	1.47
Education and Knowledge Creation	6509	2.70	62.6	2.38	69.1	4.42
Plastics	5762	5.70	106.5	2.45	27.9	-3.63
Metal Manufacturing	3590	6.10	107.7	9.31	93.2	-4.41
Building Fixtures, Equipment and Services	3442	4.50	93.1	1.01	49.6	-7.86
Production Technology	3425	0.20	66.1	-1.80	60.7	-0.75
Motor Driven Products	2881	1.60			75.0	-3.01
Publishing and Printing	2729	-1.80	77.7	0.44	35.6	-4.99
Transportation and Logistics	2695	-5.90	65.2	1.29	71.5	-6.40
Chemical Products	2681	1.30			18.0	3.10
Analytical Instruments	2569	0.70	69.7	-4.11	27.7	-8.61
Automotive	2294	3.9	68.8	-1.26	143.5	-2.29
Number Outperforming National Average		---	3	1	1	0

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

rather than actual reported employment data. In some cases, companies suppress their actual employment data and report a range rather than the actual number. The Census Bureau will report the mean of the range. A relatively small change in reported employment can tip the employment data range and significantly alter the mean reported. For example, over the 1989 to 1990 period, the aircraft parts and equipment industry in the EA moved from the 25,000 to 49,000 range to the 10,000 to 24,999 range. The Census Bureau reported a drop in the mean from 37,500 to 17,500. The industry did not lose 20,000 employees, however. According to interviews, the industry probably lost 2,000 to 3,000 workers over the 1989 to 1990 period.⁵¹ Second, this report focuses on the 1988 to 1998 period. Employment has increased dramatically over the 1998 to 2001 period, increasing by roughly 4,000 during this period.

While employment is growing among most of the region's top clusters, only three of the largest 20 clusters—plastics, distribution services, and metal manufacturing services—had wages above the national

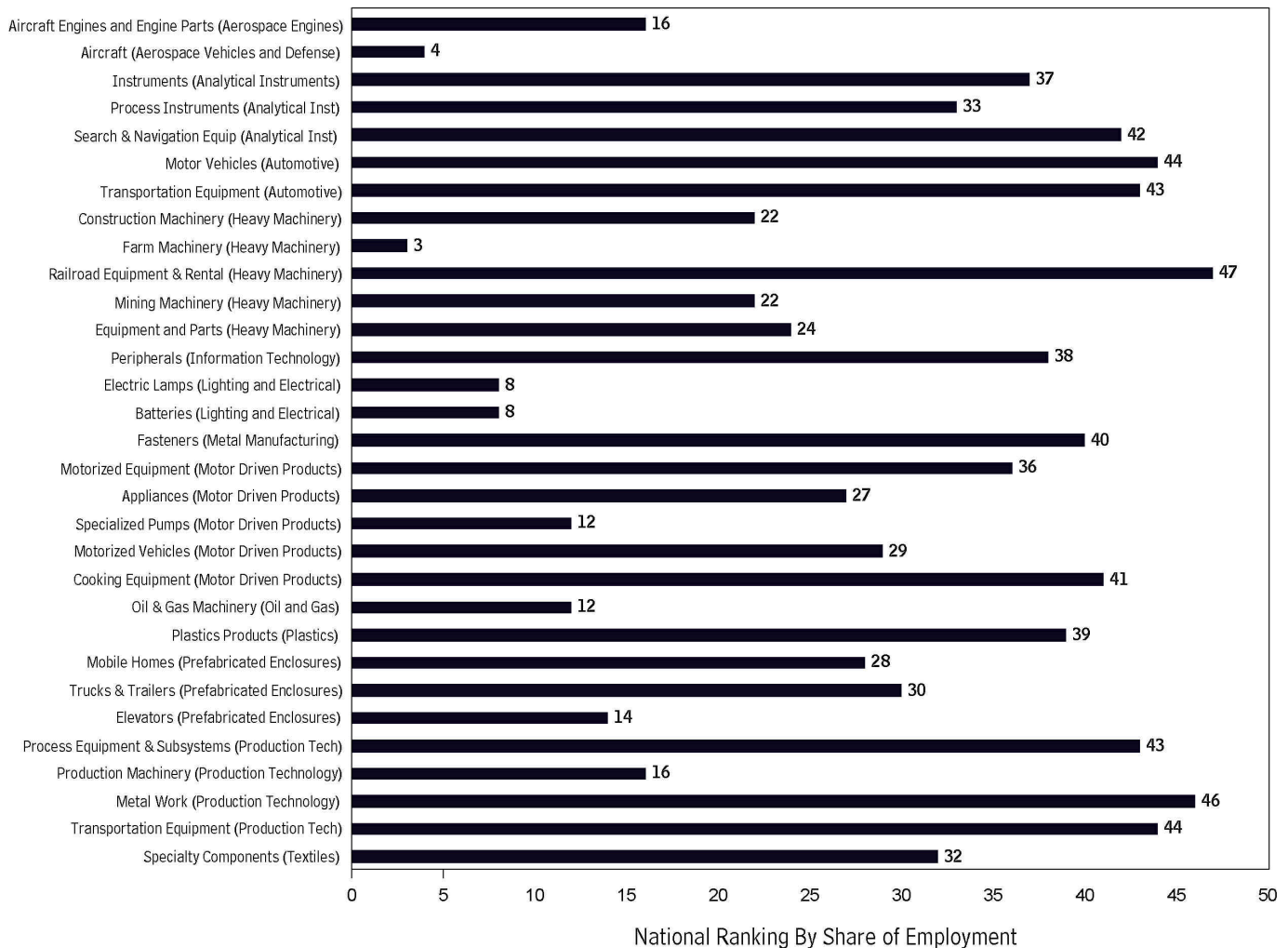
Exhibit 28. Rank of National Employment Share by Narrowly Defined Cluster, Wichita Economic Area, 1998



average for the cluster. Metal manufacturing was the only large cluster that had average wages indexed above the national average that were growing faster than the national growth rate of 3.88% over the 1988 to 1998 time period. It is interesting to note that the largest cluster, aerospace vehicles and defense, had average wages below the nation as a whole. Further, the annual growth rate of the average wage index to the nation was actually declining over the 1988 to 1998 period for this important cluster. Wages within the aerospace vehicles and defense cluster declined significantly from 103% of the national average for the cluster in 1997.

Patenting activity within the top 20 clusters follows low patenting activity trends described earlier for the region as a whole. Only one large cluster, automotive, had a higher patent per employee measure than the nation as a whole. Twelve out of the 20 large clusters had a negative growth rate of the patent per employee index. Of the eight clusters with positive patenting growth rates, none was above the national patenting growth rate of 6.54% and only four were above the regional patenting growth rate of 3% (processed food, oil and gas, education and knowledge creation, and chemical products).

Exhibit 29. National Employment Rank by Narrowly Defined Selected Subcluster, Wichita Economic Area, 1998



Note: The Wichita Economic Area is the 61st largest in the United States

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Once we understand the state of the top clusters in the region, we can examine how some of these large clusters rank in the nation as well as identify other clusters that have economic development potential. Exhibit 28 shows the national ranking in terms of percentage share of national employment of each of the Economic Area's narrowly defined clusters. In 1998, Wichita ranked 20th or better in only five out of 41 clusters in terms of share of national employment (aerospace vehicles and defense, aerospace engines, processed food, oil and gas and heavy machinery).

While these clusters have a high profile in Wichita, other clusters that represent a sizable share of national employment garner less attention and offer opportunities for economic development. Wichita is the 61st largest Economic Area in terms of employment. The region ranked higher than 61 in 16 out of the 41 clusters. Less well-known cluster examples include distribution services, analytical instruments, pre-fabricated enclosures, pharmaceuticals, and lighting and industrial equipment.

Exhibit 29 shows Wichita's rankings by selected subclusters. Not surprisingly, the region does well in aircraft engines and aircraft engine parts, aircraft, farm machinery, electric lamps, batteries, specialized pumps, oil and gas machinery, elevators, and production machinery. These are all key subclusters in the large and growing clusters located in the upper right quadrant of Exhibit 25.

A REGION OF SUBSIDIARIES

Many of Wichita's largest and highest profile entrepreneurial firms have been purchased and, in some cases, relocated to the acquirer's home location. Pizza Hut was purchased by the Pepsi Company in 1977 and moved its headquarters to Dallas in 1996. Rent-A-Center was purchased in 1998 by competitor Renters Choice and relocated operations to Texas. BriteVoice was purchased by InterVoice Inc. and moved its headquarters to Dallas in 1999. The Coleman Company was purchased by Sunbeam in 1988, Lear in 1967 by the Gater Rubber company and again in 1990 by Bombardier, Beech in 1980 by Raytheon, Cessna in 1992 by Textron, and Knowledge Communications, a high profile software start-up in Wichita, by Massachusetts-based Harcourt General in 1999 (Knowledge Communications moved its sales staff). Bank of America bought the Fourth National Bank, and Commerce Bank bought Union National, once the third largest in the state. InTrust is the only large local bank still independent.

Interviewees were highly conscious of this pattern. While acquisitions are a natural evolution for growing businesses, Wichita has rarely been on the acquiring side. Instead, it has lost some white-collar jobs with departures. In the case of Rent-A-Center, 500 jobs were lost. Allen Bell, Director of Economic Development for the city of Wichita, attributed the pattern to a number of reasons, including relatively poor air service, lack of venture capital, labor constraints, difficulty in attracting top talent, and quality of life issues. John Ek, publisher of the *Wichita Business Journal*, and Janet Nickel Harrah, Director of the Center for Economic Development and Business Research, believed that more companies left the region due to the lack of air travel options out of the Wichita airport than for any other reason.⁵² John Rolfe, former Vice President for Economic Development for the Wichita Area Chamber of Commerce, thought that the acquisition/merging trend was more prevalent four or five years ago.

Fran Jabara considers the trend of corporate headquarters departing Wichita to be a loss to the community. When corporations move out or are acquired, said Jabara, the people who run the company lose touch

and “lack a heart” for the local economy. “The people who are left behind are a different level of management and people are mobile—when they perform well, they are moved out.”⁵³ Said J.V. Lentell of InTrust Bank, “Leadership on Wichita issues is now fractured. It used to be that the heads of the major companies in aviation, Pizza Hut, local banks, were in Wichita. You would get those leaders together and get things done,” said Lentell. “Now the companies receive marching orders from outside Wichita.” Lentell said that it is more difficult to get consensus on issues.⁵⁴

The Chamber of Commerce attempts to stay close to existing companies in order to prevent corporate relocations as much as possible. “We meet with the key individuals at companies all the time,” said Rolfe. “If we hear about an impending move, we ask ‘what can we do to assure your presence here?’”⁵⁵

Exhibit 30. Employment Growth and Decline by Cluster, Wichita Economic Area, 1988 to 1998

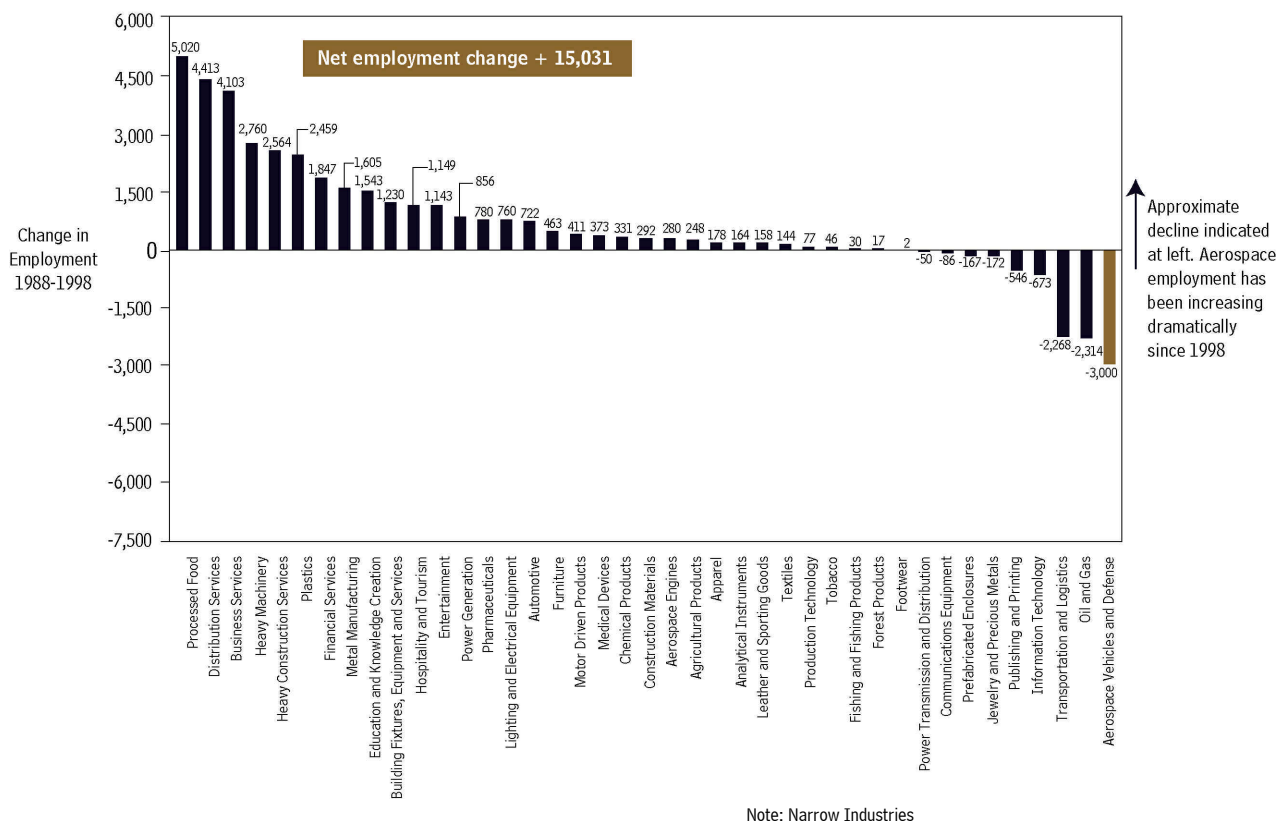


Exhibit 30 shows the growth and decline in employment by narrowly defined cluster in the Wichita Economic Area over the 1988 to 1998 period. The net gain in employment in traded clusters over the period was roughly 15,031 jobs.⁵⁶ Gains are seen in lower profile clusters such as processed foods, distribution services, business services, heavy machinery, heavy construction services, financial services, plastics, metal manufacturing, education and knowledge creation, and building fixtures, equipment and services. The more high profile clusters, such as aerospace vehicles and defense and oil and gas, experienced the largest employment losses. The aerospace vehicles and defense cluster lost workers over the 1988 to 1998 period. In addition to the employment reporting anomaly by the U.S. Census Bureau discussed earlier, it must also be noted that the aerospace vehicles and defense cluster's employment decline during the study period is a result of a serious downward cycle in the mid-1990s. During the last three years, the cluster has grown rapidly, gaining at least 4,000 jobs within the four major aircraft manufacturing companies alone.

Industries in Wichita. Exhibit 31 shows the ten industries in Wichita that added the most jobs to the economy over the 1988 to 1998 period. Except for one, foreign bank and branches and agencies, all are in manufacturing. The top four industries with the highest employment gains include aircraft, meat packing plants, transportation equipment and supplies-wholesale, and plastics products. This analysis reveals that job growth in the Wichita EA is still manufacturing-focused. While significant employment gains are found within industries that are part of the two clusters studied in this report, aerospace vehicles and defense and plastics, we find substantial gains in other, lower profile industries.

Exhibit 31. Ten Wichita Industries with the Most Employment Growth, Economic Area, 1988 to 1998

Industry	Aircraft	Meat Packing Plants	Transportation Equipment and Supplies - Wholesale	Plastic Products, n.e.c.	Foreign Bank and Branches and Agencies	Farm Machinery and Equipment	Farm Supplies - Wholesale	Engineering Services	Sausages and Other Prepared Meats	Electric and Other Services Combined
Clusters in which Industry Features	<ul style="list-style-type: none"> Aerospace Vehicles and Defense 	<ul style="list-style-type: none"> Processed Food 	<ul style="list-style-type: none"> Aerospace Vehicles and Defense Distribution Services Hospitality and Tourism 	<ul style="list-style-type: none"> Plastics 	<ul style="list-style-type: none"> Financial Services 	<ul style="list-style-type: none"> Heavy Machinery 	<ul style="list-style-type: none"> Heavy Machinery 	<ul style="list-style-type: none"> Business Services Heavy Construction Services 	<ul style="list-style-type: none"> Processed Foods 	<ul style="list-style-type: none"> Lighting and Electrical Equipment Power Generation
Total Employment Gained in Region 1988 to 1997	4,783	4,616	3,624	3,190	1,255	1,255	1,129	1,095	894	575

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Although Wichita has seen most of its job growth in the aircraft industry, there have been some losses in the aircraft parts and equipment industry. The Wichita EA also experienced employment losses in two industries that are part of the transportation and logistics cluster: 1) air transportation, scheduled and 2) airports, flying fields, and services (see Exhibit 32). Losses in these industries reflect Wichita's shrinking transportation and logistics cluster and, specifically, weak air service as exhibited by low volume of travelers. This was an issue that received criticism from interviewees and survey respondents alike. Dropping from a peak of 1055 employees in 1991 to 70 in 1998, the plastics foam products industry lost a total of 925 workers. The drop in the plastics foam products industry was the only serious setback for the plastics

cluster as it was one of the fastest expanding clusters in the region. This job loss reflects a shift away from plastic foam products to other plastic products within the cluster.

Other significant industry employment losses help to explain some of Wichita's shrinking clusters. The travel trailers and campers industry lost 893 workers. Three industries in the oil and gas cluster had a combined employment loss of roughly 2,100 workers. These employment losses explain why the oil and gas and the prefabricated enclosures clusters were shrinking over the 1988 to 1998 period.

Exhibit 32. Ten Wichita Industries with the Largest Employment Decline, Economic Area, 1988 to 1998

Industry	Oil and Gas Field Services, n.e.c.	Life Insurance	Crude Petroleum and Natural Gas	Miscellaneous Publishing	Drilling Oil and Gas Wells	Travel Trailers and Campers	Plastics Foam Products	Airports, Flying Fields, and Services	Air Transportation, Scheduled
Clusters in which Industry Features	Oil and Gas	Financial Services	Chemical Products Oil and Gas Pesticides	Education and Knowledge Creation Publishing and Printing	Oil and Gas	Building Fixtures, Equipment and Services Prefabricated Enclosures	Plastics	Hospitality and Tourism Transportation and Logistics	Transportation and Logistics
Change in Employment 1988 to 1997	-509	-529	-747	-749	-826	-893	-925	-1,157	-1,180

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

REGIONAL INNOVATIVE CAPACITY

During the last ten years, the Wichita economy has had moderate growth while it has developed a relatively strong manufacturing base with a number of large and growing clusters. We have also seen that the region has many large and growing clusters that have not received a great amount of attention. However, a large proportion of the region's traded cluster employment is still concentrated within two industries in the aerospace vehicles and defense cluster. Further, we have detected a number of problems confronting some of the largest clusters, notably low wage growth and patenting activity. This section uses the diamond framework to assess regional innovative capacity, in order to explain the composition of the regional economy as previously discussed, and determine whether the business environment will support continued economic prosperity.

Wichita has several real strengths which explain the high percentage of employment in traded clusters and near national average wages as compared to the nation as a whole. Key Wichita strengths include a solid base of manufacturing skills, a broad manufacturing presence, a moderate cost of living, a culture of vigorous competition, and positive attitudes toward entrepreneurialism. At the same time, there are several reasons which explain the region's low innovative capacity, which include a shortage of skilled workers, weakness of research institutions, insufficient risk capital, poor air services, a K-12 education system that could benefit from improvements, concerns about the quality of life, lack of cluster thinking, and ineffective institutions for collaboration. Key challenges will be for leaders to upgrade the region's productive assets, focus on workforce development, and improve collaborative attitudes and linkages.

Basic and Specialized Factor Inputs

Physical Infrastructure. In general, transportation infrastructure is strong. The average commute time of 17.4 minutes is less than the national average.⁵⁷ However, physical infrastructure connecting Wichita to other areas is not as strong. In particular, the region's air service needs improvement. Today, few air carriers provide direct service to Wichita. A study conducted in 1990 found that after manufacturing costs, transportation represented the second highest cost category for many Wichita companies.⁵⁸ Those surveyed had the strongest negative responses to the question of local transportation. Almost two-thirds reported that local transportation was very poor. Survey participants in Wichita gave regional transportation infrastructure the lowest rating among the five regions studied.⁵⁹

City leaders have made improving transportation infrastructure a priority. Citizens voted to complete Route 54, the main east-west corridor through the city in 1985. The highway is finished on the west side of the city but is not yet complete on the east side. A state highway bill that included plans to further develop road networks in Wichita was passed in 1999. In response to air service problems, there is strong corporate support for "take or pay" air service contracts (companies reserve capacity on flight schedules) to Kansas City. Wichita leaders are asking the Kansas legislature to subsidize low load situations if they occur.⁶⁰

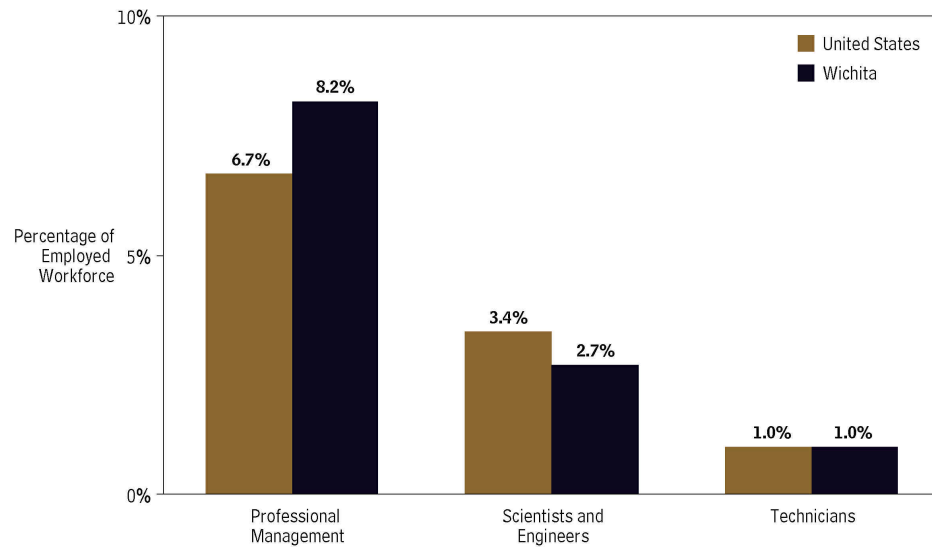
Wichita's communications infrastructure, in contrast, is relatively strong. It is one of the reasons why Wichita has attracted a fair number of call centers during the 1990s. Said Phil Davis, Director of Viking Office Products' call center, "One of the reasons that we chose Wichita was the existing communications infrastructure. Wichita has good fiber optic links. There is redundancy built into the system."⁶¹ Other call center representatives agreed. Ninety-three percent of the respondents to the survey believed that the communications infrastructure either came close or fully satisfied their business needs.⁶²

Quality of Life. While Wichita's weather conditions and crime levels track with national averages, the region's quality of life does not help to attract workers to the region. Interviewees noted that Wichita is an extremely livable city but it lacks natural amenities and a variety of urban activities, key attractions for young knowledge workers. Only 24 % of those surveyed said that the overall quality of life (e.g., climate, cultural, and recreational opportunities) makes recruitment and retention easy. In fact, Wichita survey respondents felt that their quality of life was more of a retention and recruitment problem than the other studied regions. However, a clear majority of those interviewed said that newcomers who have lived and worked in Wichita for some time do not want to leave.⁶³

Many of those interviewed mentioned quality of life as the key barrier to recruitment particularly for younger knowledge workers. "Retaining young people is difficult due to the unavailability of certain jobs and lack of amenities, i.e., the bright lights and big city," said Janet Nickel Harrah,⁶⁴ Director of the Center for Economic Development and Business Research. Jay Feist, CEO of three high-tech firms and regarded as a successful Internet entrepreneur, agreed. "Wichita is not a bad little town. But the hardest thing is getting people to move here. We have a knowledge drain; we're losing talented people to places that are more fun."⁶⁵

Skilled Workforce. An insufficient supply of scientists and engineers challenges Wichita's economy. Exhibit 33 shows that Wichita is below the national average in terms of scientists and engineers (2.7% compared to 3.4%) but has a greater percentage of professional management (8.2% compared to 6.7%).⁶⁶ Advanced education facilities are also not producing a sufficient base of science and technology graduates. While life science bachelor degrees in Wichita more than doubled over the ten-year period, engineering bachelor degrees actually decreased.⁶⁷

Exhibit 33. Skilled Workforce Base in Wichita and the United States, MSA, 1998



Note: Professional Management includes Staff and Admin Specialty Managers, Line and Middle Management Managers, Other Managerial and Administrative Positions. Scientists and Engineers include Engineers and Related Occupations, Natural Scientists and Related Occupations, Computer, Mathematical, Operations Research, and Related Occupations. Economists Technicians includes Technicians and Technologists in Scientific and Engineering Related Occupations.

Source: U.S. Bureau of Labor Statistics, Occupational Employee Statistics

The key educational institution in the region is Wichita State University. WSU offers accredited bachelor, masters and PhD degrees in aerospace and electrical, industrial and mechanical engineering. Others masters level degrees offered include engineering management. WSU also offers an undergraduate program in manufacturing engineering and computer engineering (to be accredited). While WSU offers courses to full-time undergraduates, many of the students work full time and about half are part-time students. About 60% of the undergraduate and graduate student body is from Sedgwick County and about the same percentage of graduates stay in the region. This trend has not changed recently, said representatives of WSU.⁶⁸

Although the region is generally proud of WSU and looks to the university as an important source of trained manufacturing labor, the university does not have top-ranked programs in engineering. Despite the presence of a leading aerospace vehicles and defense cluster and other manufacturing-based clusters in the region, WSU did not make the Year 2001 list of the *U.S. News and World Report's* 19 best graduate schools with aerospace vehicles and defense/aeronautical/astronautical engineering specialties, the 50 best engineering graduate schools, or the 101 best undergraduate engineering programs with PhD programs.⁶⁹

Solid economic growth and particularly strong employment gains in the aerospace vehicles and defense cluster during the last three years explain a general shortage of workers. The future employment situation will pose an even greater challenge. Wichita's population is forecast to grow by .8 % in Sedgwick County (where approximately 80% of the MSA population resides) during 2000 to 2030.⁷⁰ This compares with the 11-year employment growth rate of 1.2% over the 1990 to 2000 period.⁷¹ Further, expected immigration is not large enough to impact population forecasts.⁷²

Based on our survey, the number one barrier to expansion for firms during the next five years is access to skilled labor. Only 33% of those surveyed said that the available pool of workers was sufficient and only 36% said that qualified scientists and engineers were in ample supply. Of the five regions in the Cluster of Innovations study, survey participants in Wichita were the most likely to have said that scientists and engineers were scarce.⁷³ Survey respondents identified that the most important issue for government action was the promotion of specialized education and training programs to upgrade workers skills.

Quality of General Education. The region's public education system is below average in terms of important performance metrics. For the 1998–1999 school year, Wichita's graduation rate was 75%, as compared to 84% for the state of Kansas and 83% for the nation, though Wichita's graduation rates have climbed slightly from 72% since 1995–1996.⁷⁴ The ACT, rather than the SAT, is the college entrance exam most frequently taken by Kansas and Wichita students. Wichita's students scored an average of 20.8 over the 1992 to 2000 period, compared to 20.9 for the nation and 21.4 for Kansas. (The ACT is measured on a 30-point scale).⁷⁵

Wichita business and community leaders are concerned about regional K-12 education. Only 38% rated the K-12 system good or better. Promoting world-class primary and secondary education was the second most important issue for government action identified by survey respondents. Recently, citizens of Wichita voted a clear majority for a school bond issue. The bond issue will infuse \$284 million, the largest amount in Kansas' history, into the Wichita school system.

Supply of Risk Capital. Like the state as a whole, Wichita has chronically suffered from a scarcity of risk capital, which became a subject of concern as early as 1986.⁷⁶ A shortage of risk capital and paucity of formal venture capital firms were two of the most cited weaknesses to innovative capacity mentioned by interviewees. Only 28% of those surveyed in the region indicated that risk capital was abundant.⁷⁷

Attorney Mike Biggs of Klenda, Mitchell, Austerman & Zuercher, LLC, said that low levels of venture capital stymie entrepreneurs. "Jay and Mike [Jay Feist of Choice Solutions and Mike Shell of World Pages] are the exceptions. The rule is that you have to go out of Wichita." He cites the example of Knowledge Communications that, although funded by Wichita Technology Corporation (WTC), had to go out of state to seek sufficient financing. "What we need is about a \$25 million fund," said Biggs.⁷⁸ Tom Devlin, former founder of Rent-A-Center, agreed that Wichita needs more formal venture capital firms.⁷⁹ The Coleman Company's Ken Fisher said that the dearth of venture capital firms results from unexceptional growth in the region. "We're Steady Eddy here which may not be attractive for the VCs."⁸⁰

In response to the paucity of seed capital, the Wichita Technology Corporation (WTC) was created in 1994 to provide seed capital and business assistance to technology start-ups. A non-profit organization partnered with the Kansas Technology Enterprise Corporation (KTEC), WSU and Wichita Area Development, WTC's mission is to "create and sustain a formal innovation network that will support technology advancement, transfer and commercialization" in the region. The Wichita Technology Corporation's Wichita Technology Ventures, a for profit investment fund, has to date invested \$1.6 million in local ventures.⁸¹ In addition to initiatives from WTC, economic development and business leaders have been trying to get state venture capital legislation passed since 1998. A more conservative version of the bill was introduced last year. The 2001 venture capital bill proposes \$40 million (as compared to \$50 million in the past) in state funding through tax credits to certified venture capital firms over a ten-year period. Recipient businesses must have less than \$1 million in annual sales and have been in business for less than five years. Private investors will receive 90% of the equity benefits. The state receives 10%.⁸²

While Wichita lacks an abundance of formal venture capital firms, it benefits from a band of angel investors who supply some risk capital, provide business mentoring for start-ups and, in general, serve as the wise men of Wichita's entrepreneurial culture. Fran Jabara (former WSU business professor and entrepreneur), the Garvey family (grain elevators and real estate), Charles Koch (Koch Industries), Dan and Frank Carney (founders of Pizza Hut and Papa John's), Tom Devlin (Rent-A-Center founder), and the Pizza Hut millionaires, (the many Wichita-based franchisees who made money from purchasing and managing Pizza Hut franchises) are known for their funding of businesses in the region.

However, observers said that Wichita's angel investors cannot replace formalized venture capital firms because available angel investor money is small compared to Wichita's needs and the angels themselves are not sufficiently organized. Rich Bendis of KTEC said that many of the angel investors prefer comfortable investments. "There might be high-risk deals but in areas where they have expertise," said Bendis.⁸³ Biggs sees a difference between Wichita's "first stage" entrepreneurs (Clyde Cessna and Bill Lear, for example) and the region's "second stage" investors like Carney, Devlin, and Jabara, who tend not to focus on start-ups or technology initiatives.⁸⁴

Interviewees mentioned that the angel investors might be able to increase their impact, as seen in other regions in this study, through better structure and coordination. However, it was generally acknowledged that efforts to create more formal angel support services must be carefully crafted to gain acceptance by the angel investors themselves. Devlin said that, as an angel investor, he could do whatever he wants. "As a partner in a formal VC firm, you end up with all sorts of criteria that can bog the process down." When asked if there should be more structure to the angel community, he said, "If you change the angel community, you change Wichita."⁸⁵

Wichita also has had a low number of IPOs. Interviewees have suggested a combination of reasons for this relatively low number of IPOs: a scarcity of formal risk capital, entrepreneurship that favors comfortable (i.e., known industry or business) later-stage investments, business opportunities inappropriate for public offerings (such as service firms and small job shops that serve the aerospace vehicles and defense cluster), and the lack of a young, high-tech oriented skill base.⁸⁶

Investment in Research and Development. A good indicator of the level of local investment in R&D is federal R&D expenditures to universities. Standardizing by the number of workers, in 1998, the Wichita MSA received only about 25% of the national average of R&D investment per worker (see Exhibit 34).⁸⁷ All of the federal R&D university investments in Wichita occurred at Wichita State University.⁸⁸

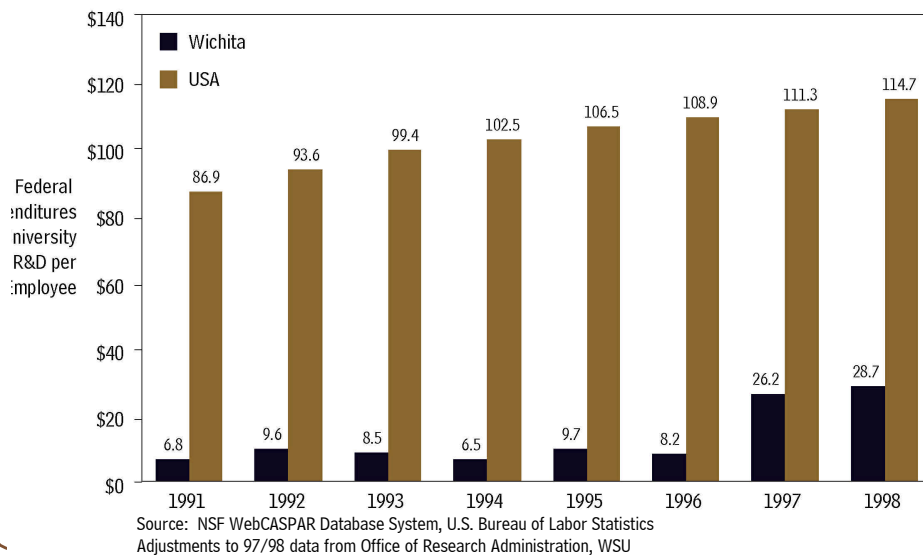
According to the Kansas Technology Enterprise Corporation (KTEC), WSU's aeronautical/astronautical engineering program (notably, the National Institute for Aviation Research) was the prime recipient of research funding and ranked ninth in national astronautical engineering programs receiving funding in 1997.⁸⁹

KTEC has completed a strategic technology cluster assessment and plan around the industries critical to the state's economy. As a result, it has recommended a five year, \$20 million per year investment in four technology categories where aerospace is included. Each of the four technology categories would receive \$5 million per year to invest in laboratories, equipment, and world-class faculty.

In comparisons to the two leading universities in Kansas, the University of Kansas and Kansas State University, WSU receives much lower levels of federal, state, and local funding for R&D (see Exhibit 35). WSU performs slightly better in terms of state and local R&D funding than in federal funding. In 1999, WSU received 28% of the University of Kansas's level of state and local funding and about 10% of the level received by Kansas State University.⁹⁰ According to some of those interviewed, WSU has not been aggressive in attracting federal funding. Wichita's low federal research investments follow state trends. The majority of Kansas funding comes from state and institutional, rather than federal, sources. For Kansas as a whole, 38% of its total research funding comes from federal sources, compared to the national average of 58%.⁹¹ In 1997, the state ranked 47th in federal funding per capita.⁹²

Wichita State University also registered modest performance on indicators of technology transfer. Over

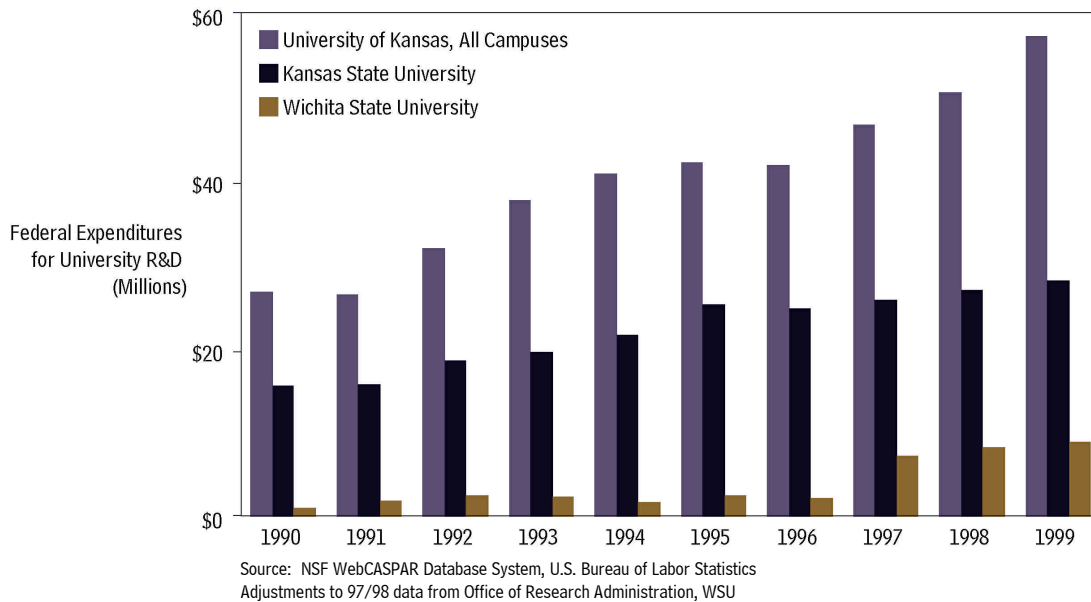
Exhibit 34. Federal Funding for University R&D per Worker, Wichita MSA, 1990 to 1998



the 1992 to 2000 period, WSU claimed only four licenses that yielded nearly \$200,000 in licensing income. Over the same period, only two patents and one copyright were issued.⁹³

Wichita survey respondents recognized that the local research and development base is underdeveloped. Only 46% of the surveyed community and business leaders reported that local research centers were readily available to support research and development needs. Among the regions in the Clusters of Innovation study, Wichita had the lowest percentage of respondents reporting availability of local research centers.⁹⁴

Exhibit 35. Federal Funding to Kansas University, 1990 to 1999



Government

Exhibit 36 summarizes government's influence on the Wichita regional economy. From the U.S. military's contracts for military aircraft built in Wichita to economic development initiatives conducted by the local government, Wichita's economy has been greatly influenced by local, state and federal government initiatives and policies.

Exhibit 36. Government Actions and the Diamond Framework

Element of the Diamond	Federal Government	State Government	Local Government
Basic and Specialized Factor Inputs	<ul style="list-style-type: none"> + NASA and FAA support of NIAR - Low funding of NIAR 	<ul style="list-style-type: none"> + Founding of NIAR and funding through KTEC 	<ul style="list-style-type: none"> - Air service is expensive and limited - Road network is not a competitive advantage - K-12 education could be improved - Seed capital
Context for Firm Strategy and Rivalry	<ul style="list-style-type: none"> + Reduced government orders after WWII and Korean War refocused aircraft companies on commercial products 	<ul style="list-style-type: none"> + Taxes are not onerous 	<ul style="list-style-type: none"> - Insufficient collaborative organizations for aerospace cluster + Support for aerospace cluster
Related and Supporting Industries	Not mentioned	<ul style="list-style-type: none"> + Funding of MAMTC, KTEC, Kansas Inc, WTC 	<ul style="list-style-type: none"> + Incenting Cessna and Lear to come to Wichita
Regional Demand	<ul style="list-style-type: none"> + Demand for military aircraft, particularly during WWII and Korean War 	Not mentioned	Not mentioned

Local government has played a supportive but conservative role. While most of those surveyed and interviewed felt that state and local government were generally responsive to business, many felt that government could offer a bolder vision for economic development. Survey findings support this mixed assessment: an equal number of respondents (39%) said that government's overall responsiveness and ability to work with the needs of business were as low as those who rated them highly.⁹⁵

Federal Government. The U.S. government's need for military aircraft during World War II and the Korean War provided infrastructure, mass production experience, and training necessary to build critical mass for the important aerospace vehicles and defense cluster. The three main manufacturers at the time—Boeing, Beech and Cessna—grew at rates that would not have been possible without government contracts.

McConnell Air Force Base, located immediately outside of Wichita, is another important federal government investment in the region. The Army Air Force Material Center established headquarters in the Wichita Municipal Airport in 1942. The Material Center moved to Oklahoma City but moved back in June 1951 to take advantage of the proximity to Boeing. The site was an important training facility for Boeing's B-47 Stratojet bomber that was built in Wichita. In the 1950s, McConnell was selected by the Strategic Air Command as the center location of 18 Titan II missile sites in the area.⁹⁶

State Government. The state is widely credited for setting in motion a number of economic development programs that followed intensive statewide strategic planning during the mid-1980s. Captured in a document titled the "Redwood-Krider" Report after its two main authors, economic development strategies were prepared in response to a recession in the aerospace vehicles and defense, oil and gas, and agriculture clusters and a collective fear that Kansas was losing its competitive edge. Many of the report's recommendations were implemented, including the formation of KTEC, Kansas, Inc. and Kansas Venture Capital, Inc. Kansas Inc. is the economic development research and strategy-setting organization in the state. It conducts policy research, initiates strategic planning, and evaluates implementation of economic development activities. KTEC was created in 1987 to stimulate economic development in Kansas by fostering innovation and development of technology.⁹⁷ KTEC offers seed capital as exemplified through the Wichita Technology Corporation, research funding for such institutions as the National Institute for Aviation Research and support for technical assistance. Kansas Venture Capital, Inc. was created to attract private venture capital in the state through tax credits and a matching public fund of \$5 million.⁹⁸ States such as California, Florida and Maine have looked to the economic development initiatives originated in this report.⁹⁹

Notable state-led strategic planning initiatives conducted by Kansas Inc. since the Redwood-Krider report of 1986 include a 1993 visioning document (Kansas, Inc.'s 1993 *A Kansas Vision*) which focused on the importance and needs of quality employment through value-added products and high wage jobs, a follow-up document in 1997,¹⁰⁰ and a strategic study and plan using cluster analysis due this year (2000 Kansas Economic Development Strategy). The plan emphasizes the need for increased research investments and a workforce training program for the aerospace vehicles and defense cluster.

Local Government. Local government played an important catalytic role in the establishment of the important aerospace vehicles and defense cluster and has provided economic development assistance since the 1970s. Wichita attracted the railroads and early manufacturing companies, funded a landing field to capitalize on the interest in aviation, recruited Clyde Cessna and Bill Lear to Wichita, and built the transportation infrastructure and school system that exist today. Modern economic development efforts began

in earnest in 1962 with the first float of industrial bonds. Local government conducted aggressive firm recruitment in the 1970s following a downturn in the economy. Wichita budgeted more funds for economic development than the entire state of Kansas at the time.¹⁰¹ Since 1979, local government has offered \$3 billion in revenue bonds.

Today, local economic development leaders share the following priorities outlined in Wichita's Long Range Planning Task Force of 1996-1997: helping established companies grow (focus on plastics and other manufacturing-related business with less emphasis on agricultural-related concerns),¹⁰² attracting high-skilled, knowledge-based companies with regional and corporate headquarters; building Wichita's high-technology base; nurturing the aerospace vehicles and defense cluster;¹⁰³ developing a world-class, skilled workforce that will meet the needs of growing companies (particularly aerospace vehicles and defense and technology companies); and revitalization of the urban core.¹⁰⁴ The Wichita Long Range Planning Task Force created seven committees to address the above objectives: Cost of Doing Business, Diversified Economy, Education and Training, Image and Marketing, Infrastructure, Quality of Life, and Leadership (see Exhibit 37).

Exhibit 37. Progress Since 1997 on Wichita's Long Range Planning Task Force

Issue	Progress
Cost of Doing Business <ul style="list-style-type: none"> ■ Tax structure ■ Government efficiency 	<ul style="list-style-type: none"> ■ Established Development Coordinating Committee (top people in all departments) ■ Re-engineering of government did not get past pilot phase ■ Attention focused on state taxes. Property taxes are yet to be reviewed
Diversified Economy <ul style="list-style-type: none"> ■ Exports ■ Business cluster development ■ Air service ■ Vocational-tech ■ Venture capital/franchise center 	<ul style="list-style-type: none"> ■ Council on Competitiveness study ■ Business Investment Group established. Focus is on diversification and finding investments with new firms ■ Support for aerospace initiative for workforce training
Education and Training <ul style="list-style-type: none"> ■ K-12 education 	<ul style="list-style-type: none"> ■ K-12 \$280 million bond vote to upgrade school facilities (air conditioning and high-tech equipment) throughout the system
Image and Marketing <ul style="list-style-type: none"> ■ Wichita marketing campaign 	<ul style="list-style-type: none"> ■ Hired marketing expert who did major study and recommended how to reposition Wichita. In the process of restructuring the convention and visitors bureau to take the lead
Infrastructure <ul style="list-style-type: none"> ■ Utilities ■ Roads/highways, rail improvements ■ Central business district ■ Air service 	<ul style="list-style-type: none"> ■ Roads: State highway bill of 1999 included program to build the east-west freeway ■ Rail: Initiated program with funding from railroads, state and local governments for grade separation throughout the city. Project will begin next year ■ Utilities: Wichita pays 30% more than northern areas. Attempting to secure rate decrease ■ Air service: Working aggressively on this issue. Strong corporate support through "take or pay" air service contracts. Contract with companies in Wichita for estimated number of flights to KC
Quality of Life <ul style="list-style-type: none"> ■ Affordable housing ■ Crime and public safety ■ Downtown development 	<ul style="list-style-type: none"> ■ Neighborhoods: More balanced approach to land use development. Wichita Independent Neighborhoods Association has helped quite a bit ■ Crime: Completed transition of Wichita police force to community policing operation ■ Downtown development: Old Town, Hyatt, Exploration Place. Continues to be out migration of office renters
Leadership <ul style="list-style-type: none"> ■ Consolidation of government services 	<ul style="list-style-type: none"> ■ Consolidation has shifted from political consolidation to functional consolidation where appropriate

Source: City of Wichita documents, interviews

The city has made progress on infrastructure issues, particularly utilities and roads and, only very recently, on the air service problem. The city was a major force behind the passage of the K-12 bond vote. In addition, the local government believes that it was a stimulus to the establishment of the Business Investment Group¹⁰⁵ and the undertaking of the Clusters of Innovation study. In terms of the Image and Marketing committee, the city hired a marketing expert who conducted a major study and developed a new positioning strategy for Wichita. The first priority is to create a positive image of Wichita for local residents. Urban revitalization efforts have included gentrification of the old downtown warehouse area and Exploration Place, a \$62 million entertainment/educational science center located on the banks of the Arkansas River in downtown Wichita. Areas where the city has been less effective include reducing property taxes, re-engineering government, and consolidation of government services.

In general, local government is viewed as responsive to business in Wichita. Interviewees have a favorable impression in terms of government support for aerospace vehicles and defense cluster businesses, labor recruitment, retraining (as in 1993 when Boeing laid off 7,000 workers), and promotion of the recent school bond issue. Wichita's John Ek, publisher of the *Wichita Business Journal* said that it is easy to do business in Wichita and easy to get an audience, two key criteria for starting a new business.¹⁰⁶ The city also prides itself on keeping red tape to a minimum. "We hear prospects say they're surprised they can get a facility built in 100 days in Wichita," Tim Witsman, Executive Director of the Wichita Area Chamber of Commerce, said. "It takes less time to get something done than it does in California."¹⁰⁷

Criticisms of local government focus on its conservative nature in making productive investments. Interviewees cited delayed responsiveness to K-12 education and air service problems. One community leader said, "There is a pervasive mentality that Wichita is not a big city and that it doesn't engage in overly ambitious projects. For example, the downtown arena project was put on hold when the city voted affirmatively for the school bond issue. This shows an attitude of not wanting to do too much at once."¹⁰⁸ Others mentioned the need for better coordination among the various education players (technical colleges, boards of regents, and community colleges), a further reduction in the tax burden, more involvement from local government in company recruitment and expansion, greater support for increased risk capital, re-introduction of a small business incubator, and more aggressive image enhancement of Wichita.

Institutions for Collaboration

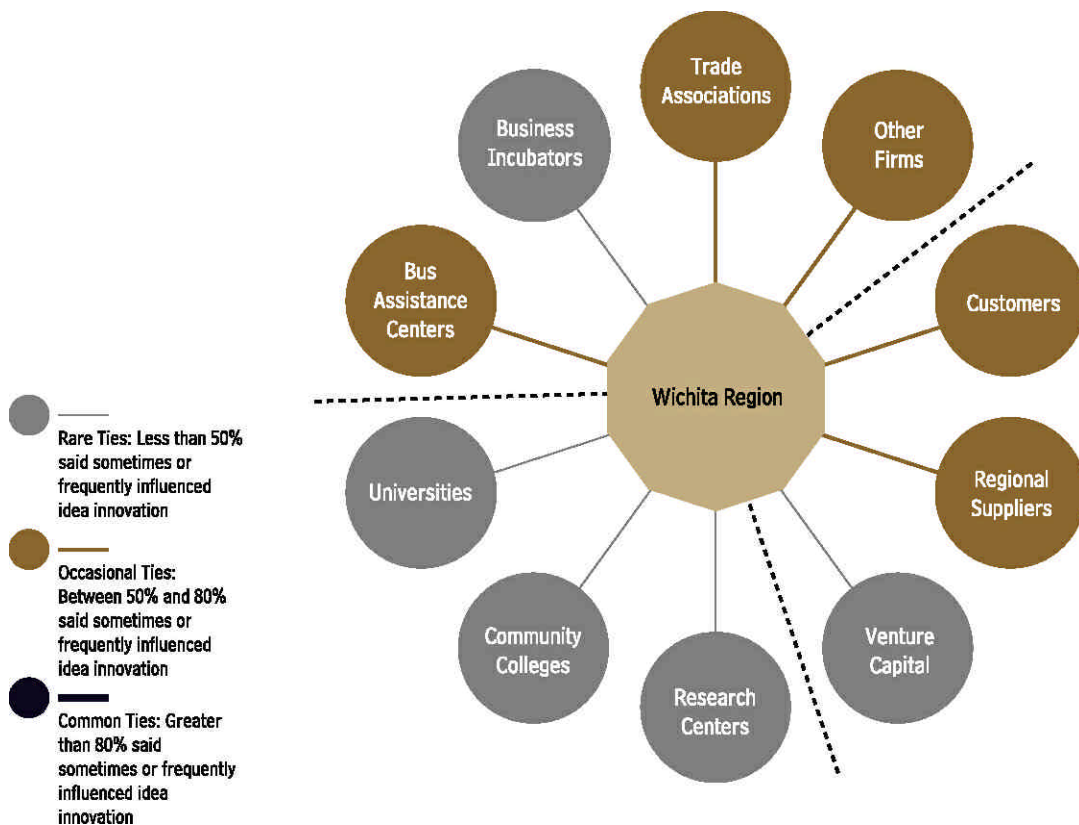
Wichita has a relatively small set of institutions for collaboration that are aimed at fostering interaction and providing support to the business community. These institutions for collaboration offer limited ability to spur innovation. Established firms in Wichita rely on only a few formal institutions for collaboration. Entrepreneurial firms tend to collaborate through a small set of business assistance organizations and an informal network of angel investors.

No institution for collaboration had a common tie (greater than 80% of those surveyed said the organization sometimes or frequently influenced idea innovation) with survey respondents' companies regarding the idea development phase of innovation (see Exhibit 38). Trade associations, other firms, customers, regional suppliers, and business assistance centers were the only organizations that had an occasional tie

(between 50% to 80% of those surveyed said the organization sometimes or frequently influenced idea innovation) with survey respondents' companies. Universities, research centers, and venture capital firms were noticeably missing from the list of commonly or occasionally used partners in terms of idea development. Among the regions studied in this report, Wichita ranked the lowest in frequency of use of universities in helping with idea development and generation.¹⁰⁹

For established businesses, national trade associations were considered the most helpful (see Exhibit 39). Economic development organizations were the next most helpful, followed by university-based networking organizations, and regional industry or cluster councils. However, an almost equal number of those surveyed said that these three institutions for collaboration were unhelpful. Wichita survey respondents gave the lowest ratings to regional industry or cluster councils, as compared to respondents in the other regions studied. The fourth type of institution for collaboration, university technology transfer offices, received the greatest number of unhelpful responses. Wichita had the second lowest rating of this institution for collaboration among the regions studied in this report.¹¹⁰

Exhibit 38. Wichita's Innovation Network in Terms of Idea Development



Source: Clusters of Innovation Initiative Regional Survey

The most important economic development and university-based networking organizations include the Wichita Area Chamber of Commerce, the Economic Development Advisory Group, the Regional Economic Area Partnership, and the Center for Economic Development and Business Research. These are explained in more detail below.

- The Wichita Area Chamber of Commerce is by far the most prominent institution for collaboration in the region. The Chamber has been at the center of business networking and economic development in Wichita for at least half a century. The Chamber helps with private sector recruitment, attracts companies to Wichita, helps set economic development policy (for example, education, infrastructure, quality of life, and transportation issues) in concert with local government and other organizations, and serves as an important venue for business networking through its many cluster-like roundtables and committees. The city of Wichita and Sedgwick County both contract the Chamber to conduct economic development activities. Last year, the Chamber was credited for recruiting four companies and retained or expanded 13 existing area businesses.¹¹¹
- The Economic Development Advisory Group is the premier economic development policy-making structure in Wichita. Led by Mayor Bob Knight, the Economic Development Advisory Group consists of local government representatives and key established businesses in Wichita.¹¹² The Economic Development Advisory Group is the successor to the Wichita Sedgwick County Economic Partnership (WISE), an outgrowth of the Wichita Area Chamber of Commerce that played a prominent role during the last decade.
- Another key economic development organization formed by Mayor Knight is the Regional Economic Area Partnership (REAP), which includes representatives from seven counties around Wichita (three within the MSA and four outside) and 30 municipalities. REAP acts as a cohesive group to lobby state government and an umbrella to create a common agenda around economic development. REAP's constituents represent 25% of the employed population in the state. Issues discussed range from improving Wichita's air service and water supply to reduction in electricity rates. The counties have also collaborated in creating a tourism strategy.
- The Center for Economic Development and Business Research (CEDBR) of Wichita State University conducts research and analysis of business and economic trends and serves as an important link between the business, economic development players, and WSU.

Compared to established company executives, entrepreneurs ranked the institutions for collaboration slightly better and in a similar order: national trade associations, economic development organizations, university-based networking organizations, university technology transfer offices, and regional industry or cluster councils (see Exhibit 39). Entrepreneurs rated economic development organizations, university-based networking organizations, and university technology transfer offices better and national trade associations and regional industry or cluster councils worse than did their established company colleagues.

The significant institutions for collaboration for entrepreneurs include the Wichita Technology Corporation (discussed earlier), the Small Business Development Center at WSU, WSU's Center for Entrepreneurship, the South Central Kansas Economic Development District, Inc. (SCKEDD), and the Wichita Independent Business Association (WIBA). A brief description of these institutions for collaboration follows:

Exhibit 39. Reported Helpfulness of Regional Institutions for Collaboration

	Percent Reporting Helpful		Percent Reporting Unhelpful	
	Established	Entrepreneurial	Established	Entrepreneurial
National Trade Associations	67%	63%	33%	37%
Economic Development Organizations	55%	58%	45%	42%
University-based Networking Organizations	50%	57%	50%	43%
Regional Industry or Cluster Councils	50%	43%	50%	57%
University Technology Transfer Offices	41%	48%	59%	52%

Source: Clusters of Innovation Initiative Regional Survey

- The Wichita State University Small Business Development Center assists small businesses with technical and business management consulting (business plan development, for example), provides networking opportunities, and offers educational courses on basic and advanced business issues. WSU's Center is one of ten throughout the state. In 1999, the Small Business Development Center served 644 companies throughout the region.
- WSU's Center for Entrepreneurship, part of the business school, offers an undergraduate major and graduate specialization in entrepreneurship. The Center is also a source of advice to entrepreneurs in the region. The Center for Entrepreneurship sponsors the Kansas Family Business Forum (KFBF), a membership organization for family-run businesses that also provides seminars and business assistance.
- The South Central Kansas Economic Development District, Inc. (SCKEDD) provides loans to small businesses.
- The Wichita Independent Business Association (WIBA) is a quasi-chamber of commerce for small businesses. More than 1100 members, representing over 240 different industries, and ranging from 1 to 50 employees, constitute WIBA. WIBA provides educational seminars, lobbies on behalf of small businesses, and provides small business services such as pooled health insurance.

Several leaders in the community have been trying to create new institutions for collaboration to benefit entrepreneurs. Dan Meyer, partner at Grant Thornton, said that Wichita could benefit from the sort of technology councils seen in more mature high-tech cities. "The problem, obviously, is that we don't have enough software companies to do something that specific."¹¹³ One prominent innovation supporter tried to initiate a local chapter of a national technology-related networking organization in Wichita without any interest from local leaders.¹¹⁴

In contrast to established business leaders, entrepreneurs also tend to rely on an important informal network. All interviewees mentioned former entrepreneurs and now angel investors such as Fran Jabara, Dan Carney, and Tom Devlin.

For a more comprehensive listing of institutions for collaboration in Wichita, see Exhibit 40.

Attitudes toward Business

While entrepreneurialism is held in high regard in Wichita and clusters are considered to be beneficial, Wichita business leaders do not exhibit highly supportive attitudes toward new entrepreneurs, nor do they demonstrate a strong proclivity to collaborate. In addition, there are concerns that the local university does not possess sufficiently strong attitudes toward commercialization of ideas.

Exhibit 40. Wichita's Institutions for Collaboration

Private Sector	Joint Private/Public
<ul style="list-style-type: none"> Wichita Area Chamber of Commerce Cluster Specific Organizations Wichita Manufacturers' Association SCORE—Wichita Chapter 143 Wichita Independent Business Association South Central Kansas Economic Development District (SCKEDD) 	<ul style="list-style-type: none"> Kansas Technology Enterprise Corporation Economic Development Advisory Group Kansas World Trade Center Wichita Technology Corporation National Institute for Aviation Research
Informal Networks	Public Sector
<ul style="list-style-type: none"> Wichita State University Alumni Angel investor community Wichita Technology Council 	<ul style="list-style-type: none"> Small Business Administration Center for Economic Development and Business Research Small Business Development Center Bureau of Community Development, Sedgwick County Kansas Minority Business Development Council Regional Economic Area Partnership (REAP) Mid-America Manufacturing Technology Center (MAMTC) Center for Entrepreneurship (WSU)

Source: Clusters of Innovation Initiative Regional Survey

said that firms in clusters rarely contribute to cluster-wide programs (23% said that firms frequently contribute; 31% reported that they were neutral to this question).¹¹⁶ These attitudes were confirmed in numerous interviews.

Regarding the university, there is widespread sentiment that while WSU successfully reaches out toward the private sector, it could be much more aggressive and visionary in efforts to commercialize ideas. Community leaders laud new president Dr. Donald Beggs for taking an active stance toward the private sector. However, according to those who have been affiliated with the university for several decades, WSU is not a model for innovation commercialization. As a professor at the WSU Business School for many years, Fran Jabara speaks for others when he said that the university should reward professors for commercialization work. "Today, only a few faculty are willing to get involved in innovative ideas. The University has to reward professors for other things beside publications."¹¹⁷ Many of those interviewed said that they expect to see positive changes with President Beggs.

Interviewees nearly all agreed that Wichita is special in that it fosters a disproportionate number of entrepreneurs. The region looks to Cessna, Lear, Stearman, Beech, Koch, Devlin, Jabara, the Carney brothers, and others as their hometown heroes. Besides aerospace vehicles and defense, interviewees were most likely to mention entrepreneurialism as the characteristic that makes Wichita unique. Interestingly, fewer respondents in Wichita, as compared to respondents in two other studied regions, felt that supporting start-ups was a government priority.¹¹⁵

A majority of those surveyed demonstrated a strong cluster orientation, indicating that clusters were beneficial to innovation and competition. Seventy-one percent of those surveyed also said that competition is intense but consider competition positive in that it fosters innovation. However, there seems to be a limit to the perceived value of intense competition and collaboration. Sixty-eight percent of those surveyed disagreed that entry of a new competitor benefits the business environment. Forty-six percent of those surveyed

CONCLUSION

The Wichita regional analysis reveals an economy that has grown steadily during the last century, due in large part to the innovations of past entrepreneurs, but must now focus on future innovation to maintain its economic prosperity.

Wichita entrepreneurs established companies that became important anchor firms within a number of clusters. Nurtured by both the federal and local governments, these firms contributed to the development of the region as a broad-based manufacturing center. The region owes its impressive percentage of employment in traded clusters and near national average wages to these anchor firms and their respective clusters. In addition to such notable clusters as aerospace vehicles and defense, plastics, and chemical products, the region has created several other large and growing clusters, including aerospace engines, lighting and electrical equipment, heavy construction services, motor driven products, processed foods, heavy machinery, building fixtures, equipment and services, agricultural products, distribution services, and power generation.

However, the region's solid economic track record and cluster portfolio mask key clusters with relatively low wages, wage growth rates and patent activity when compared to national benchmarks. Weaknesses in regional and cluster-specific innovative capacity explain these lackluster findings. Concerns about Wichita's innovative capacity include a shortage of skilled workers, weakness of research institutions, insufficient risk capital, poor air services, a K-12 education system that could perform better, concerns about the quality of life, lack of cluster thinking, and ineffective institutions for collaboration. These challenges are addressed in more detail in Section 5 of this report.

In addition to regional innovative capacity, we also look to the key clusters themselves to better explain such performance indicators as cluster wages and patent activity. This report examines two key clusters among the region's top 20 largest clusters—aerospace vehicles and defense and plastics—to understand cluster-specific aspects of the region's innovative capacity. In addition to addressing the challenges within the business environment as a whole, the region will need to upgrade these clusters and spur the development of other large and growing clusters.

4 COMPETITIVENESS OF SELECTED CLUSTERS

Many factors that foster innovation are best understood by analyzing business clusters. Economic performance and innovative capacity vary among clusters, even within a region. Sophistication of demand, context for firm rivalry, and related and supporting industries are often more relevant for understanding clusters than entire regions. Factor inputs are important at the cluster level, but our focus will be on specialized inputs (e.g., the presence of aviation research centers) particularly useful for the cluster, rather than general inputs (e.g., quality of K-12 education). We also look at government policy and cluster specific institutions for collaboration.

To better understand how these factors lead to innovation in Wichita, we analyze two clusters: aerospace vehicles and defense and plastics. Wichita's aerospace vehicles and defense cluster is nationally recognized, the largest in the Wichita EA and mature while the plastics cluster is ranked eleventh in the EA and has a lower share of national employment. While they are not representative of all clusters in Wichita, they offer lessons for other clusters and regions.

THE WICHITA AEROSPACE VEHICLES AND DEFENSE CLUSTER

Nationally, the aerospace vehicles and defense cluster is composed of industries that research, manufacture, test, and market aircraft, aviation products, defense-related products and aviation-related services.¹¹⁸ Narrow industries tend to be those that manufacture final aerospace vehicles and defense vehicles and defense equipment, whereas broad industries supply services (software and computer services, research, facilities support and computer related services), equipment (instruments, semiconductors and computers, communications equipment), and inputs (metallic parts and electronic parts). Due to the high capital requirements of the products manufactured, the aerospace vehicles and defense cluster's manufacturers tend to be large companies with global business operations.

The aerospace vehicles and defense cluster is concentrated in certain distinct pockets throughout the country. In 1998, the Los Angeles-Riverside-Orange County, Economic Area had the highest share of national cluster employment with 23.5%, followed by Seattle-Tacoma-Bremerton, (22.1%), St. Louis, (9.3%), and Dallas-Fort Worth, (8.6%).¹¹⁹

The mature aerospace vehicles and defense cluster dominates all other clusters in the Wichita Economic Area. In 1998, aerospace vehicles and defense employed 34,260, compared to the second largest traded cluster, processed foods, which employed 26,631 workers. In the same year, the Wichita aerospace vehi-

cles and defense cluster had a 7.8% share of national cluster employment. The Wichita cluster with the next highest share of national cluster employment after aerospace vehicles and defense was heavy machinery at 2.5%.¹²⁰

Although the dominant cluster in the region, the aerospace vehicles and defense cluster is heavily concentrated in two industries, has lower wages as compared to the national average for the cluster, and demonstrates low patent activity. Our assessment of the innovative capacity of the Wichita aerospace vehicles and defense cluster shows the vital importance of having quality factor inputs, including vibrant research institutes and sufficient high-quality human capital. The U.S. government's need for military aircraft during WWII and the Korean War was the cluster's most significant enabler. Local government also provided important infrastructure and helped to recruit anchor firms to the area. Due to the narrowness of the cluster and its focus on aircraft assembly, a narrow range of suppliers is available to the cluster. Professional services are well represented. Cluster members exhibit intense rivalry, which provides both benefits and challenges for the cluster. Other factors and elements of the diamond, supply of risk capital and local demand, have not been sources of competitive advantage for the cluster but neither have they prevented its successful development.

Development of Wichita's Aerospace Vehicles and Defense Cluster

Wichita's aerospace vehicles and defense cluster features both commercial aircraft production and ancillary services through Boeing, the world's largest aerospace company measured in total sales, and "general aviation,"¹²¹ represented by the three largest general aviation companies in the United States: Raytheon Aircraft, Cessna, and Bombardier. Seventy percent of the general aviation planes built in the U.S. are manufactured in Wichita.¹²² In addition to being home to manufacturers and dozens of suppliers, Wichita claims the National Institute for Aviation Research, which is connected to Wichita State University.

The aerospace vehicles and defense cluster accounts for more than 60% of manufacturing earnings in the Wichita MSA.¹²³ In 1999, one in six residents in the Wichita MSA worked for one of the four large aviation manufacturers or aerospace vehicles and defense suppliers.¹²⁴ In 2000, the four anchor firm manufacturers—Boeing Wichita, Raytheon Aircraft, Cessna, and Bombardier—provided \$2.1 billion in annual payroll to the Kansas economy.¹²⁵

The Wichita aerospace vehicles and defense cluster follows the history of aviation in the United States. The first commercially produced aircraft in the country, the Laird Swallow, was built in Wichita in 1920. The next 80 years have been marked by continued entrepreneurship, federal and local government support, product development and operational expansion, out-of-state acquisitions, growing export sales, and boom and bust business cycles.

Wichita's aviation history started in 1925 when a group of Wichita entrepreneurs, including Walter H. Beech, Lloyd C. Stearman, Clyde V. Cessna, Walter Innes, Jr., and William R. Snook, formed the Travel Air Manufacturing Co. of Wichita. Shortly thereafter, each of the original founders moved on. Stearman left for California while Cessna stayed in Wichita to start his own business. Beech left but returned to Wichita in 1932 to form the Beech Aircraft Corporation. In 1926, Stearman formed the Stearman Aircraft Company that later became part of the United Aircraft and Transport Corporation and then a subsidiary of Seattle-based Boeing Aircraft Company (see Exhibit 41).¹²⁶

All three aviation companies—Boeing, Beech and Cessna—expanded dramatically during World War II in response to the government’s desire to have safe, inland aviation production facilities.¹²⁷ It was to be the cluster’s first experience with a shortage of skilled workers. After the war, aviation employment dropped from a wartime high of 60,000 to 38,000. Wichita’s aviation companies countered with innovative commercial aircraft. New civilian aircraft designs were rolled out and well accepted by the market. With the start of the Korean War, demand for military aircraft resumed and employment shot back to near World War II levels.

Following the end of the Korean War, Wichita’s aerospace vehicles and defense cluster once again applied entrepreneurship and innovation to get it through the lean post-war years. Models such as the Cessna 120, 190, and 195 and Beech V-tail Bonanza revolutionized small plane aviation. By 1956, Beech and Cessna were responsible for 72% of all light commercial aircraft sold in the country. The next year, Cessna was the largest manufacturer of private planes in the world. A key event in the cluster’s development occurred in the late 1950s, when the U.S. government awarded the contract to build a military transport plane to Boeing (see Exhibit 42). “You talk about a critical event that transformed Wichita, it was that military contract for that transport plane,” said Fran Jabara. “This one event transitioned Boeing into the civilian aircraft business.” Later, Boeing converted the transport craft into the 707, one of the most ubiquitous commercial airplanes in the world.¹²⁸

The 1960s were a time of product innovation and commercial success with the introduction of business jets. Learjet set up operations in the early 1960s, adding new competition to Wichita’s general aviation manufacturers. The 1970s saw continued growth within the cluster. By 1974, Kansas was responsible for 70% of all business, utility and general aviation aircraft in the world. Thirty percent of sales were overseas with \$182 million in aircraft exports.

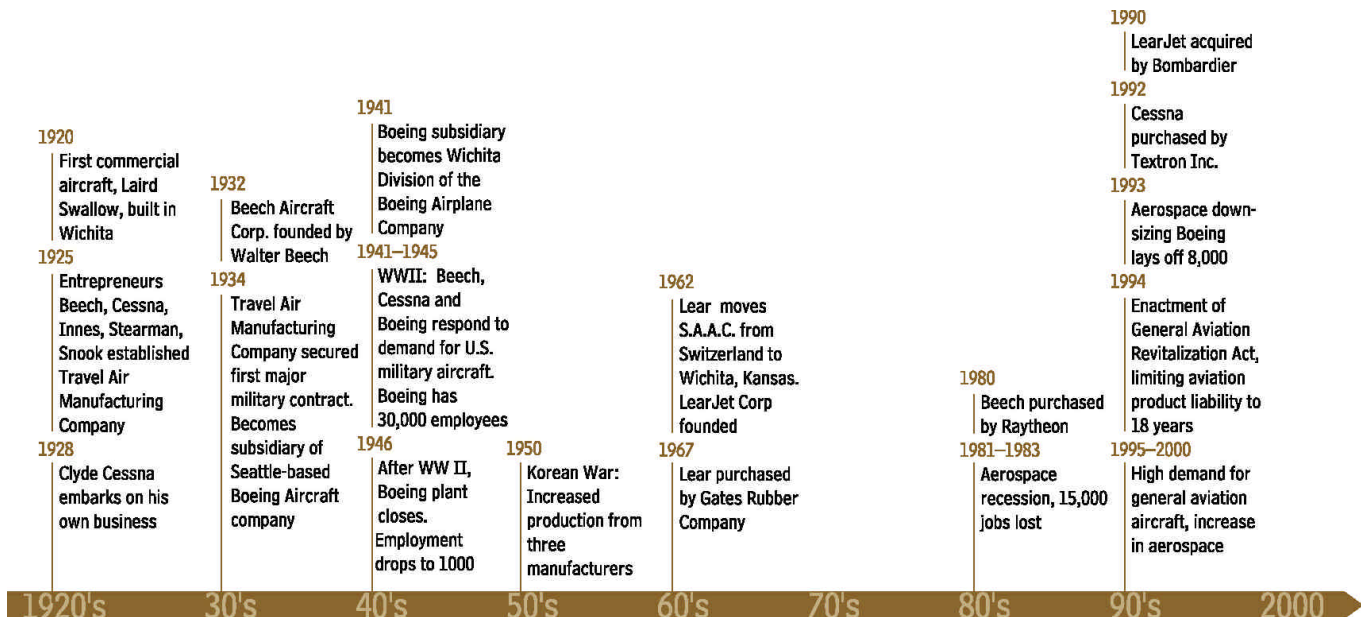
The cluster lost 15,000 workers due to a serious recession during the early 1980s. Cessna’s earnings fell from nearly \$20 million to less than \$2 million. The Tax Equity and Fiscal Responsibility Act of 1982 levied a federal tax on general aviation fuel, placed a luxury tax on airplanes, and allowed for larger liability awards against the manufacturers. At this time, Raytheon purchased Beech in 1980. According to the authors of *Borne on the South Wind*, it was Wichita’s entrepreneurial spirit that pulled the cluster out of the recession with innovative models and modifications. Boeing modified 747s, and built 737 fuselages, 747 cockpits, and the KC-135 military tanker. Cessna modified its Citation model and introduced a new single-engine turboprop. Beech modified a Mitsubishi Diamond into the Beechjet.

Following a depressed market for civil aircraft in the mid-1990s, where close to 7,000 more jobs were lost from Boeing alone, the cluster of 2001 has had strong revenue and employment growth until only recently. The near-term future looks bright for both the commercial aircraft and general aviation companies where Bombardier, Cessna, and Raytheon Aircraft play dominant roles. The commercial airline fleet is expected to grow from 12,000 at present to 21,000 in 2009.¹²⁹ Reasons for predicted strong growth include overseas demand and replacement of aging planes. The FAA forecasts the United States’ general aviation fleet to grow by 12% or 24,000 aircraft over the 2000 to 2011 period.¹³⁰ General aviation is expected to have strong growth in the future due to new niche products and the popularity of fractional ownership, where companies purchase or lease a portion of a business aircraft.¹³¹

Despite high growth potential, particularly for the general aviation companies during the next ten years, U.S. aerospace vehicles and defense industries face a number of serious challenges. Kansas Senator Pat Roberts’ Advisory Committee on Science, Technology and the Future singled out increased international

competition from Europe, the Pacific Rim, and Brazil. Roberts' committee proposed more federal support for basic and applied research to sustain the United States' leading position in aerospace vehicles and defense.¹³² Other challenges include acute labor shortages forecasted for skilled aviation workers.

Exhibit 41. Wichita Aerospace Vehicles and Defense Cluster Timeline



WICHITA'S AIRCRAFT MANUFACTURERS: GROWTH SPURRED BY U.S. MILITARY NEEDS

Boeing Wichita

Boeing Wichita, a unit of the Seattle-based Boeing Company, is involved in aircraft engineering, fabrication, assembly, and modification for both commercial and military aircraft. Boeing Wichita became a subsidiary of the Seattle-based Boeing Company in 1934.

Boeing Wichita grew dramatically during World War II. It received the contract for the B-29 Superfortress, an unprecedented plane in size and performance. Forty-four percent of the B-29s were built in Wichita, increasing Boeing's employment from 766 to 30,000 by the end of the war. Employment plummeted after the war; 16,000 received notice in one day. By 1946, less than 1,500 worked at the Wichita facility. This was only temporary; Boeing Wichita's employment rose again as it was contracted to build a large percentage of all B-47s and later B-52s. Boeing Wichita also had a major role in the building of B-1B bombers for the U.S. military as well.¹³³ Today, Boeing Wichita specializes in subassemblies, producing 75% of the 737 and major components for the 747, 757, 767, and 777 jet aircraft and a number of significant military aircraft.

Boeing Wichita's impact on the Wichita economy is dramatic. Boeing Wichita accounted for 20% of earnings generated in the Wichita MSA and 21% of employment in the Wichita MSA in 1998.¹³⁴ Boeing Wichita employs approximately 17,500 workers.

Cessna

Cessna has had its headquarters located in Wichita for 73 years. Like the other aviation companies, Cessna grew during World War II. The company manufactured more than 6,000 aircraft for the war effort. Cessna entered the business jet market in the 1960s with its Citation model. In 1992, Providence, Rhode Island-based Textron purchased Cessna. Two years later, after the General Aviation Revitalization Act limited liability exposure for aircraft, Cessna re-entered the single-engine aircraft business.¹³⁵ Cessna claims 57% of the business jet market. Cessna employs approximately 12,500 workers today.

Raytheon Aircraft

Walter Beech founded the company that bore his name in 1932. During World War II, Beech tripled employment and had an 800% increase in plant space.¹³⁶ Raytheon Aircraft, a subsidiary of the Raytheon Company, purchased Wichita-based Beech Aircraft in 1980. Today, Raytheon Aircraft's products include business jets, light jets, turboprops, and piston aircraft. Raytheon Aircraft also manufactures military and special mission aircraft and operates Raytheon Travel Air, a fractional ownership operation. The Pentagon awarded the Joint Primary Aircraft Training System (JPATS) to Raytheon's Wichita facility in the mid-1990s. The majority of Raytheon Aircraft's operations are located in Kansas, with manufacturing sites in Andover and Salina and headquarters in Wichita. In April 2001, citing a "softening" economy, Raytheon Aircraft cut 450 administrative and managerial jobs.¹³⁷ In 2000, Raytheon employed approximately 10,000 workers at its Wichita facility.¹³⁸

Bombardier/Learjet

With the help of Wichita's city fathers, Bill Lear moved his business jet operation from Switzerland to Wichita in 1962. In 1967, the Gates Rubber Company purchased Learjet. Montreal-based Bombardier Aerospace, a unit of the Bombardier Company, purchased Learjet in 1990. Bombardier's Wichita location is the production site for the Learjet aircraft and is the center for all of the company's aircraft certification flight-testing. One year after the Bombardier acquisition in 1990, Bombardier built its flight test center in Wichita, the world's busiest such center. Today, Bombardier employs approximately 3,600 at its Wichita facility.¹³⁹

RECENT ECONOMIC PERFORMANCE

The Wichita aerospace vehicles and defense cluster is an important cluster to study because it is the dominant cluster in the region and contributes to the region's near national average wages and low unemployment. Although the cluster's employment declined over the 1988 to 1998 period, employment has been growing since 1998 in response to high demand for its aviation products. However, the cluster is heavily concentrated within four firms in two industries. Wages are solid but have not kept pace with the national average for the cluster. Most important, the cluster has low innovation output as measured by patents. Local interviewees and industry experts also expressed concern about the cluster's sustained capacity to innovate.

Employment.¹⁴⁰ Employing more than 34,260 people in 1998, the Wichita cluster was the fifth largest in the nation in terms of employment, representing 7.8% of total national employment in the cluster (see Exhibit 43). This is nearly 20 times the Wichita Economic Area's .43% share of national employment. Over the 1988 to 1998 period, Wichita's aerospace vehicles and defense cluster had an annual growth rate of -3.5%, ranking it seventh among the 20 largest aerospace vehicles and defense Economic Areas for growth rates.¹⁴¹ Since 1998, the cluster has increased employment by roughly 4,000 jobs.¹⁴²

In 1998, the Wichita cluster was the third most concentrated of the 20 largest clusters, as measured by location quotient.¹⁴³ As location quotient reveals the concentration of employment within a defined geographical area, it is not surprising that the cluster's location quotient is high. Wichita's aerospace vehicles and defense cluster is the largest in terms of employment in the Wichita EA while the EA has lower employment than the other 20 top aerospace vehicles and defense clusters.

Exhibit 42. Building the Wichita Aerospace Vehicles and Defense Cluster

Historical Obstacles	Important Enablers	Key Events
<ul style="list-style-type: none"> ■ Boom/bust cycles ■ Insufficient labor supply (during booms) ■ Poor local air service ■ Extended liability on aircraft 	<ul style="list-style-type: none"> ■ Wichita topography: flat and "good wind" ■ Regional leaders recruiting of Cessna to Wichita ■ Government defense build-up during WW II and Korean War ■ Wichita entrepreneurial culture ■ Establishment of NIAR ■ Government's efforts to attract Lear to Wichita ■ Accelerated demand for general aviation planes in late 1990s 	<ul style="list-style-type: none"> ■ Boeing awarded government contracts for B-29, B-47 and B-52 ■ Decision by Boeing to purchase land from the DOD and remain in Wichita during the 1980s ■ Reversal of Nixon's dictum to cut fuel allocations to aviation by 40% ■ General Aviation Revitalization Act ■ Acquisitions of Cessna, Beech and Lear

Source: Clusters of Innovation Initiative Regional Survey and In-person Interviews

Exhibit 43. Top Twenty Economic Areas for Aerospace Vehicles and Defense Employment, 1998

Economic Area	Total Employment 1998	CAGR 1988-1998	Share of National Employment 1988	Average Wages 1988	CAGR of Average Wages 1988-1998
Los Angeles-Riverside-Orange County, CA-AZ	103,503	-5.29	23.53	\$49,957	2.49
Seattle-Tacoma-Bremerton, WA	97,380	1.75	22.13	n/a	n/a
St. Louis, MO-IL	40,905	-1.09	9.30	n/a	n/a
Dallas-Fort Worth, TX-AR-OK	37,913	-5.50	8.62	\$51,268	5.46
Wichita, KS-OK	34,260	-3.54	7.79	\$37,731	2.09
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	24,634	-9.54	5.60	\$45,519	3.34
San Francisco-Oakland-San Jose, CA	20,551	-7.49	4.67	n/a	n/a
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	9,485	-1.47	2.16	n/a	n/a
Tucson, AZ	9,330	1.16	2.12	n/a	n/a
Denver-Boulder-Greeley, CO-KS-NE	8,699	-7.33	1.98	\$45,991	12.37
Atlanta, GA-AL-NC	8,470	-8.45	1.93	n/a	n/a
Salt Lake City-Ogden, UT-ID	6,795	-6.17	1.54	n/a	n/a
Phoenix-Mesa, AZ-NM	6,420	-7.03	1.46	\$39,003	2.11
San Diego, CA	5,319	-9.99	1.21	\$55,873	n/a
Tulsa, OK-KS	5,181	-4.84	1.18	\$44,609	n/a
Chicago-Gary-Kenosha, IL-IN-WI	4,469	-2.06	1.02	n/a	n/a
Miami-Fort Lauderdale, FL	4,450	1.92	1.01	\$35,436	6.08
Washington-Baltimore, DC-MD-VA-WV-PA	4,410	-8.38	1.00	n/a	n/a
Cleveland-Akron, OH-PA	3,956	-9.48	0.90	\$43,003	6.09
Savannah, GA-SC	3,925	-6.27	0.89	n/a	n/a

Note: Narrow industries

Source: Clusters Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Wages.¹⁴⁴ In 1998, the average wage in the Wichita aerospace vehicles and defense cluster was \$37,731, about 73% of the national average for the cluster (down from 103% of the national average for the cluster in 1997). Aerospace vehicles and defense wages were 46% higher than the Economic Area average wage. While employment dropped during the period, average wages increased by an annual rate of 2.1% over the 1988 to 1998 period versus 3.5% nationally.

Patents.¹⁴⁵ Wichita's aerospace vehicles and defense cluster, with 7.8% of national cluster employment, had just .5% of the national cluster patent share. The region claimed only two patents in 1998 and created

.05 patents per 1,000 workers, about 5.8% of the national average for the aerospace vehicles and defense cluster. Wichita ranked 18th out of the 20 largest aerospace vehicles and defense clusters in terms of patent registrations in 1998. St. Louis, the third ranked aerospace vehicles and defense cluster for employment among the 20 largest regions, registered five patents.

Over the 1988 to 1998 period, Wichita's aerospace vehicles and defense patenting activity grew at an average annual rate of 5.3% compared to St. Louis' annual patent growth of 11.25% (see Exhibit 44). This earned Wichita a ninth ranking out of the largest 20 aerospace vehicles and defense clusters in terms of patent growth.

Exhibit 44. Establishment and Patents of the 20 Largest Aerospace Vehicles and Defense Clusters

Economic Area	Total Establishments 1998	CAGR of Establishment 1988-1998	Total Patents 1988	CAGR of Patents 1988-1998
Los Angeles-Riverside-Orange County, CA-AZ	247	-2.43	50	5.17
Seattle-Tacoma-Bremerton, WA	123	3.41	32	1.20
St. Louis, MO-IL	22	6.25	5	11.25
Dallas-Fort Worth, TX-AR-OK	76	0.51	12	13.61
Wichita, KS-OK	70	1.90	2	5.33
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	133	-1.97	40	-1.42
San Francisco-Oakland-San Jose, CA	21	-1.79	28	8.83
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	24	1.84	8	0.97
Tucson, AZ	7	3.42	4	32.21
Denver-Boulder-Greeley, CO-KS-NE	16	-3.22	6	5.74
Atlanta, GA-AL-NC	15	5.24	4	0.08
Salt Lake City-Ogden, UT-ID	19	1.73	3	2.37
Phoenix-Mesa, AZ-NM	40	4.40	12	6.61
San Diego, CA	27	1.13	7	-2.52
Tulsa, OK-KS	20	5.17	1	9.92
Chicago-Gary-Kenosha, IL-IN-WI	20	2.85	11	-1.28
Miami-Fort Lauderdale, FL	49	6.93	14	1.32
Washington-Baltimore, DC-MD-VA-WV-PA	22	4.62	11	2.86
Cleveland-Akron, OH-PA	24	-2.70	9	1.32
Savannah, GA-SC	2	0.00	0	47.35

Note: Narrow industries

Source: Clusters Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

The cluster had .002 cited patents per 1,000 employees, which was roughly .9% of the national average for the cluster. Two and a half percent of Wichita's aerospace vehicles and defense patents registered from 1993 to 1997 were cited in 1998. Data limitations preclude measuring growth in cited patents.

This relatively low patent trend can be explained by the observation that the Wichita cluster is not design or research intensive. Bombardier said that complicated system suppliers such as avionics, electronics, and aerospace software systems, which are not generally found in Wichita, would be more apt to patent their products.¹⁴⁶ Boeing's research and development and Bombardier's product development centers are based in Seattle/St. Louis (for manufacturing processes) and Montreal, respectively. Cessna does not have a research and development department in Wichita, nor is one located at Textron's headquarters. Randy Nelson, Vice President, Engineering, New Product Development at Cessna, said that Cessna is hoping to create a separate research and development line item in the future.¹⁴⁷

Innovation measures in the Wichita aerospace vehicles and defense cluster are a reflection of the industry concentration in final assembly/integration. According to interviewees, general aviation focuses on product development rather than research and development. Raytheon's Vice President for Engineering, Tom Salama, said that general aviation's focus is to take existing high technologies and adapt them to create affordable products. An example of this is the composite aircraft developed by Raytheon Aircraft. While the composite technology existed, Raytheon applied the technology in a new way.¹⁴⁸ Other manufacturing firms stressed the product development nature of their business. Bombardier's Vice President for Engineering and Product Development, John Holding, described Bombardier "as a little 'R' and big 'D' company. "We won't be the first to have a breakthrough but we apply technology very quickly."¹⁴⁹

Cessna, Bombardier, and Raytheon Aircraft indicated that they have not placed an emphasis on patent creation and inventor recognition until recently. Boeing also reported that it was placing an even stronger emphasis on patent creation throughout the company.¹⁵⁰ Interviewees said that there has not been an aggressive patenting culture within the Wichita aerospace vehicles and defense cluster. Particularly for interviewees within the general aviation business, invention or significant process or product modification has been typically viewed as a step in the path of delivering airplanes rather than ends in themselves. Said Nelson at Cessna: "There is a strong base of engineers who grew up on the farm in Wichita. They do not pursue inventions for invention's sake but rather focus on the work required to get a product to market."¹⁵¹

The now defunct Manufacturers Aircraft Association (MAA) also played a role in the historical de-emphasis on patent registration. Thirty years ago most of the commercial and general aviation firms were members of the MAA. To become a member, firms had to make their patents licensable. According to Wichita patent lawyer Ed Brown, members soon realized that this was a disincentive to patent. Brown said that this history limited aggressive attitudes toward patent registration.¹⁵²

It is important to note government certifications, another important innovation metric for this cluster. Certifications are required for new aircraft or for significant changes to legacy aircraft. The Federal Aviation Administration (FAA) mandates certifications to ensure that new or modified aircraft fulfill federal safety standards in all areas: design, production quality, and finished product. Certifications indicate that substantial changes such as the introduction of an entire new aircraft or a material change to an existing aircraft (for example, a new avionics system, gross weight increase, change in engine, cabin stretch, payload increase, or range increase) have been made. Manufacturers have had significant numbers of certifications (ten for Cessna alone) during the last ten years.

INNOVATION IN THE WICHITA AEROSPACE VEHICLES AND DEFENSE CLUSTER

Industry experts have said that, in general, aircraft assembly is a relatively low technology, labor-intensive activity.¹⁵³ Craig Miner, a historian at WSU and specialist in aviation, said that the basic airframe designs have not changed much during the last 30 years. “A local aircraft company came out with an executive aircraft in 1937. Arguably, they’re building the same plane.”¹⁵⁴ This comment was repeated by a number of industry experts. Jerry McDougal, chairman of both the Light Commercial/General Aviation Committee and the Business Aviation Subcommittee of the non-profit Transportation Research Board, said, “If there’s one area of aircraft manufacturing that has not seen major innovation, it is the production process. There have been great advances in avionics, engines and design. The manufacturing process is old fashioned.”¹⁵⁵

Production process innovations for aircraft are difficult because the component pieces are large and the final production numbers are small. Said Miner, “Wichita had an opportunity to become the ‘Detroit of the Air’ but it never reached sufficient capacity to revolutionize production. It is difficult to innovate when you have few production units because you lack a sufficient base to spread risk.”¹⁵⁶ Morgan Stanley analyst Heidi Wood said that general aviation companies are not innovating at the rate of the larger aircraft companies because they lack the “balance sheets to support real innovation. They also don’t have the wealthy customer base, such as Gulfstream, that are demanding innovations. For example, Cessna is low-to-mid-end of the market. They don’t have the scale or the demanding clientele.”¹⁵⁷ Adding to the reasons for perceived low innovation in the cluster, Mike Pompeo of Thayer said that the lack of a strong R&D presence in Wichita could be limiting innovation. “WSU cannot provide the engineering support needed to do cutting edge manufacturing process research and development.”¹⁵⁸

Industry analysts said that innovation is uneven within the Wichita cluster. Boeing was singled out for its investments in manufacturing process R&D and innovative manufacturing processes that include conveyor belts that move parts through a production process. Industry experts agreed that Raytheon’s Hawker and Premium aircraft, made with composites, are important new innovations. Industry experts are more apt to look to experimental aircraft companies for profound innovation. Morgan Stanley’s Wood said that a company like Eclipse that focuses on general aviation aircraft has many in the industry watching. Eclipse is expected to launch a general aviation aircraft for a price well below its more established competitors.¹⁵⁹

Establishments.¹⁶⁰ Wichita had 70 aerospace vehicles and defense cluster establishments in 1998 (see Exhibit 44). Compared to the largest 20 aerospace vehicles and defense clusters, Wichita ranked fourth in number of establishments. St. Louis ranked eleventh with 22 firms in 1998. Wichita’s relatively large number of establishments reflects the dozens of small but important suppliers within the cluster.

We use growth in establishments as a proxy for new firm formation. Establishments within the Wichita cluster grew at an annual rate of 1.9%, giving it a ranking of ten in terms of establishment growth rate among the 20 largest aerospace vehicles and defense clusters. St. Louis grew at a rate of 6.25%, giving it a second place growth rate ranking.

Aerospace Vehicles and Defense Investments. None of the four Wichita venture capital deals mentioned previously was in the aerospace vehicles and defense cluster. Air One Transport Group was the only company in the aerospace vehicles and defense cluster that made the Inc. 500 list over the 1991 to 2000 period.

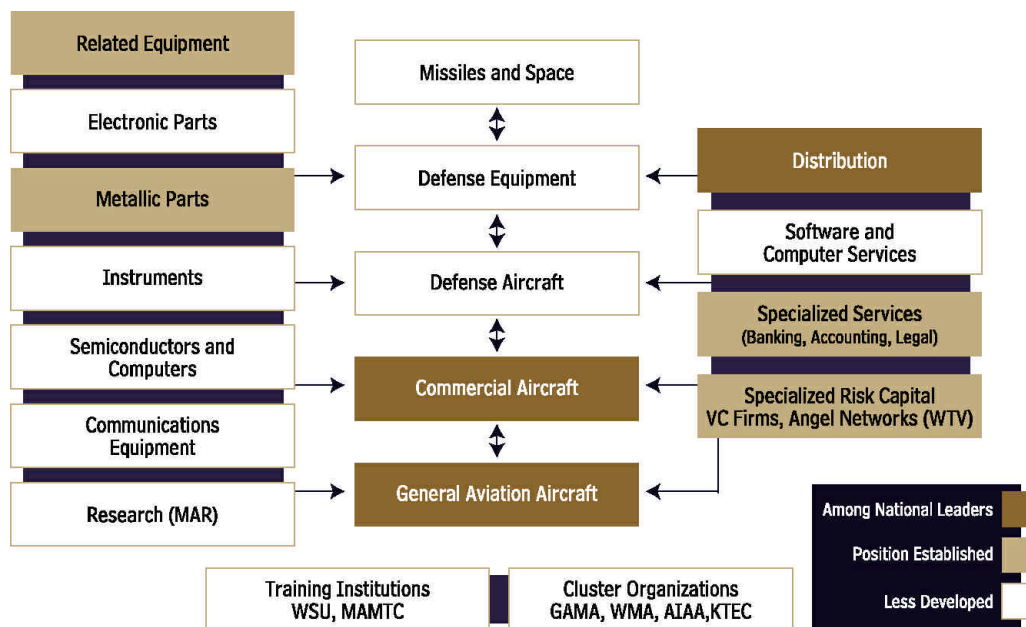
For this mature cluster, it is important to review other investment indicators, besides venture capital funding, as a measure of innovation output. According to Jeff Turner, Vice President, General Manager, Wichita Division of Boeing, Boeing has invested \$3 billion in the Wichita plant during the last ten years. “We have equipment at this plant that does not exist in any other place.”¹⁶¹ Starting in 1992, Raytheon Aircraft invested “hundreds of millions” for significant new development projects.¹⁶² Raytheon Aircraft used the bulk of \$517 million in industrial revenue bonds floated during the last five years to upgrade facilities and machinery for their new composite manufacturing processes.¹⁶³ Cessna said that it has invested in engineering personnel, up by 60% over the last ten years.¹⁶⁴

DESCRIPTION OF THE REGIONAL AEROSPACE VEHICLES AND DEFENSE CLUSTER

Wichita’s aerospace vehicles and defense cluster is highly concentrated within two industries in one subcluster. Cluster narrowness explains the region’s firm-level focus on aircraft assembly and thus the cluster’s limited supply base and low patenting activity.

Exhibit 45 shows the Wichita aerospace vehicles and defense cluster. Four boxes (Specialized Services, Specialized Risk Capital, Training Institutions, Cluster Organizations) represent related organizations and institutions that are important components of the Wichita cluster. They are assessed qualitatively through interviews and surveys. These organizations and institutions include the National Institute for Aviation

Exhibit 45. Wichita Aerospace Vehicles and Defense Cluster, 1998



Note: Broad Industries

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Research, Wichita State University and, while outside of the region, both Kansas State and the University of Kansas. Aerospace vehicles and defense firms also utilize a number of government organizations and associations including the General Aviation Manufacturers Association, the Kansas Technology Enterprise Corporation, the Mid-Atlantic Manufacturing Technology Center (MAMTC), the Wichita Chamber of Commerce, and the Wichita Manufacturers Association. The remaining boxes in Exhibit 45 are the industry-based subclusters present in the region, and their relative strength has been statistically assessed through the Cluster Mapping Project data set.

Wichita's Competitive Position.¹⁶⁵ The Wichita aerospace vehicles and defense cluster is narrow at the subcluster level, being competitive in only commercial and general aviation aircraft, distribution, related equipment, and metallic parts subclusters. The aircraft and distribution subclusters represent 7.3% and 10% of the national subcluster share, respectively. The cluster's narrowness drives its economic and innovation performance in terms of wages, which are relatively high for the region but low compared to national averages, and patenting activity, which is low.

Wichita had a strong position in only two subclusters, aircraft (ranked fourth) and distribution (ranked third), when compared to the top 20 aerospace vehicles and defense Economic Areas (see Exhibit 46). St. Louis ranked third in aircraft but ranked 26th in terms of distribution.¹⁶⁶

Exhibit 46. Subcluster Rankings of 20 Largest Economic Areas, 1998

Economic Area	Aircraft	Missiles and Space	Defense Equipment	Communications Equipment	Distribution	Electronic Parts	Instruments	Metallic Parts	Related Equipment	Research	Semi-conductors and Computers	Software and Computer Services
Los Angeles-Riverside-Orange County, CA-AZ	2	1	4	5	2	1	4	1	2	6	7	5
Seattle-Tacoma-Bremerton, WA	1	10	15	24	5	18	34	13	6	12	36	9
St. Louis, MO-IL	3	12	19	72	26	51	36	19	42	47	46	31
Dallas-Fort Worth, TX-AR-OK	5	7	26	4	6	7	7	10	8	27	6	7
Wichita, KS-OK	4	Nil	Nil	120	3	124	97	44	50	78	54	76
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	6	26	8	6	4	4	3	3	5	2	17	2
San Francisco-Oakland-San Jose, CA	47	3	5	1	9	2	1	9	3	3	1	1
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	7	14	Nil	10	10	12	5	20	14	9	25	8
Tucson, AZ	29	5	19	82	82	101	37	75	46	39	38	34
Denver-Boulder-Greeley, CO-KS-NE	36	5	41	21	31	10	6	41	17	11	12	10
Atlanta, GA-AL-NC	8	10	Nil	14	16	25	25	22	34	25	47	11
Salt Lake City-Ogden, UT-ID	42	2	28	35	21	26	32	64	26	34	28	19
Phoenix-Mesa, AZ-NM	11	17	32	11	18	11	59	30	12	49	11	21
San Diego, CA	14	21	14	13	38	17	25	28	10	5	33	18
Tulsa, OK-KS	13	Nil	41	53	15	75	42	34	43	77	93	44

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 47 reveals narrowness at the industry level as well. The cluster is heavily concentrated in two industries—aircraft and aircraft parts and equipment—within the aircraft subcluster. Other important industries in the cluster include transportation equipment and supplies-wholesale, plating and polishing, computer storage devices, instruments to measure electricity, and facilities support services. Some of the industries in which the cluster has had better employment representation in the past, such as aircraft parts and equipment and electronic computers, have lost national share over the 1988 to 1998 period. Wichita's

Exhibit 47. Competitive Position of Industries in Wichita's Aerospace Vehicles and Defense Cluster

Sub-Cluster	SIC Code	Industry	National Industry Percent Share 1997	Total Employment 1997	CAGR of Total Employment 1988-1997
Overall Cluster			1.40	39,602	-2.6%
Aircraft*	3721	Aircraft	7.12	15,385	3.7%
	3728	Aircraft parts and equipment, n.e.c.	12.74	17,500	-7.3%
Missiles & Space*	3761	Guided missiles and space vehicles	0.00	0	
	3764	Space propulsion units and parts	0.00	0	
Defense Equipment*	3769	Space vehicle equipment, n.e.c.	0.00	0	-100%
	3795	Tanks and tank components	0.00	0	
Distribution	5088	Transportation equipment and supplies - wholesale	9.87	4,531	17.1%
Metallic Parts	3463	Nonferrous forgings	0.00	0	
	3471	Plating and polishing	0.25	185	0.6%
Electronic Parts	3671	Electron tubes	0.00	0	
	3672	Printed circuit boards	0.01	10	0%
	3676	Electronic resistors	0.00	0	
	3677	Electronic coils and transformers	0.00	0	
	3678	Electronic connectors	0.03	10	
	3679	Electronic components, n.e.c.	0.04	72	1.8%
Instruments	3826	Analytical instruments	0.00	0	
	3827	Optical instruments and lenses	0.00	0	
Semiconductors and Computers	3571	Electronic computers	0.01	10	-24.9%
	3572	Computer storage devices	0.86	375	-6.7%
	3575	Computer terminals	0.00	0	
	3674	Semiconductors and related devices	0.00	0	
	95	Magnetic and optical recording media	0.00	0	
Related Equipment	3511	Turbines and turbine generator sets	0.00	0	
	3629	Electrical industrial apparatus, n.e.c.	0.00	0	
	3810	Search and navigation equipment	0.15	284	-4.8%
	3825	Instruments to measure electricity	1.19	750	0%
	3829	Measuring and controlling devices, n.e.c.	0.03	10	0%
Communications Equipment	3661	Telephone and telegraph apparatus	0.01	10	
	3663	Radio and TV communications equipment	0.00	0	
	3669	Communications equipment, n.e.c.	0.04	10	
Software and Computer Services	7372	Prepackaged software	0.02	46	5.5%
	7379	Computer related services, n.e.c.	0.08	137	21.8%
	8744	Facilities support services	0.05	57	
Research	8731	Commercial physical research	0.08	168	13.8%
	8733	Noncommercial research organizations	0.07	53	-2.8%

Note: *denotes a unique Industry; Shading indicates industry with higher than expected concentration (i.e., > 43% of the nation's employment).
Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

cluster is not defense-related and thus shows low employment in the missiles and space and defense equipment industries. The cluster also has low employment in the electronic parts, instruments, communications equipment, software and computer services, and research industries. Other industries either had very low levels of employment and disproportionately small shares of national industry employment or have no representation in Wichita at all.

Relative strength in two industries within one subcluster makes the Wichita cluster exceptionally narrow overall. Wichita is ranked 18th for industry breadth out of the 20 largest aerospace vehicles and defense clusters in the country. Tied with Atlanta, only St. Louis is more concentrated, having an industry breadth measure of 8.6 versus 20 for the Wichita aerospace vehicles and defense cluster. Seattle, another region with large employment concentration in aircraft production (aircraft and aircraft parts and equipment industries), had an industry breadth measure more than two times greater than Wichita.¹⁶⁷

CLUSTER INNOVATIVE CAPACITY

Wichita's innovative capacity is greatly influenced by the four aircraft manufacturers within the aircraft and aircraft parts and equipment industries. Innovative capacity strengths are a skilled workforce, intense rivalry exhibited among the four manufacturers, sophisticated local demand and availability of supporting industries. Weaknesses include a narrow supply base and historical supplier dependency on the manufacturers for innovation, a research center that is not reaching its full potential, and relatively low levels of collaboration-driven innovation.

Specialized Training and Talent Base. The Wichita aerospace vehicles and defense cluster benefits from a high-quality labor market that is becoming increasingly constrained as the four manufacturers grow. Thirty-eight percent of those surveyed stated that qualified scientists and engineers in the region were scarce (36% said that the pool of qualified scientists and engineers was ample; 27% gave a neutral response). The labor constraint problem, according to survey data and interviews, is more serious among skilled workers than scientists and engineers. Fifty-one percent of those surveyed said that the available pool of skilled workers in Wichita is "too small" (32% said that the pool of skilled workers was adequate; 17% gave a neutral response). Looking five years ahead, cluster representatives view the lack of skilled labor as the most significant barrier to firm expansion. Cluster representatives ranked training to upgrade worker skills as government's most important priority.¹⁶⁸

Interviewees were highly concerned about the availability of skilled labor. Doug Mahin, former Vice President, Strategic Planning & New Business Development at Raytheon Aircraft Company, said, "Eventually, you'd have to say that if you were going to expand a great deal more, you'd have to look at a new location."¹⁶⁹ John Moore, Vice President for Community and Government Affairs at Cessna, said that it was the tightest, most competitive labor market he had seen in 30 years.¹⁷⁰ One of the reasons Cessna moved its operations to Independence, Kansas, was the perceived inadequacy of skilled workers in Wichita.¹⁷¹

Interviewees cite three reasons for poor labor availability in the region: rapid growth in general aviation during the last three years, difficulty in attracting talent to Wichita, and the cyclical nature of the cluster, which can act as a turn-off to candidates. Said Richard Danforth, Vice President, Operations at Raytheon Aircraft: "It's hard to attract recently degreed young people to Wichita. Wichita is not in the top five places to go."¹⁷² Linda Jackson, President of 40-person Mid-Central Manufacturing, said, "The cyclical nature of

the business makes it difficult. Some people have invested time in training only to turn around and be laid off.”¹⁷³ Linda Guerra, Vice President of Perfekta, an 85-person supplier to the cluster’s large manufacturers, said, “It’s particularly difficult to find machinists. The demographics are hurting us. For the last 20 years, we have not valued technical training. You used to learn mechanical engineering in school. You now have to learn it on the job. The computer industry has also taken some of the skilled labor, too.”¹⁷⁴

Cluster representatives have undertaken a number of initiatives to address the labor problem. Cluster executives and the Wichita Area Chamber of Commerce created a cluster-wide recruitment road show called “Flying in Formation” and the “Home Again” program to attract skilled workers and engineers who were born in Wichita back to the region. Raytheon established an aggressive cooperative program with five universities (University of Texas at Austin, Georgia Tech, University of Missouri Raleigh, Southern University, and Embury-Riddle) to provide an introduction to Raytheon. Most recently, cluster executives, the city of Wichita and the Chamber have been discussing plans for a workforce development initiative, which would boost existing workers’ skills and help to attract new workers to the region.

While cluster representatives draw talent from universities in other regions, it is Wichita State University that plays the most important role in providing high-quality talent to the cluster. Roughly 30% of all engineers employed in the cluster are WSU graduates.¹⁷⁵ WSU offers accredited bachelor, master and PhD degrees in aerospace vehicles and defense, electrical, industrial, and mechanical engineering. Other master level degrees offered include engineering management. WSU offers an undergraduate program in manufacturing engineering and computer engineering (to be accredited).

New WSU president Donald Beggs received generally positive reviews for supporting aviation’s hiring needs. Said Raytheon’s Mahin, “Beggs has helped to recruit students, particularly engineering students. Don’s attitude is if it is good for business, it is good for us.”¹⁷⁶ However, both Mahin and Cessna’s Moore believed that there might be some missed opportunities at WSU. Moore wished that there were degrees in aviation management, airframes, and power plants.¹⁷⁷

A number of other education and training programs related to the aerospace vehicles and defense cluster exist in Wichita. Wichita Area Technical College (WATC) offers the Associate of Applied Science degree. Additionally, WATC creates industry or company specific training programs to some 13,000 students in 100 occupational programs. An example of one of these programs is the Basic Manufacturing Orientation for Employment program, a collaborative effort by the WATC, Wichita Area Chamber of Commerce, and local manufacturing companies to improve worker skills. Boeing has instituted the Boeing Degree Program at the Southside Education Center, sponsored by the Wichita Area Technical College. The Boeing Degree program offers four Associate of Applied Science (AAS) degree programs.¹⁷⁸

Specialized Research. Wichita possesses only one aerospace vehicles and defense research center, the National Institute for Aviation Research. Founded in 1985, NIAR is Wichita’s nationally recognized aviation research institution. NIAR is a Wichita State University-based research center that places programmatic emphasis on education, research and training. NIAR received close to \$9 million of funding in 1999, about \$3.3 coming from federal grants and contracts, \$2.6 million coming from industry contracts and the balance from the Kansas Technology Enterprise Corporation, university and other sources.¹⁷⁹ NIAR has proposed a five-year budget of \$45 million with close to 60% requested from state (KTEC) resources, 27% from federal sources, and the balance from WSU and industry.¹⁸⁰ In the future,

NIAR intends to upgrade its research capabilities, particularly in aerodynamics, aviation safety, and aviation manufacturing technology. NIAR claims that it can provide a \$348 million return on investment for the \$45 million needed during the next five years.¹⁸¹

NIAR is staffed with 47 full-time employees and more than 100 WSU student assistants and graduate research assistants. NIAR also works with Kansas State University and the University of Kansas (Rawlins and Salina). The research institute operates 16 applied research testing labs with key areas being aerodynamics, crash dynamics, CAD/CAM, and composites and advanced materials. The FAA has designated NIAR as a site for composite certification, a significant accomplishment according to a KTEC peer reviewer.¹⁸² NIAR is also involved in a number of important regional and national research partnerships:

- Federal Aviation Association (FAA) Airworthiness Assurance Center of Excellence focuses research and development efforts on aircraft safety issues.
- Aircraft Design and Manufacturing Research Center (ADMRC), based at NIAR, is an industry-driven research consortium of Kansas universities (University of Kansas, Kansas State University, WSU, and Pittsburgh State), state government, the four manufacturers, and about 20 suppliers. NIAR acts as a facilitator for decisions on projects undertaken.
- Advanced General Aviation Transport Experiments (AGATE) is a research program that investigates common aviation issues such as avionics, materials, engine issues (such as noise), icing, de-icing, and safety.
- Manufacturing Innovation and Development Initiative in Aviation (MIND) attempts to foster new manufacturing technologies.
- Mid-America Manufacturing Technology Center (MAMTC) offers technology application assistance to small and medium-sized manufacturers and suppliers.
- Small Aircraft Transportation System (SATS) is attempting to create a “highway in the sky” logistical system.

In addition to these programs, NIAR has established important relationships with Wichita-based industry players for which it conducts limited basic research, applied research, product development, testing, and certification.

Cluster survey respondents said that research centers are available but under-funded and only somewhat helpful in terms of innovation. While 56% stated that specialized research facilities are readily available and 54% believe that these institutions frequently transfer knowledge to their industry, survey respondents look to research centers as only occasional innovation partners in terms of both idea development and commercialization. Research centers were not as important as, principally, their own firms, followed by other firms, suppliers, customers, and business assistance centers in terms of idea development. Only 26% believed that state and local government support for investment in R&D is ample. However, surveyed respondents reported that funding or support for funding of these research facilities was considered a very low priority for government.¹⁸³

Analysis of the National Institute for Aviation Research

A recent NIAR peer evaluation and interviews with cluster representatives reveal that NIAR is a strong asset for Wichita but it could do more. A peer review conducted in the spring of 2001 gave good to excellent ratings to NIAR (the ratings of four peer reviewers gave scores of 4 out of 5 for most areas of the evaluation). Peer reviewers were impressed with NIAR's close relationship with the key manufacturers, which facilitates technology transfer to the established firms. Strong research areas singled out were composites, deicing, and crash worthiness. Said one peer reviewer, "NIAR provides significant benefit to its local customers in the aviation industry. The benefits of their research show up in the form of improved competitiveness, improved aircraft performance, new jobs, and retained jobs."¹⁸⁴

Interviewees consider NIAR's role in FAA certifications, safety issues, and manufacturing process research to be important. They view NIAR as a rare, non-threatening forum to engage competitors on common issues such as safety. Cluster representatives also value the human capital benefits of forming relationships with WSU's graduate students. "NIAR is a genuine asset to the industry," said Moore of Cessna, which plans to contract with NIAR to help develop new composite technology. Boeing's Turner said, "NIAR is the best coordinating mechanism in terms of pooled research with other manufacturers. NIAR is unique and highly valuable in that it allows four aviation companies to work together cooperatively and comfortably."¹⁸⁵ Raytheon was also effusive about NIAR's Mid-America Manufacturing Technology Center (MAMTC) and the institute's assistance in composite research for the company.¹⁸⁶

However, peer reviewers and interviewees identified a number of challenges facing NIAR. NIAR's activities are focused on a small number of clients that compose the institute's Industry Advisory Board (these are the cluster's anchor manufacturing firms). There is also an opportunity to increase commercialization of technologies related to advanced materials, design, and manufacturing technologies, which have applications beyond aerospace vehicles and defense. As an example, according to the peer reviewers, NIAR's Innovation Commercialization Center is not a focus of the institute's attention. Research was also characterized as application development that "solves short-and near-term problems, is industry-oriented and not necessarily long term, and cutting edge." Further, peer reviewers recommended that NIAR take a more proactive stance in marketing its services and creating greater visibility.¹⁸⁷

Peer reviewers were critical of the institute's low patent activity.¹⁸⁸ Said one peer reviewer: "There is not an urgency to patent technology. Most of their projects have multiple industry sponsors who are the principal beneficiaries of the development. On a global basis, this lack of patent activity may be detrimental, since protection of intellectual property rights from foreign use is not possible. For selected technologies, this policy should be reviewed."¹⁸⁹ Another peer reviewer said that there was significant potential for intellectual property registration, but it was unclear how it was being handled at NIAR. He suggested that intellectual property issues be integrated across the state by KTEC.¹⁹⁰

Interviewees corroborate the peer review findings as they remarked that NIAR is reluctant to commercialize due to the intense competition among the manufacturers. One Wichita community leader said, "NIAR has received feedback from the manufacturers who say, 'why are you doing that when we already have that and the benefits will go to the competition?'"¹⁹¹ Others said that NIAR and WSU have not created a fast-paced and dynamic innovation culture where the faculty have the interest or

motivation to commercialize ideas.¹⁹² Said one interviewee involved in technology transfer issues: “There is no leadership in terms of commercialization. How do they get their faculty to generate wealth? They don’t do a good job of stimulating faculty research. They don’t have a shining star to point to.”¹⁹³ Said another interviewee familiar with NIAR’s commercialization efforts: “[NIAR’s] reward system is based on being published and being recognized by their peers. There has been only one commercialization spin-off at NIAR. A key factor in why it didn’t work was that neither NIAR nor the university was invested in the idea. Until the university changes its reward system, nothing will happen.”¹⁹⁴

Boeing’s Turner mentioned that WSU is not as aggressive as it should be in commercializing applied research.¹⁹⁵ Moore from Cessna didn’t think NIAR should actually play a role in commercialization. He believed the individual manufacturers do a better job of commercializing technology. “We’re a \$2.5 billion business. We can do the innovation better than the university. I think the other manufacturers think the same.”¹⁹⁶ A peer reviewer said that NIAR is not set up to act as an “entrepreneurial incubator” as the research efforts respond to the manufacturers who compose the Industrial Advisory Board. The peer reviewer noted that the number of start-up companies created should not be a gauge of the institute’s success.¹⁹⁷

Some of those interviewed did not necessarily fault NIAR per se but rather the definition of its mission and its need for more funding. Jim Ziegler, VP, General Manager, Bombardier Learjet said, “They’re in a Catch 22 situation. They have to run it like a business to succeed but they’re a public institution. We’re asking them to be two different entities at once.” Ziegler felt that the work of NIAR was not monumental but rather focused on issues of efficiency. He questioned whether NIAR would be able to produce big breakthroughs. “NIAR could probably do more but they lack resource dollars.”¹⁹⁸ Specifically, some mentioned the urgent need for funds to upgrade NIAR’s wind tunnel.

Reflecting on the mission of NIAR, Dr. Ramesh K. Agarwal, NIAR’s former Executive Director, said that funders require relevance to all research. “There is not a lot of pure research here. Most of our clients want relevant research. Another problem is low level of funding that impacts the ability to attract nationally recognized talent. NIAR suffers from the same problem as the industry. Wichita is not an attractive place for many people.”¹⁹⁹

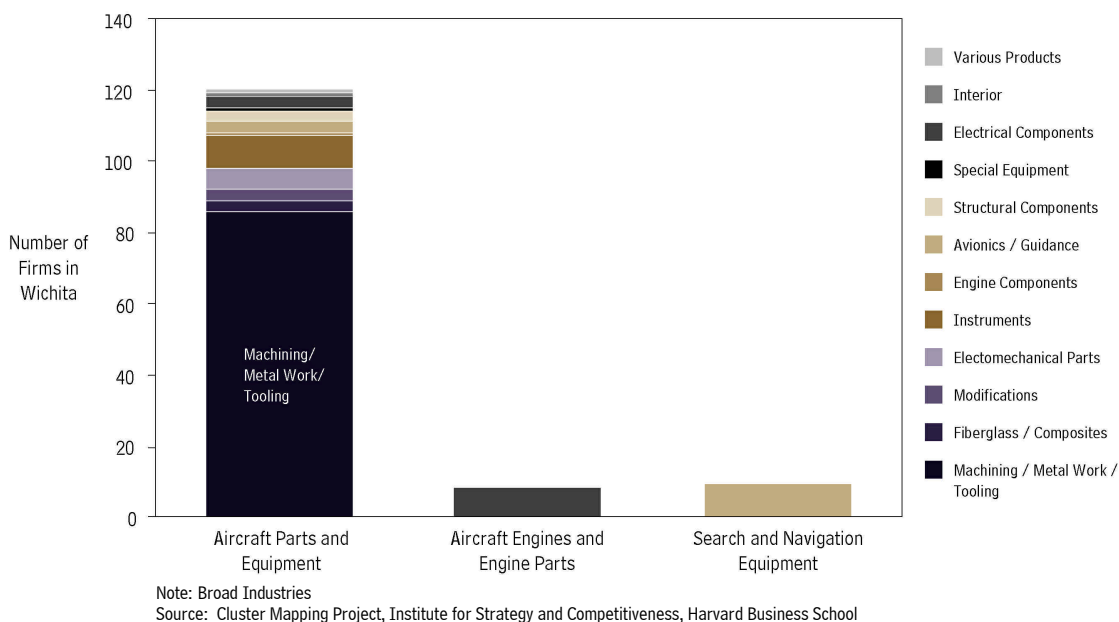
Context for Firm Strategy and Rivalry. The Wichita aerospace vehicles and defense cluster exhibits intense firm rivalry. Eighty-three percent of those surveyed viewed competition within their cluster as intense (there was no other issue related to competition that received a higher ranking). Said Mahin of Raytheon: “There are 15 million vehicles sold per year. There are 400 turbo airplanes sold. You can lose one deal and you can lose millions of dollars.”²⁰⁰ As discussed later, this extreme rivalry among the large manufacturers impacts the level of collaboration within the cluster.

Sophistication of Regional Demand. Wichita cluster executives expressed positive views about the level and sophistication of their local customer base. Eighty-one percent of the respondents believed that their regional customers were sophisticated and demanding. And almost as many, 73%, reported that their customers had special needs, which can spur product innovation. Sixty-eight percent of those surveyed reported that they received frequent feedback that reveals the need for new features or enhanced performance of business products and services.²⁰¹

Related and Supporting Industries. The range of parts suppliers available in Wichita is relatively narrow due to the cluster's airframe integration/assembly focus, but supporting firms, such as specialized legal and accounting resources, are readily available in the region.

Parts Suppliers. Wichita's suppliers have expertise in machining, tooling, and metal work. Wichita aerospace vehicles and defense suppliers are not providers of major equipment such as avionics, engines, or sophisticated electrical systems. Out of the 120 firms listed under the aircraft parts and equipment industry category in the Wichita Area Chamber of Commerce's Directory of Major Employers, 1999/2000, 71% were machining/metal work/tool shops (see Exhibit 48). According to the same source, Wichita claims just eight firms in the aircraft engines and engine parts industry and nine in the search and navigation industry.²⁰²

Exhibit 48. Wichita Aerospace Vehicles and Defense Supply Base



Due to this relatively narrow supply base, Wichita's aerospace vehicles and defense manufacturers source a large portion of necessary equipment outside of Wichita. Boeing sources roughly 30% of its inputs from Wichita firms, with 50% coming from larger suppliers and 50% from smaller metal working job shops.²⁰³ Raytheon sources approximately 20% of its inputs from Wichita-based suppliers.²⁰⁴ Bombardier sources about 10% to 60% of its aircraft supplies from Wichita-based companies, depending on the aircraft models (10% to 15% for the new Learjet 45 and 50% to 60 % for the legacy Learjet 31 and 60 models).²⁰⁵

There is a historical explanation for Wichita's concentration of final assembly/metal work suppliers. The early aircraft entrepreneurs focused on airframe design and aircraft production. "Innovation in Wichita was never focused on avionics and engines," said industry expert and former Wichita resident Jerry McDougal.²⁰⁶ Craig Miner, a historian at WSU, agreed that, historically, the cluster did not concentrate on major equipment with the exception of instrument suppliers.²⁰⁷ Another reason for Wichita's narrow supply base is that firms that produce sophisticated components such as avionics, engines, and software

tend to be part of aerospace vehicles and defense clusters that have a stronger position in commercial and defense aircraft. “General aviation is a niche market for the engine and avionics suppliers such as Honeywell and GE,” said McDougal.

While all the cluster’s manufacturers said that there are distinct benefits in having suppliers in close proximity, Wichita’s manufacturers have grown accustomed to sourcing outside of the region and are generally satisfied with both the quantity and quality of the limited suppliers within the region. Fifty-eight percent of those surveyed stated that specialized suppliers of cluster inputs could be found in the region and an even higher percentage believed that the regional suppliers were of high quality. However, 44% said that suppliers do not help with new product development and processes (34% said infrequently; 22% gave a neutral response).²⁰⁸

While suppliers are considered occasional innovation partners in terms of idea development, interviewees diverged concerning their innovative capacity. Boeing was extremely positive regarding collaboration with suppliers.²⁰⁹ Bombardier also praised the innovative capacity of Wichita suppliers. “It’s one of the reasons Bill Lear came here.”²¹⁰ However, Cessna emphasized the manufacturers in the innovation process.²¹¹ And while Raytheon regularly partners with suppliers on design and development, there are no examples of such partnerships in Wichita.

Innovation collaboration is less common among the pervasive small suppliers of Wichita.²¹² According to Elaine Hanna, Regional Director of MAMTC, the manufacturers are more likely to be the innovators than their local suppliers. She could not provide any examples of small suppliers who have patented designs or processes. “Active collaboration between small supplier and large Original Equipment Manufacturers (OEM) is in the early stages,” said Hanna. One small supplier remarked, “Perhaps because we’re so small, the OEMs don’t involve us in their innovation plans.”²¹³ Another said that the smaller machine shops are slow to adopt new ideas. “Many of the small machine shops in Wichita are not that forward-thinking,” said Jim Rundell, President/CEO, Air Capitol Plating, Inc. “Innovation is not in the machine shop’s mindset. But if they don’t adopt these practices, as has already been shown, they will go out of business.”²¹⁴

A number of recent trends will impact manufacturer-supplier relationships and, potentially, the supply base in Wichita. To tackle the problem of manufacturer and supplier collaboration, MAMTC is spearheading a supply chain group and working on a software package that will facilitate communication among manufacturers and suppliers.²¹⁵ Cessna has a nearly three-year-old program in place to forge an integrated supply chain in response to problems in delivery, quality, prices, management, and long-term planning. Cessna had 5,000 suppliers and only 17% were on any long-term agreement. Cessna characterized the supply base as “all the little mom and pop shops that didn’t know that the Baldrige wasn’t another brand of soft drink.” As part of the rationalization process, Cessna has been selecting the best suppliers, improving the relationship with these suppliers through assistance in quality, delivery, service, cost, and technology/integration, and integrating the suppliers into their design and manufacturing processes. Cessna worked with Wichita’s Friends University and Wichita State University to create tools for supply chain management.²¹⁶

Tighter supply relationships have also been the focus of the manufacturers during the last few years. The availability of suppliers in Wichita may improve as manufacturers demand more timely access to parts. Some of the manufacturers, like Cessna, are requesting suppliers to set up a local facility to improve clustering effects. For example, Crane Aerospace, a parts supplier to the aerospace vehicles and defense

cluster based in California, set up a distribution center in Wichita in 2000 to respond to the needs of the four manufacturers.²¹⁷ Another important trend is toward supplier integration. During the last few years, the manufacturers have been looking to integrators, such as Thayer Aerospace in Wichita, to decrease parts management burdens, inventory, and costs.

Supporting Firms. Supporting firms such as specialized legal, accounting, advertising, and credit resources are available in Wichita. Cessna benefits from local advertising, legal, and banking (Bank of America) services.²¹⁸ Raytheon uses a balance of local and headquarter resources for marketing and banking.²¹⁹ The four largest law firms in Wichita specialize in serving the aerospace vehicles and defense cluster. Hinkle Elkouri provides counsel to the three general aviation manufacturers, helping those companies issue bonds. Klenda, Mitchell, Austerman & Zuercher, LLC, offers a specialty law practice in aircraft finance. Martin, Pringle, Oliver, Wallace & Swartz has worked for Beech (now Raytheon Aircraft) for 31 years and was a key player behind the General Aviation Revitalization Act of 1994.²²⁰ While the region does offer these specialized services to the cluster, the availability of patent lawyers is extremely low.²²¹

Wichita's advertising agencies have also developed specialty aviation practices. The region's three top agencies, Associated Advertising Agency Inc., Sullivan Higdon & Sink, and the Greteman Group, all represent Wichita-based and external aerospace Vehicles and Defense firms, including Stanford & Associates based in Fredricksburg, Virginia; Sherwin-Williams Aerospace Vehicles and Defense Coatings, based in Dallas, Texas; Rockwell Collins, an avionics manufacturer based in Cedar Rapids, Iowa; and BFGoodrich Aerospace Avionics & Lighting Systems based in Grand Rapids, Michigan. Rand Mikulecky, president of SHS, said that aviation advertising is "a somewhat specialized industry. [In Wichita], people are exposed to it every day. It's a part of our life."²²²

Regarding financial services, it is the smaller suppliers that tend to rely solely on local resources. Local bank loans or assistance from the Mid-America Manufacturing Technology Center and the Small Business Administration, rather than venture capital or seed capital, have been the key sources of funding for smaller suppliers. Local banks have developed some expertise in financing cluster suppliers. J.V. Lentell, Vice Chairman of InTrust Bank, the largest of the few locally owned banks in Wichita, said that many small suppliers in the cluster have received funding from his bank. In some cases, InTrust will loan entrepreneurs money guaranteed by the local Small Business Administration.²²³ Linda Guerra of Perfekta said that she does not have a problem accessing capital in Wichita. "Local banks are highly attuned to the entrepreneurial spirit and will definitely support you."²²⁴

Government. Government has had a dramatic impact on the aerospace vehicles and defense cluster. The federal government's demand for military aircraft in both World War II and the Korean War provided the critical boost to the cluster's development in its early stages. Hundreds of miles away from the coasts and the danger of naval attacks, Wichita's inland location was one of the city's original advantages. As early as September 1940, Wichita's aircraft plants had four times the orders they had one year previously.²²⁵ The federal government's decisions to grant the contracts for a military transport plane and the B-29 Superfortress bomber to Boeing served as key events for the cluster and the regional economy as a whole.²²⁶

While government orders spurred the cluster, federal government policy has acted as both accelerator and brake to cluster development. The federal government dealt a blow to the cluster with the passage of the Tax Equity and Fiscal Responsibility Act of 1982 that levied a federal tax on business jet fuel and allowed for larger liability awards against the manufacturers.²³⁷ The act prompted Cessna to exit the

single-engine aircraft market. On the other hand, the General Aviation Revitalization Act of 1994 gave the industry a boost when it capped the years of liability on general aviation aircraft. General aviation production has increased by 69% and exports have doubled since the enactment. The market for single engine piston-powered aircraft, the type made by Cessna, has increased over 103% since 1994 (see the box below).²²⁸

GENERAL AVIATION REVITALIZATION ACT

The General Aviation Revitalization Act (GARA) of 1994 was a response from industry to a major decline in sales during the late 1980s and early 1990s. The industry claimed that it was being hurt by expensive product liability lawsuits on its aircraft. The general aviation industry, led by the General Aviation Manufacturing Association (GAMA), pushed through the act to limit the statute of repose, or liability, for defective general aviation aircraft to 18 years.

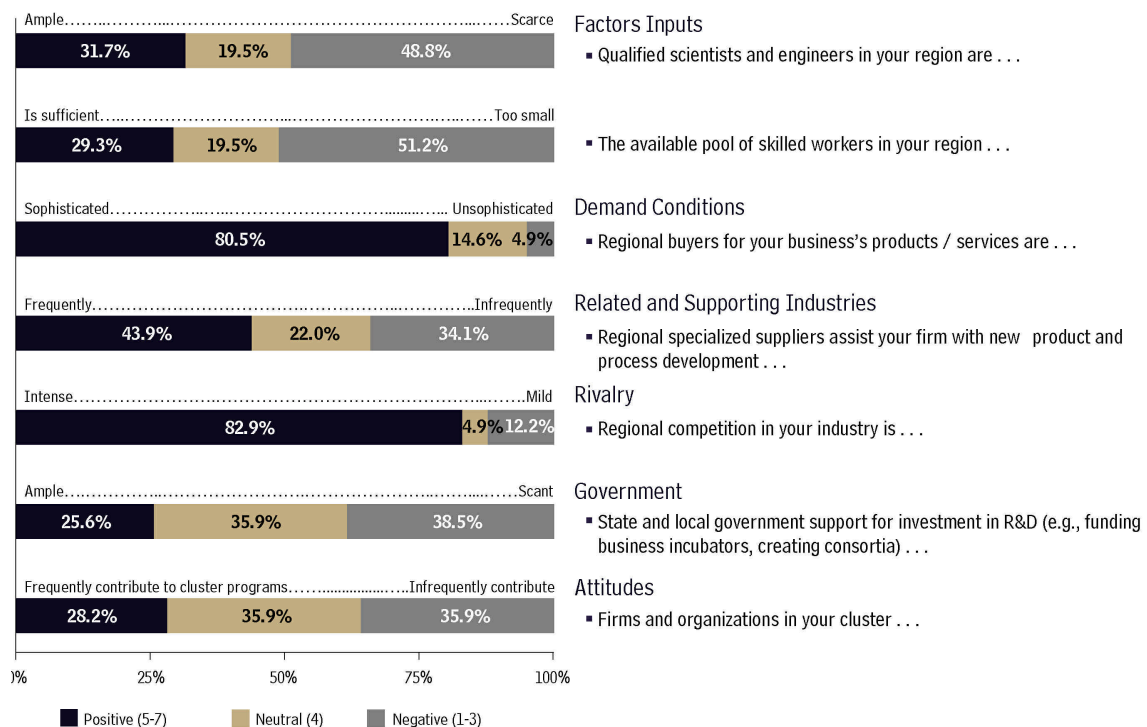
The General Aviation Manufacturing Association considers GARA responsible for the success of general aviation during the last seven years. Since the passage of the Act in 1994, employment at seven of the General Aviation Manufacturing Association's members climbed from 23,879 in 1994 to 33,913 in 1997. Cessna made its re-entry into the single-engine piston-powered market conditional on the enactment of GARA. New Piper claims that the GARA saved it from liquidation once it emerged from Chapter 11 in 1995. GARA's limited statute of repose reduced Piper's liability exposure from about 60,000 airplanes to 12,000. Suppliers have also benefited from the passage of GARA.²²⁹ According to GAMA, investment in R&D at general aviation companies and their suppliers has grown by more than 150%.²³⁰

Opponents of GARA do not fault product liability costs for general aviation's problems in the early 1990s, nor do they attribute the rebound of the general aviation business to the follow-on effects of the Act. Public Citizen has said that the general aviation decline in the 1980s was due to a saturated market and increased fuel costs that limited demand.²³¹ Other observers have said that the product liability exposure has shifted to suppliers. Public Citizen reports that Cessna's liability costs have, in fact, not substantially decreased. According to Cessna, the company's liability costs per aircraft have not declined due to an "enormous case backlog." Cessna's John Moore expects the liability costs to drop in the years ahead.

Local government has also played a significant role in the cluster's development. Since 1979, the city has provided Boeing with billions in industrial revenue bonds.²³² To attract Learjet to Wichita, the city offered to raise \$1.2 million in industrial revenue bonds to assist with Learjet's new plant.²³³ More recently, local government helped to attract aluminum producer Alcoa to neighboring Hutchinson. NMF America, a Montreal-based supplier of wing fabrication and a newcomer to the Wichita cluster, was impressed by the city's show of interest and incentives. Jeremy Artus, former CEO of NMF America, said that many Wichita government officials and Chamber representatives visited NMF in Montreal. "They demonstrated that they wanted us in Wichita. Hutchinson actually had a bigger war chest but Wichita was more aggressive." Wichita won out over five or six other potential cities. (NMF's total incentives package, including city, county and state contributions, was approximately \$300,000.)²³⁴

The majority of those interviewed stated that the local government has been willing to “bend over backwards” to help firms within the cluster. However, cluster representatives were highly critical of the state and local government in terms of their support for R&D investments. Only 26% of those surveyed in the aerospace vehicles and defense cluster reported that the support for investment in R&D was ample (see Exhibit 49).²³⁵

Exhibit 49. Select Survey Results from the Aerospace Vehicles and Defense Cluster



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

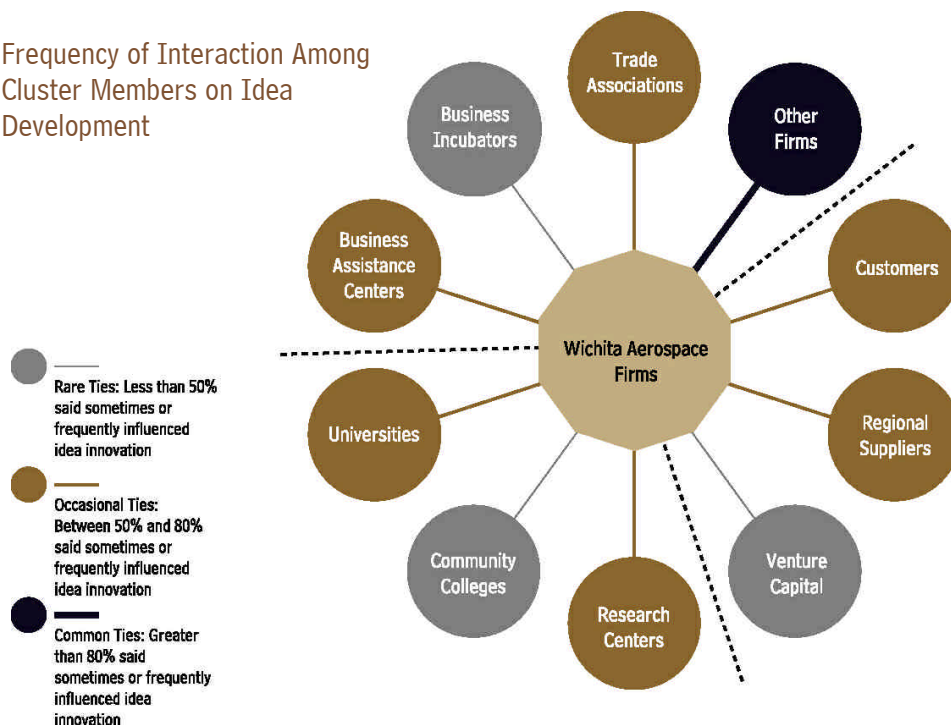
Institutions for Collaboration. The aerospace vehicles and defense cluster does not have a strong culture of collaboration, nor does it have an abundance of formal institutions for collaboration that foster idea sharing and networking. Forty percent of those interviewed said that associations and organizations that represent the cluster do not exist or are ineffective compared to a range of 28% to 55% of respondents in the other regions of the Cluster of Innovation study who responded similarly. Forty-three percent reported that firms and organizations in the cluster infrequently share knowledge compared to a range of 35 to 40% of respondents in the other regions of the Cluster of Innovation study who responded similarly.²³⁶

Existing cluster organizations include NIAR (discussed previously) and local chapters of the General Aviation Manufacturers Association (GAMA), the American Institute of Astronautics and Aviation (AIAA), the Institute of Electrical Engineers (IEE), the Machine Tooling Association (MTA), and the Wichita Manufacturers Association, among others. None of these organizations acts as an umbrella for the entire Wichita cluster.

Some interviewees link intense competition and the strength of the manufacturers themselves to the low number of strong and highly relevant cluster-wide organizations. Dwight Henry of Plastic Fabricating said, “There isn’t much networking or sharing of ideas in the cluster. It would be helpful to have some formal organization to allow suppliers and manufacturers to share information.”²³⁷ Mahin of Raytheon said, “I’ve been in three industries: automotive, heavy equipment and aviation and this is by far the most secretive. There was a real belief within Raytheon that you shouldn’t talk to other competitors. There’s very little exchange. Innovation issues we try to hide.”²³⁸ Agreeing that there are few opportunities to network within the Wichita cluster, Jeremy Artus, former director of NMF America, suggested that Wichita create a cluster-wide club akin to an organization in Montreal. The Quebec government sponsors such a club and hosts monthly meetings that usually draw 100 to 200 people, including both manufacturers and suppliers.²³⁹

To learn more about the innovation process in each region, we asked cluster respondents to identify their partners in two phases of new product or service innovation: idea development and commercialization. Generally, cluster participants prefer to innovate on their own. When firms do collaborate, there is a greater tendency to partner on idea generation and development than commercialization. The idea stage of the innovation process is influenced most strongly by other firms (see Exhibit 50). Research centers, universities and trade associations, all key drivers of the idea development process in other cluster locales, are less important. Venture capital firms and business incubators, important players for start-ups and early stage companies, are insignificant within this mature cluster. In terms of commercialization, no organization is considered to be a regular innovation partner. Occasional partners are customers, business assistance centers, and regional suppliers. Again, research centers and universities are less important.²⁴⁰

Exhibit 50. Frequency of Interaction Among Cluster Members on Idea Development



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

CONCLUSION

Exhibit 51 provides a summary assessment of the aerospace vehicles and defense cluster. The cluster provides a number of useful lessons for other regions seeking to develop their own cluster and substantiates several propositions of the diamond framework. First, conscious entrepreneurial efforts were instrumental in launching the cluster. Second, government can act as an influential player, in this case as a transformational source of demand as seen during World War II and the Korean War. Local government can also be a constructive partner in attracting important anchor firms and suppliers to the region. Third, a cluster can benefit from a labor market of similarly qualified skilled workers.

The diamond framework can also be used to expose challenges to a cluster. Wichita's aerospace vehicles and defense cluster is highly concentrated within four key manufacturers in two industries within one sub-cluster. Cluster narrowness helps to explain intense rivalry in the cluster, competition for a small pool of talent, a low level of collaboration-driven innovation, relatively low patent creation, historical supplier dependency on the manufacturers for innovation, and a research center focused on the needs of the anchor manufacturers. The results of cluster narrowness are limiting the innovation benefits that normally accrue to a cluster and could be undercutting cluster participants' perceived value of the cluster as a whole. Only 34% of those surveyed in the cluster said that Wichita's location was very beneficial for innovation. Looking out to five years in the future, 24% of the surveyed respondents felt the same way.²⁴¹

Exhibit 51. Summary Assessment of Wichita's Aerospace Vehicle and Defense Innovative Capacity

Element of Diamond	Strengths	Challenges
Basic and Specialized Factor Inputs	<ul style="list-style-type: none"> Trained and skilled workers National Institute of Aviation Research 	<ul style="list-style-type: none"> Low levels of investment in basic research in aerospace science NIAR has limited funding and limited focus on commercialization and break-through technology Tight labor supply for trained and skilled workers Lack of advanced education opportunities in aerospace and engineering offerings WSU not listed among top 50 aerospace engineering programs in the U.S.
Context for Firm and Strategy Rivalry	<ul style="list-style-type: none"> Vigorous competition among regionally based rivals Four global aircraft manufacturers in region act as anchors to the cluster 	<ul style="list-style-type: none"> Aerospace vehicles and defense employment is concentrated within one subcluster
Related and Supporting Industries	<ul style="list-style-type: none"> Regional business support firms (legal, accounting, banking) have developed to support specialized needs of the aerospace cluster Abundant local machine shops making quality parts 	<ul style="list-style-type: none"> Few suppliers of sophisticated parts and components Limited contribution by suppliers in the innovation process
Regional Demand	<ul style="list-style-type: none"> Local aircraft companies are considered to be sophisticated, have special needs and are demanding buyers 	
Government Policy	<ul style="list-style-type: none"> Local government considered to be responsive to the cluster 	<ul style="list-style-type: none"> Very low levels of federal and state funding for basic and applied research
Quality of Linkages	<ul style="list-style-type: none"> Small community allows for informal networking 	<ul style="list-style-type: none"> Limited collaboration on issues common to cluster members Lack of cluster umbrella organization

THE WICHITA PLASTICS CLUSTER

The plastics cluster consists of industries that supply petrochemical raw materials, specialized chemicals and materials, and process equipment as well as industries that produce and distribute unfinished and end use plastic products. Generally, narrow industries tend to be those that manufacture unfinished and final products whereas broad industries supply raw materials to the cluster (such as chemicals and petroleum-based resins). Various related industry organizations, educational institutions, and government agencies play important roles.

Plastics clusters are broadly distributed nationally. The Economic Areas with the highest share of national cluster employment are New York-Northern. New Jersey-Long Island, with 9.3% of national cluster employment, Los Angeles-Riverside-Orange County, (6.5%), and Houston-Galveston-Brazoria, (5%).

The Wichita plastics cluster²⁴² is an important economic entity in the region, as it is growing in terms of employment and number of establishments and provides good wages that are growing relatively fast. The cluster compares well with regional benchmarks. However, the cluster is concentrated within one sub-cluster, plastic products, that provides the high wages within the cluster as a whole. Anchor firms and their related suppliers create relatively simple products that tend to compete on price. Plastics cluster leaders report a lack of cluster cohesiveness, a constrained labor supply, a paucity of R&D and limited institutions for collaboration. Our analysis shows that the Wichita plastics cluster is not reaching its full potential.

Development of Wichita's Plastics Cluster

The Wichita plastics cluster includes manufacturers of plastic products through “blow molding” (air and plastic combined in a mold to create hollow plastic products) and “injection molding” (plastic injected through a high-pressure process into a mold to create a hard plastic object) processes and a lesser number of fiberglass and composite manufacturers. The Wichita plastics cluster traces its roots back to the adoption of plastic technology by the region's Coleman Company and the aerospace vehicles and defense cluster.²⁴³

Large plastics employers in the Wichita Economic Area include consumer plastic product manufacturers, the Coleman Company Inc., the cluster's anchor, Wescon (custom injection molding), Century Manufacturing, Inc. (acrylic molded products), Norland Plastics (injection molded plastics), Burnham Composites, Inc. (composite parts and assemblies for the aerospace vehicles and defense cluster), and Smith Fiberglass Products (fiberglass).

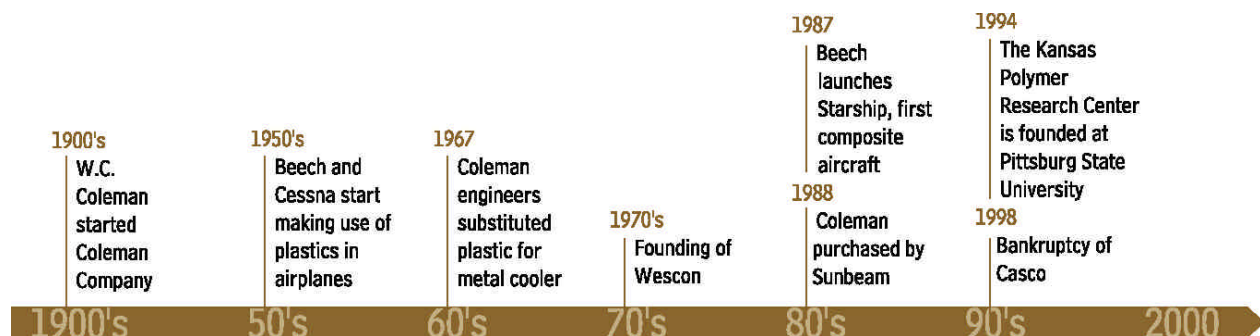
McPherson, located approximately 60 miles north of the city of Wichita, is the home of about 15 plastics-related firms led by the anchors of the McPherson plastics companies, CertainTeed Corporation (plastic pipes, siding, and fence). Other noteworthy plastics companies in the McPherson area include Ferguson Productions (injection molder and supplier to the Coleman Company and some of the aerospace vehicles and defense manufacturers), Spartech (manufacturing extruder company), Waretech (manufactures screws for injection molding and extrusion companies), and Precision Screws (injection molding components). McPherson has its own electricity production facility, which it uses to maintain the lowest electricity rates in the state and attract manufacturing-oriented firms.

Winfield, south of the city of Wichita, hosts a similar number of plastics companies as McPherson, including Rubbermaid, KSQ (a large custom blow molder) and Winfield Consumer Products (plastic

automotive add-ons). Rubbermaid-Winfield, Inc. employs 950 and is a manufacturing facility for Newell Rubbermaid, based in Wooster, Ohio. KSQ and Winfield Consumer products are both spinouts from Rubbermaid.

W.C. Coleman, an entrepreneur who developed and merchandised the popular Coleman lantern, founded the Coleman Company at the turn of the century (see Exhibit 52). Today, the Coleman Company is one of the world's largest manufacturers of outdoor recreational equipment and the "anchor" blow molding plastics company in Wichita. Products include lanterns, coolers, thermoses, plastic canoes, and cook stoves. The most significant event in the development of the cluster took place in 1967, when the Coleman Company substituted plastic for liners in its galvanized metal lined coolers (see Exhibit 52). In the early 1960s, the Coleman Company started developing a polyurethane foam insulation plastic liner to replace the existing fiberglass one. The vacuum forming technology, developed by Coleman engineers, was

Exhibit 52. Development of the Wichita Plastics Cluster



Source: Corporate Information, Interviews

extremely innovative at the time. During the mid-1960s, the Coleman Company had started using plastic blow molding technology to make cooler cases and thermoses. By the summer of 1967, the Coleman Company had developed its first all plastic cooler. Suppliers like Wichita's Pawnee Plastics (later purchased by Spartech) supplied plastic sheeting made from polyethylene to the Coleman Company. At this time, Pawnee started Ponca, a plastics color supplier, which later became Spartech Color. National Plastics Color Company was a spinout of Ponca. Like many of the suppliers at the time, a significant percentage of Pawnee's sales were attributed to the Coleman Company. The Florida-based Sunbeam Company purchased the Coleman Company in 1998. Today, the Coleman Company employs 1,230 people in Wichita.

The Coleman Company was an important customer for injection molding suppliers. All the faucets and handles for the coolers and ice chests were made with injection molded parts provided by some Wichita area companies such as Casco. Later, the Coleman Company brought some of the injection molding functions in-house due in part to the bankruptcy of Casco in 1998. Other notable injection mold companies in Wichita include Wescon and Norland. Wescon is a manufacturer of cables and wires and also a custom injection molder of plastic parts. Norland Plastics is an injection molder of plastic components for the automotive parts, outdoor power equipment, and other commercial and industrial applications.

The injection molding side of the plastics family tree has roots in the aerospace vehicles and defense cluster. In the early 1950s, Beech and Cessna started incorporating plastic non-structural parts such as wing tips, wheel fairings, interior décor, instrument panels, window sides, seat parts, knobs and door handles.

Exhibit 53. Building the Wichita Plastics Cluster

Obstacles	Important Enablers	Key Events
<ul style="list-style-type: none"> ■ Competition with large aerospace manufacturing companies for labor ■ Only two large plastic manufacturers in the region ■ Increasingly, cost of power ■ For blow molding companies, distance from customers and resin suppliers 	<ul style="list-style-type: none"> ■ Presence of Coleman and Rubbermaid ■ Need for injected molded plastics from aerospace cluster ■ Availability of affordable and motivated labor ■ Inexpensive power in McPherson ■ Presence of the Kansas Polymer Research Center at Pittsburg State University 	<ul style="list-style-type: none"> ■ Early 1950s, Beech and Cessna replaced metal non-structural parts with plastic parts ■ During 1960s, Coleman replaces metal products and parts with plastics

Source: Clusters of Innovation Regional Survey and in-person interviews

RECENT ECONOMIC PERFORMANCE

The Wichita plastics cluster is a significant contributor to the region's economic prosperity. The cluster has had positive trends in terms of employment, wage, and establishment growth over the 1988 to 1998 period. In addition, the cluster ranks well when compared to the top 20 plastics clusters in the nation. However, except for the cluster's anchor firm, the Coleman Company, Wichita's plastics firms have not registered a large number of patents. Low patent activity is a reflection of the cluster's relatively simple, end product focus.

Employment.²⁴⁴ Wichita's plastics cluster ranked eleventh in the Wichita Economic Area in 1998 with 5,762 employees (see Exhibit 54). The cluster ranked 41st among the largest plastics clusters by Economic Area in the country in terms of employment and had .67% of national plastics cluster employment. This compares with the Economic Area's .43 % of national employment share in 1998. Over the 1988 to 1998 period, Wichita's plastics cluster had an annual growth rate of 5.72%. Compared to the top 20 plastics clusters, Wichita's annual employment growth rate would be ranked third.

Average Wages.²⁴⁵ In 1998, the Wichita plastics cluster's average wage of \$34,594 was higher than the 20 largest plastics clusters with the exception of four clusters: Houston-Galveston-Brazoria, Milwaukee-Racine, Philadelphia-Wilmington-Atlantic City, and Louisville. Wichita plastics workers' wages were 107% of the national average for the cluster and 29% higher than the average wage for the Economic Area. Wages grew at a rate of 6% annually over the 1988 to 1998 period, higher than both the Economic Area's wage growth rate of 3% and the national cluster's average wage growth rate of 3.5%.

Exhibit 54. Top Twenty Economic Area Regions for Plastics Employment, 1998

Economic Area	Total Employment 1998	CAGR 1988-1998	Share of National Employment 1988	Average Wages 1988	CAGR of Average Wages 1988-1998
New York-New Jersey, NY-NJ-CT-PA-MA-VT	65,590	-1.59	7.63	\$31,211	4.08
Chicago-Gary, IL-IN-WI	55,652	2.33	6.47	\$32,662	3.58
Los Angeles-Orange County	53,588	-0.33	6.23	\$29,954	3.65
Detroit-Ann Arbor-Flint, MI	42,429	1.62	4.94	\$30,911	3.55
Cleveland-Akron, OH-PA	37,503	1.75	4.36	\$33,756	5.01
Boston-Worcester, MA-NH-RI-VT	31,839	-0.19	3.70	\$32,840	4.50
Dallas-Fort Worth, TX-AZ-OK	28,809	3.00	3.35	\$29,905	4.06
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	25,597	-0.29	2.98	\$36,612	4.30
Houston-Galveston-Brazoria, TX	23,364	2.64	2.72	\$42,373	2.86
Minneapolis-St. Paul, MN-WI-IA	21,393	3.44	2.49	\$28,989	2.22
Grand Rapids-Muskegon, MI	19,736	6.23	2.30	\$30,441	3.06
Atlanta, GA-AL-NC	19,346	3.76	2.25	\$32,480	4.24
Indianapolis, IN-IL	17,694	2.89	2.06	\$33,906	3.41
Milwaukee-Racine, WI	16,849	4.55	1.96	\$34,992	4.39
St. Louis, MO-IL	15,126	5.93	1.76	\$27,869	3.10
San Francisco-Oakland-San Jose, CA	14,653	0.97	1.70	\$30,622	2.02
Washington-Baltimore, DC-MD-VA-WV-PA	13,876	2.13	1.61	\$29,339	3.04
Columbus, OH	13,494	-0.21	1.57	\$33,350	4.29
Toledo, OH	13,195	2.76	1.54	\$25,385	1.28
Louisville, KY-IN	12,338	4.64	1.44	\$47,941	8.45
Wichita, KS-OK #41	5,762	5.72	0.67	\$34,594	6.00

Note: Broad Industries

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

The plastics cluster was the tenth highest paying cluster in 1998 among 26 clusters for narrow industries and 19th among 41 clusters for broad industries. While wage data is available for only three subclusters, plastic products, distribution and petroleum materials, we can detect that the plastic products subcluster is providing the high wages within the cluster. The plastic products subcluster pays 117% of the national average wage for that subcluster. Half of the total cluster's employment is found within the plastic products subcluster.²⁴⁶

Patents.²⁴⁷ The cluster's patents increased from five to eight over the 1988 to 1998 period with an annual growth rate of 4.6% (see Exhibit 55). The 1998 figure represents .2% of the total plastics patents in the country or about a third of what would be expected, given the Economic Area's share of national employment (.67%). The plastics cluster's one patent per 1,000 employees is 28% of the national average per 1,000 workers for the cluster.

The plastics cluster had .4 cited patents per 1,000 employees, which was roughly 22% of the national average for the cluster. Seven and a half percent of Wichita's plastics patents registered from 1993 to 1997 were cited in 1998.²⁴⁸ Interviewees reported that low patent activity in the cluster is due to the composition of firms and types of products manufactured in the Economic Area. With the exception of the Coleman Company, which had the highest number of cumulative patents registered among all companies over the 1994 to 1998 period, the Wichita cluster is generally focused on consumer products, which are less likely to be patented than plastic resin formulations or composites, for example.

Exhibit 55. Total Patents and Patent Growth of Select Plastics Economic Areas

Economic Area	Total Establishments 1988-1998	CAGR of Establishment 1988-1998	Total Patents 1988	CAGR of Patents 1988-1998
New York-New Jersey, NY-NJ-CT-PA-MA-VT	1,288	-1.90	519	1.47
Chicago-Gary, IL-IN-WI	869	1.13	203	3.37
Los Angeles-Orange County, CA-AZ	1,162	-0.91	264	6.63
Detroit-Ann Arbor-Flint, MI	567	0.72	214	2.99
Cleveland-Akron, OH	504	0.96	145	1.26
Boston-Worcester, MA-NH-RI-VT	593	-0.25	175	5.27
Dallas-Fort Worth, TX-AR-OK	407	0.76	59	5.85
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	386	-1.04	254	4.75
Houston-Galveston-Brazoria, TX	299	2.74	138	2.24
Minneapolis-St. Paul, MN-WI-IA	365	2.13	181	7.71
Grand Rapids-Muskegon, MI	214	3.00	26	6.61
Atlanta, GA-AL-NC	291	1.61	91	11.02
Indianapolis, IN-IL	186	2.24	41	7.43
Milwaukee-Racine, WI	223	1.34	35	4.59
St. Louis, MO-IL	190	1.16	52	8.74
San Francisco-Oakland-San Jose, CA	359	-0.93	177	5.57
Washington-Baltimore, DC-MD-VA-WV-PA	157	0.05	72	5.95
Columbus, OH	133	1.21	44	-0.77
Toledo, OH	120	0.48	24	1.40
Louisville, KY-IN	104	3.04	9	-3.81
Wichita, KS-OK #41	60	1.38	8	4.61

Note: Broad Industries

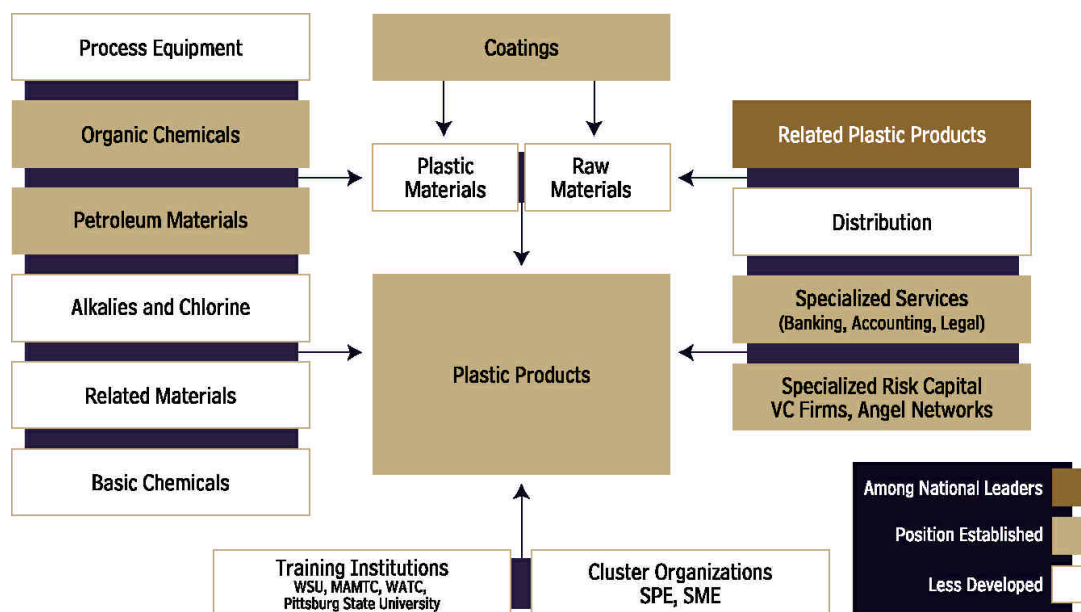
Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Investments/VC Funding. Plastics firms received no formal venture capital funding during the study period.

Establishments.²⁴⁹ Wichita had 60 plastics cluster establishments in 1998, growing at an annual rate of 1.38% (see Exhibit 55). Compared to the top 20 plastics clusters, Wichita's annual establishment growth rate would be ranked seventh.

Important firm losses during the last ten years were CAC Tool and Wichita Tool, both mold making firms, and the important injection molder, Casco. Ken Fisher, Senior Vice President, Supply Chain for the Coleman Company, said that in order for the cluster to grow, another large manufacturer on the scale of the Coleman Company must set up operations in Wichita.²⁵⁰

Exhibit 56. Wichita Plastics Cluster



Source: Cluster Mapping Project, Initiative for Strategy and Competitiveness, Harvard Business School Interviews
Clusters of Innovation Initiative Regional Opinions Survey

DESCRIPTION OF THE REGIONAL PLASTICS CLUSTER

Wichita's plastics cluster is even narrower than the region's aerospace vehicles and defense cluster, as 42% of the cluster's employment is found in the plastics products, n.e.c. industry. Cluster narrowness explains the cluster's limited innovation output as measured by patents. Reliance on one industry also raises concerns for this cluster and the regional economy as a whole because the products produced in the plastics products, n.e.c. industry are relatively simple and are subject to price competition.²⁵¹

The Wichita plastics cluster is shown in Exhibit 56. Four boxes (Specialized Services, Specialized Risk Capital, Training Institutions, Cluster Organizations) represent related organizations and institutions that are important components of clusters overall. They are assessed qualitatively through interviews and surveys. The remaining boxes are the industry-based subclusters present in the region, and their relative

strength has been statistically assessed through the CMP data set. Key organizations and institutions include the Society of Plastics Engineers, Pittsburgh State University's Institute of Polymer Research, Wichita State University, Wichita Area Technical College, the Kansas Technology Enterprise Corporation, the Mid-America Manufacturing Technology Center, the Wichita Chamber of Commerce, and the Wichita Manufacturers Association. The remaining boxes in Exhibit 56 are the industry-based subclusters present in the region, and their relative strength has been statistically assessed through the CMP data set.

The focus of the Wichita plastics cluster is on manufacturing of plastics products and related products for businesses and consumers. The region is home to a number of petroleum producers and chemical companies, which explains the competitive position of the organic chemicals and petroleum materials subclusters. Wichita is also competitive in coatings. The cluster is less developed in raw material inputs, distribution, plastic materials, basic chemicals, related materials, alkalies and chlorine, and process equipment.

Exhibit 57 shows the relative size and growth of the plastics subclusters in Wichita. The exhibit reveals the extremely high concentration of employment in the plastics products subcluster — 50% of the cluster's total employment can be found in this one subcluster. The plastics products subcluster was one of four subclusters that had both positive employment growth and high national share of subcluster employment (i.e., above the Economic Area's share of national employment of .43%). The other three subclusters are coatings, organic chemicals, and related plastics products.

Compared to the largest plastics clusters by Economic Areas, Wichita had a strong position in two subclusters—plastics products (ranked 37th) and petroleum materials (ranked 15th) (see Exhibit 57). These were the only two subclusters within the plastics cluster that performed better than the overall cluster ranking of 41 when compared to other large plastics clusters in the nation.²⁵²

Exhibit 57. Subcluster Rankings of 20 Largest Economic Areas, 1998

Economic Area	Plastic Materials	Plastic Products	Coatings	Raw Materials	Alkalies and Chlorine	Basic Chemicals	Distribution	Organic Chemicals	Petroleum Materials	Process Equipment	Related Materials	Related Plastic Products
New York-New Jersey, NY-NJ-CT-PA-MA-VT	12	1	2	15	28	8	1	3	36	2	1	2
Chicago-Gary, IL-IN-WI	6	3	1	23	Nil	6	3	12	14	8	2	3
Los Angeles-Orange County, CA-AZ	10	2	4	8	19	7	2	20	3	5	6	1
Detroit-Ann Arbor-Flint, MI	3	4	7	6	Nil	71	4	5	39	10	3	10
Cleveland-Akron, OH-PA	14	5	3	7	12	14	8	10	30	6	4	4
Boston-Worcester, MA-NH-RI-VT	13	6	17	16	19	36	11	9	81	1	5	11
Dallas-Fort Worth, TX-AR-OK	22	7	8	11	28	23	9	13	4	14	14	6
Philadelphia-Wilmington, PA-NJ-DE-MD	4	10	6	13	11	9	5	11	7	3	10	5
Houston-Galveston, TX	1	18	13	3	2	4	7	1	1	11	23	12
Minneapolis-St. Paul, MN-WI-IA	68	8	26	53	Nil	72	10	37	37	4	11	20
Wichita, KS-OK	Nil	37	47	Nil	Nil	74	68	29	15	63	95	57

Note: Economic Areas, narrow industries

Source: Cluster Mapping Project, Initiative for Strategy and Competitiveness, Harvard Business School

The narrowness of the cluster is revealed when we examine industry employment in Exhibit 58. One industry, the plastics products, n.e.c., accounted for 42% of the cluster's entire employment. Those who work for the Coleman Company, Rubbermaid, and the many smaller plastic blow and injection molding companies contribute to this anchor industry.

Other important industries in terms of employment include crude petroleum and natural gas and petroleum refining, both found within the petroleum materials subcluster, and industrial organic chemicals, n.e.c., part of the organic chemicals subcluster. In addition to the plastics products, n.e.c. industry, fast growing industries include the custom compound purchased resins also found in the plastics products subcluster and the unsupported plastics profile shapes industry in the related plastics products subcluster. Notable employment declines were seen in the crude petroleum and natural gas industry, part of the petroleum materials subcluster, and the plastics foam products industry, found within the plastics products subcluster.

Exhibit 58. Wichita Economic Area Plastics Cluster Industries

Sub-Cluster	SIC Code	Industry	National Industry Percent Share 1998	Total Employment 1998	CAGR of Total Employment 1988-1998
Overall Cluster			0.80	11,239	2.7%
Plastic Materials*	2821	Plastics materials and resins	0.00	0	
Plastic Products*	2673	Bags: plastic, laminated, and coated	0.00	0	-100%
	3081	Unsupported plastics film and sheet	0.80	435	1.5%
	3083	Laminated plastics plate and sheet	0.19	30	-6.7%
	3086	Plastics foam products	0.10	70	-23.3%
	3087	Custom compound purchased resins	0.63	175	33.1%
	3089	Plastics products, n.e.c.	0.92	4,788	11.6%
Coatings*	2850	Paints and allied products	0.50	264	0.7%
Raw Materials*	2822	Synthetic Rubber	0.00	0	-100%
Distribution	5612	Plastics materials and basic shapes - wholesale	0.23	98	-0.8%
Organic Chemicals	2869	Industrial organic chemicals, n.e.c.	0.85	867	1.1%
Alkalies and Chlorine	2812	Alkalies and chlorine	0.00	0	
Basic Chemicals	2819	Industrial inorganic chemicals, n.e.c.	0.14	86	
Related Plastic Products	3082	Unsupported plastics profile shapes	1.22	350	11.3%
	3084	Plastics pipe	1.54	268	0.9%
	3085	Plastics bottles	0.23	80	2.9%
	3088	Plastics plumbing fixtures	0.11	20	0.0%
Petroleum Materials	1310	Crude petroleum and natural gas	1.97	1,693	-3.6%
	2895	Carbon black	3.36	60	0.0%
	2910	Petroleum refining	2.70	1,875	2.4%
Related Materials	2843	Surface active agents	0.00	0	
	2891	Adhesives and sealants	0.05	10	0.0%
Process Equipment	3823	Instruments for process measurement	0.14	70	

* Denotes a unique industry, shading indicates industry with a higher than expected concentration (i.e., > 24% of the nation's employment)

Source: Cluster Mapping Project, Initiative for Strategy and Competitiveness, Harvard Business School

CLUSTER INNOVATIVE CAPACITY

The plastics cluster benefits from a sophisticated buyer and prominent anchor company, the Coleman Company, availability of high-quality suppliers, high rivalry, and a labor base with solid manufacturing skills. Weaknesses for the cluster include cluster narrowness, firms that produce relatively simple plastic products, a constrained labor supply, the lack of research partnerships, and weak cluster cohesiveness and institutions for collaboration. Plastics firm members are aware of the weaknesses and emerging nature of the cluster. Only seven percent of those surveyed in the plastics cluster considered the physical location of Wichita to be a very beneficial factor for their firm to innovate.²⁵³ Our analysis suggests a cluster that demonstrates limited innovative capacity at this time.

Specialized Educational Institutions and Talent Pool. Wichita plastics firms have four options for specialized workforce training programs. In addition to the Mid-America Manufacturing Technology Center (MAMTC), which offers seminars and field technical assistance to manufacturing firms, WSU, and the Wichita Area Technical College's manufacturing-related courses and customized, skills-based education programs, workers in the plastics cluster benefit from Pittsburgh State University's highly specialized plastics curriculum. Pittsburgh State University offers a Plastics Engineering Technology degree. Pittsburgh State also serves as a talent pool for plastic companies located in south-central and south-eastern Kansas. For example, four of the Coleman Company's managing engineers were educated at Pittsburgh State University. Survey respondents were satisfied with the caliber of both the teaching and training at these facilities. Sixty-nine percent of the plastics executives said that the advanced educational programs provided high-quality employees.²⁵⁴

However, even with these educational assets and the more general assets, plastics cluster leaders were concerned about the supply of skilled labor in the region. Only 38% said that the pool of skilled workers was ample to meet the expansion needs of their firms.²⁵⁵ The responses decreased to 31% when those surveyed were asked about the supply of scientists and engineers in the region. While interviewees said that scientists were in shorter supply, cluster participants were most concerned about the effect of availability and associated cost of labor on their ability to expand in the next five years.²⁵⁶ For example, McPherson-based Ferguson plastics' labor problem is so acute that the company is forced to bus workers in from Wichita.²⁵⁷ A contributor to the low availability of workers is competition from the fast-growing aerospace vehicles and defense cluster. "Wichita has a dynamic pool of skilled workers because of the training from the aerospace vehicles and defense industry. But when all aviation companies are booming, aerospace vehicles and defense can suck up labor," said Fisher from the Coleman Company.²⁵⁸

Competition for labor may explain the fast-rising wages in the Wichita plastics cluster. Wage concerns were confirmed through interviews and other surveys conducted by the Wichita Area Chamber of Commerce. Perhaps because of their worry about the availability of skilled talent and the rising costs of labor, cluster leaders considered primary and work-based education and training as the most important priorities for government action.²⁵⁹

Specialized Research Centers. Pittsburgh State University's Kansas Polymer Research Center is available to the Wichita plastics cluster but it is located about 100 miles away in southeast Kansas. The Polymer Research Center's mission is to provide research and product development services and attract polymer industry development to southeast Kansas. The Center's focus is on the raw materials that go into plastics rather than plastics manufacturing processes or end products. To date, the Center has not worked

with any Wichita plastics firms.²⁶⁰ Executive Director Phil Helstead said that Wichita's plastics firms are manufacturing companies that use "off-the-shelf" ingredients and do not put an emphasis on polymer research and development. "Most innovation occurs with the resin makers [which are not based in Wichita],"²⁶¹ said Steven Sutherland, President, National Plastics Color, Inc., a supplier to the Coleman Company.

Helstead said that they would like to do more with Wichita firms but the Center has a limited marketing budget.²⁶² The other available research institution in the area, NIAR, has a nationally recognized composites and advanced materials laboratory that specializes in composite manufacturing processes and materials testing for certifications programs. However, NIAR does not work with any of the few composite producers in Wichita.²⁶³

Research facilities were not considered conveniently available or markedly relevant to the plastics cluster. Only 41% of those surveyed in the plastics cluster said they had ready access to local research centers (31% answered that research facilities were limited, 28% gave a neutral response) and 48% said these research institutions rarely transferred knowledge (21% answered frequently, 31% gave a neutral response).²⁶⁴ The importance of specialized research facilities was not widely mentioned during interviews. The Coleman Company, which self-reports high investment in research and development,²⁶⁵ does not generally collaborate with research centers (with the exception of very limited work with WSU) to improve existing products or invent new ones.²⁶⁶ The Coleman Company perceived that working with a research facility would slow down their aggressive annual product launch schedule.²⁶⁷

Context for Firm Strategy and Rivalry. The Wichita plastics cluster exhibits high competitive rivalry. While survey respondents did not view their cluster as being as competitive as the aerospace vehicles and defense cluster, almost 60% of those surveyed said they considered regional competition as intense (responses ranged from 43% to 71% for four other regions that responded to this question). About 50% of those surveyed said that the number of regional competitors was high.²⁶⁸

International competition, in the form of less expensive wages, is increasing among the consumer product side of the injection molded and blow molded manufacturers such as Rubbermaid and the Coleman Company. As an example, Ferguson plastics, based in nearby McPherson, has lost customers due to competition in Mexico and China.²⁶⁹

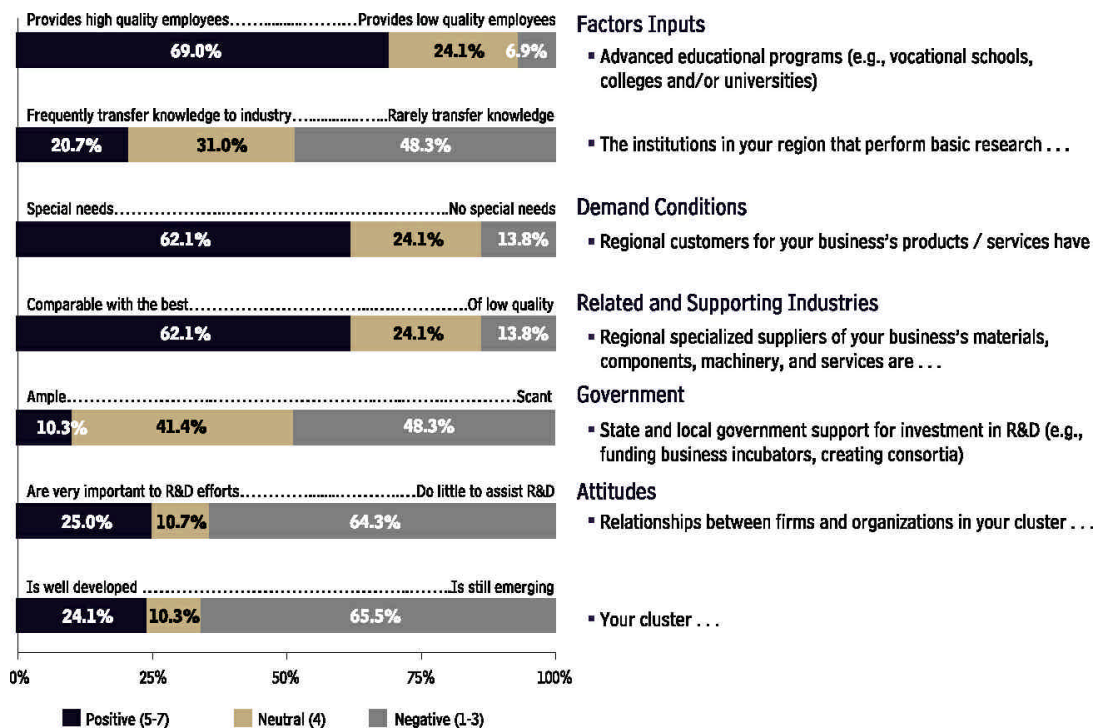
Sophistication of Regional Demand. According to those surveyed, the level of regional demand for plastics products is relatively limited. However, the sophistication of regional demand by plastics customers seems to be an enabling element for innovation. Sixty-two percent of plastics cluster leaders believed that their customers' special needs influenced their product offerings. A majority of those interviewed also said that their customers were sophisticated and provided feedback.²⁷⁰ Sophisticated customers in the region include Coleman, Rubbermaid, Wescon, Seeber Manufacturing (vacuum forming), Vornado Company (plastic fans), and Winfield Consumer products.

Related and Supporting Industries. While plastics cluster firms were not completely satisfied with the availability of suppliers, they were more content with the quality of those that exist. Cluster leaders were split on the issue as to whether specialized suppliers of components, materials, and services were mostly available in Wichita. However, 66% thought that these suppliers were comparable with the best elsewhere. This positive assessment is limited. More cluster leaders said that suppliers did not assist with new products or processes than those who said suppliers did assist (45% versus 41%).²⁷¹

The Coleman Company relies relatively little on regional supporting firms. It sources the majority of its supplies overseas and then actually makes roughly 90% of the components at the company site. However, there are firms that are dependent on the Coleman Company's continuing business.²⁷² "One management change could increase or decrease our business substantially," said Norlan Ferguson of Ferguson Plastics.²⁷³

Government. Plastics cluster participants gave a poor rating to local and regional government policy vis-à-vis their cluster. A majority of those surveyed said that government's overall responsiveness and ability to work with the needs of business were low. Cluster leaders responded most negatively to the two questions related to government support for research and development. Forty-eight percent of those surveyed said that investment in R&D is actually discouraged by state and regional taxes and incentives (17% said that investment in R&D is encouraged by the state, 35% gave a neutral response). A similar percentage said that state and local government support for investment in R&D (e.g., funding business incubators, creating consortia) is scant (only 10% said that support is ample, 42% gave a neutral response—see Exhibit 59). Few of those surveyed said that the state and regional government regulations were appropriate, and 60% said state and regional environmental standards and safety regulations were strict.²⁷⁴

Exhibit 59. Select Survey Results of the Wichita Plastics Cluster



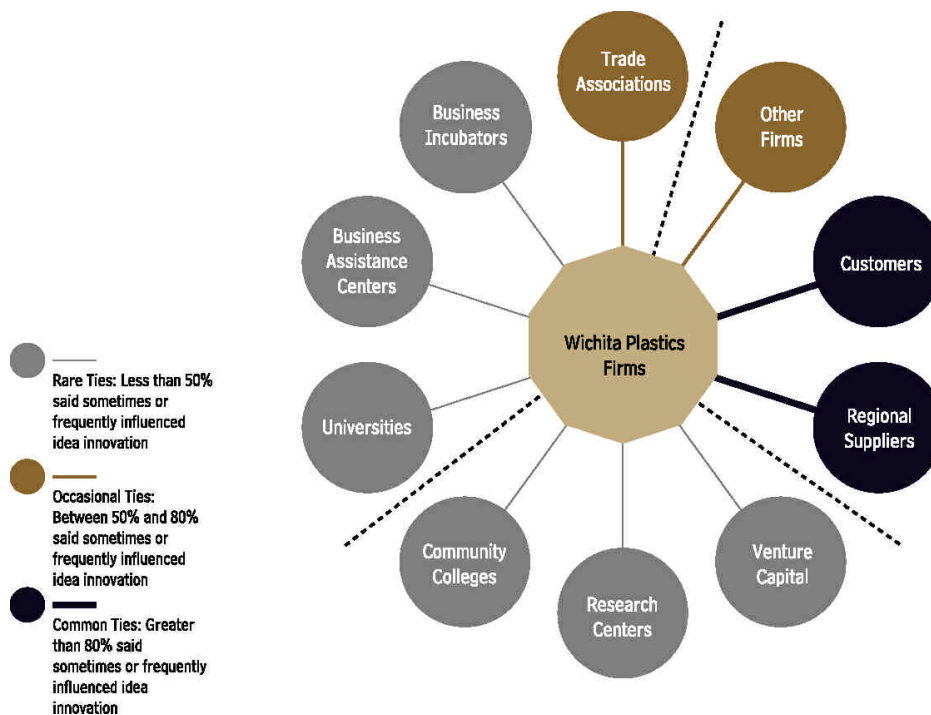
Source: Clusters of Innovation Regional Survey
December 2000 N=30

Institutions for Collaboration. A high percentage of Wichita plastics firms rely on themselves for idea development and commercialization. When they do collaborate on innovation matters, they rely on suppliers, customers, and other firms. Research centers and universities were considered to be much less relevant in the innovation process.²⁷⁵ This would be expected, as Pittsburgh State University's Polymer Research Center is not conveniently located to the Wichita plastics cluster members.

The plastics survey sample was evenly split about the availability of associations and organizations that represent the cluster. Few cluster members thought these organizations were extremely helpful in providing valuable business advice and contacts. For both established and entrepreneurial firms, the most valued organizations were national trade associations and university-based networking organizations. Interactions within these institutions for collaboration may not always be substantial, however. Fifty-five percent of those surveyed said that they infrequently share knowledge (31% said that firms frequently share knowledge; 14% answered neutral). And almost two-thirds said that relationships with other firms and organizations in the cluster did not help with research and development efforts (25% said that firms and organizations are important to R&D efforts; 11% answered neutral).²⁷⁶

Notions of weak cluster institutions for collaboration follow from the fact that there is only one significant national trade association related to plastics in the Wichita area. The relevance of this organization, the Society of Plastics Engineers (SPE), is not particularly strong. In Wichita, the SPE serves members in Sedgwick, McPherson, and Cowley counties. Membership within the SPE has dropped from 150 to 135 during the last three years due to the loss of firms such as Casco, Wichita Tool, and CAC Tool. In

Exhibit 60. Frequency of Interaction among Communications Cluster Members on Idea Generation



Source: Clusters of Innovation Initiative Regional Survey

addition, active involvement by the members is limited to just a few firms.²⁷⁷ Interviewees confirmed a declining relevance of the SPE.

In terms of idea development, plastics firms considered customers and regional suppliers as most important within the innovation network (see Exhibit 60). This underscores the relatively less important role of the Society of Plastics Engineers. There are no organizations that were considered significant innovation partners during the commercialization phase. Other firms, customers and suppliers were acknowledged as occasional innovation partners. As one would expect, the strongest innovation partners, suppliers and customers, received high satisfaction rankings from plastics firms. Surprisingly, two other partners—community colleges and business assistance centers—received even higher accolades from the plastic firms. Business assistance centers include KTEC, the Small Business Administration, Wichita Technology Corporation, the Small Business Development Center, South Central Kansas Economic Development District, MAMTC, the Center for Economic Development and Business Research, and the Wichita Area Chamber of Commerce.²⁷⁸

While plastics executives valued the abstract concept of clusters, they did not view their own as particularly strong, cohesive, or providing unique benefits. Some of those interviewed were surprised that a plastics cluster actually existed and had been selected for this study. The survey confirmed these interview comments: 66% of those surveyed said that their cluster was still emerging.²⁷⁹ Other survey data point to the weak state of this cluster. Almost half of those surveyed stated that the firms in the cluster had no preference for the geographic location of their business partners, a clear signal of weak cluster attitudes. Regarding cluster cooperation, only 21% said that cluster participants frequently contributed to cluster-wide programs (55% said that firms and organizations rarely contributed; 24% answered neutral). Twenty-eight percent said that new entrants to the cluster were welcomed as equals (35% said that cluster members are unwilling to accept new members into cluster activities and organizations; 38% answered neutral).²⁸⁰

CONCLUSION

The Wichita plastics cluster is instructive for small, manufacturing-based clusters in the country (see Exhibit 61). Individual companies such as the Coleman Company demonstrate the importance of an original anchor firm to build a supply base and create cluster elements such as a local chapter of a national trade association, specialized educational and training programs, and some limited cluster cohesiveness. This analysis also exposes cluster gaps and weak points. Like aerospace vehicles and defense, narrowness marks this cluster, as it depends heavily on only one industry, plastics products, to maintain its employment base. There has been a declining number of plastics establishments in the region. Since the cluster produces relatively simple products, firms often compete on price. A plastics research center exists in the state, but its raw material focus and location limit greater use. The cluster is not innovating at a sufficient rate to improve productivity, thus engendering prosperity. The cluster lacks critical cohesiveness in terms of attitudes and institutions for collaboration. An existing chapter of a national trade association is not highly relevant. Firms do not commonly look to other competing firms or suppliers for partnership opportunities.

Looking forward, executives are highly concerned about access and costs of skilled workers but have not yet developed a coordinated workforce development plan that could develop workers more effectively. As wages rise, firms may be motivated to move operations outside of the Wichita economic area to gain access

to cheaper labor. The Wichita plastics cluster requires more active involvement by its members to build the network of supporting industries and perhaps capitalize on the presence of such advanced factors as the existing research facility in the region. The local chapter of the Society of Plastics Engineers, anchor firms within the cluster, or the Wichita Area Chamber of Commerce could take the lead in helping to improve collaboration among the plastics firms in the region.

Exhibit 61. Summary Assessment of Wichita's Plastics Innovative Capacity

Elements of Diamond	Strengths	Challenges
Basic and Specialized Factor Inputs	<ul style="list-style-type: none"> Plastics curriculum at Pittsburg State University Polymer research institute at Pittsburg State University 	<ul style="list-style-type: none"> Low levels of R&D investment, and limited use of existing local research
Context for Firm and Strategy Rivalry	<ul style="list-style-type: none"> Two nationally recognized firms located in the region Competition among regionally based rivals, particularly among injection molding companies 	<ul style="list-style-type: none"> Cluster is narrow, relying on only one industry for bulk of employment For the most part, relatively simple products manufactured
Related and Supporting Industries	<ul style="list-style-type: none"> Suppliers of satisfactory quality 	<ul style="list-style-type: none"> Little feedback from local suppliers on innovation Limited supplier base
Regional Demand	<ul style="list-style-type: none"> Sophisticated and demanding local buyers 	<ul style="list-style-type: none"> Potential of local demand has not been fully realized
Government Policy		<ul style="list-style-type: none"> Low levels of federal and state government funding for basic research
Quality of Linkages	<ul style="list-style-type: none"> Small community allows for informal networking 	<ul style="list-style-type: none"> Lack of regional cluster organization Cluster awareness is low Local assets not well linked or utilized

SUSTAINING COMPETITIVE ADVANTAGE: ACCOMPLISHMENTS AND ASSETS, LESSONS, CHALLENGES, AND OPPORTUNITIES

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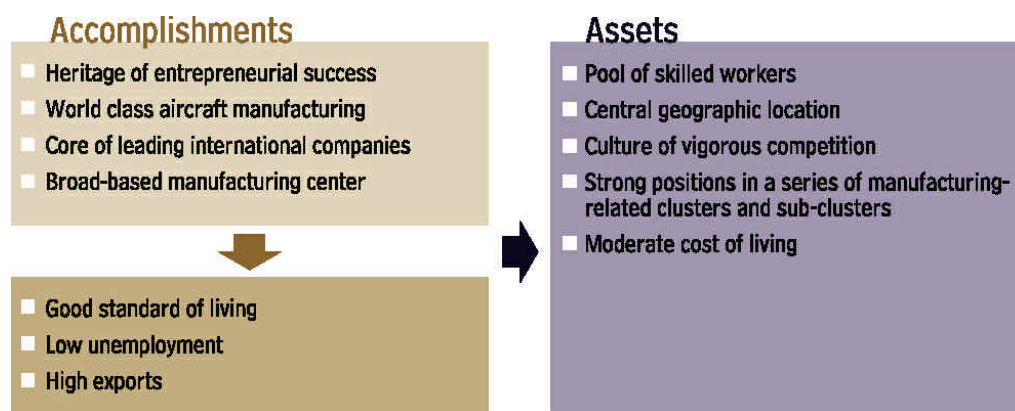
ACCOMPLISHMENTS AND ASSETS

Starting with only a few basic advantages, including a central geographic location and weather conditions amenable to flying, Wichita's economy has grown steadily over the last 80 years. Much of Wichita's modern success is owed to the early entrepreneurs who innovated in profound ways, building important and, in some case, global business. Today, these businesses serve as anchors to the region's well-known aircraft and plastics clusters.

Wichita, however, has developed a surprisingly diverse economy. A number of other large and fast-growing but relatively low-profile businesses such as lighting and electrical equipment, heavy construction services, motor driven products processed foods, heavy machinery, chemical products, building fixtures, equipment and services, agricultural products, and distribution services, and power generation have distinguished Wichita as a broad-based manufacturing center.

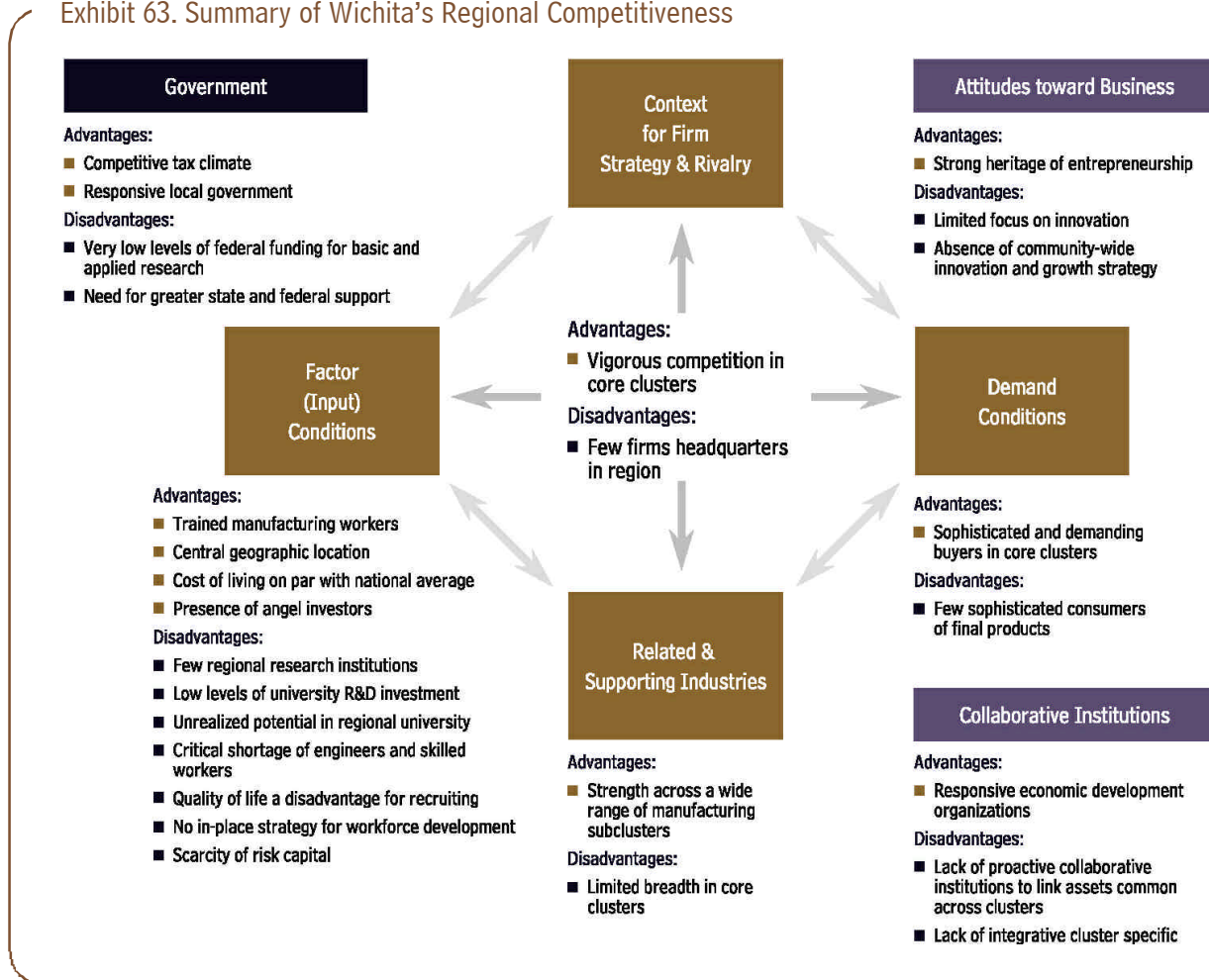
The region's strength in manufacturing has produced a good standard of living, relatively high wages, low unemployment, and high exports per capita. Wichita also has a moderate cost of living and assets that include a pool of skilled workers, a culture of vigorous competition, and strong positions in a series of manufacturing-related clusters and subclusters.

Exhibit 62. Wichita's Accomplishments and Assets



However, the regional economy confronts significant challenges. The region is facing a shrinking workforce and relatively few new firms are being formed. Wichita's good wages and steady economic growth are mainly the result of past innovation, and Wichita is lagging today as an innovation center. In order to grow, or even maintain economic prosperity, the region needs to improve its innovative capacity through greater R&D spending, greater investments in local research and development institutions, enhanced workforce training, and more institutions for collaboration. A bold, highly coordinated economic development strategy will be needed if Wichita is to sustain its success over the coming decade. Exhibit 63 summarizes the innovative capacity of the region using the diamond framework.

Exhibit 63. Summary of Wichita's Regional Competitiveness



LESSONS

Wichita's economic development offers a number of important lessons for other regions.

- Successful economic development leverages a region's natural and other distinctive assets. Wichita prospered because of the presence of oil, which created local capital used to finance many early entrepreneurs. Wichita's growth was built on aircraft, which benefited from a central location, flat land, good winds, and excellent year-round flying weather. City leaders leveraged these assets by building an airfield well before anyone realized how important commercial air travel would become and, later, by attracting Cessna and Lear. Today, the presence of a wide range of manufacturing clusters and industries represents another rare asset upon which local leaders can build.
- Entrepreneurial leadership is at the core of economic growth. The success of entrepreneurs such as Cessna, Lear, Beech, Koch, Coleman, and the Carney brothers underpins the Wichita economy, and has created a regional culture that encourages start-ups. Wichita's success is built on the risky decisions and hard work of entrepreneurs in plastics, restaurant franchising, chemicals, oil and gas, and other fields.
- Innovation underpins competitive advantage. Perhaps no region in the country better illustrates this lesson than Wichita. Commercial aviation innovations were dominant in Wichita's current prosperity. Coleman's innovative use of plastics and novel designs are another example. The proliferation of service franchises (e.g., Pizza Hut, Pappa John's, Rent-A-Center, Taco Tico, Candlewood Hotel Co., BriteVoice, Inc., and Residence Inns) is yet a third case.
- Anchor firms have a disproportionate influence on an economy. Wichita's economy is composed of a few large and powerful anchor firms. In aircraft, world-class companies such as Boeing, Cessna, Bombardier, and Raytheon Aircraft have driven growth and triggered supplier development. Coleman and Rubbermaid play a similar role in the plastics cluster. Interviewees cite these multinational companies as bringing in new people and ideas that benefit the regional economy. Similarly, anchor companies spinoff other companies that tend to feed the parent. For example, former aerospace and defense workers also have started machine shops that now supply these firms. The skills sets dominant within the anchor firms largely determine the character of the spin-off and greatly influence the make-up of the cluster.
- Clustering creates unique labor pools and other assets. Aircraft firms are the first to admit that their workers tend to circulate among the four key manufacturers. This labor rotation and the resulting thick labor market are considered to be advantages of doing business in Wichita. The combination of manufacturing-based skills in tooling, machining, metal work, and the like and an entrepreneurial culture has fostered suppliers serving the aerospace cluster, as well as attracting investments in other manufacturing clusters.
- Cluster breadth and depth are essential to sustained vitality. Wichita has an exceptionally strong position in aerospace vehicles and significant positions in 13 other clusters. While the region has a relatively broad set of manufacturing-oriented clusters, they tend to be concentrated. A challenge for Wichita is how to deepen its position in upstream and machinery businesses supporting its manufacturing firms.
- Spillovers across clusters spur new business formation and economic development. Clusters beget other clusters, as interactions across disciplines seed new lines of business. The aerospace vehicles

and defense cluster spurred the development of the plastics cluster in Wichita, together with Wichita's presence in chemicals. Chemicals grew out of oil and gas. Wichita's clusters are surprisingly inter-related.

- Specialized R&D is required for success in the new knowledge economy. To sustain traditional clusters and develop newer clusters like biotechnology/pharmaceuticals, medical devices, communications, and information technology, a region must be a place where firms invest in research and development, and where specialized research centers and pools of scientists and technologists develop. Wichita must develop best-in-class expertise in such fields as advanced plastics and materials, aerospace engineering, industrial engineering, applied engineering, and so forth. Mechanisms are needed to transfer technology beyond anchor firms and research institutions to local entrepreneurs.

CHALLENGES

Wichita faces challenges to its long-term economic prosperity. A majority of those surveyed in the region said that they did not consider Wichita to be a beneficial location for innovation.²⁸¹ In an age when a regional anchor like Boeing can leave an established city like Seattle, Wichita must do all it can to improve its business environment, strengthen its clusters and build its overall innovative capacity.

Some of the challenges listed below are similar to ones identified in the early 1970s by a Sedgwick County economic development committee and match closely with findings from the Long Range Planning Task Force of 1996–1997. Laudable efforts have been made to address problems with infrastructure and K-12 education, while the government is attempting to address problems with air service. Other challenges are recognized, but a renewed commitment will be needed to solve them. As Allen Bell said, “The status quo is not an option. We need to meet the needs in terms of the population or companies will move.”²⁸²

Dependency on the Employment and Wages of the Aircraft Subcluster. Aerospace employs close to 20% of all traded employment in the Wichita economic area. Wichita ranks second out of ten metros with concentration in terms of aircraft and parts. While Wichita's economy is less concentrated than it was in the 1970s, aircraft's impact on the economy makes it susceptible to downturns. The Milken Institute ranked aircraft and parts as the second most sensitive to recession after computer and office equipment. Wichita is ranked fourth in terms of metro areas sensitive to “high-tech recession” because of its concentration in aerospace vehicles and defense.²⁸³

Community leaders have recognized the need for diversification for decades. To broaden the aerospace vehicles and defense cluster, the city's Long Range Planning Task Force suggested that WSU develop degree programs for manufacturing occupations and programs for air services such as flight training, aircraft maintenance, and aircraft marketing and sales. We strongly concur. The city and the Chamber of Commerce, in particular, are targeting business recruitment efforts toward non-aviation manufacturing companies and high-technology firms. Efforts by the Wichita Area Chamber of Commerce's World Trade Center to help a wider range of small and medium-sized business export their products are important and should be intensified.

It is important to note that future downturns may be tempered by shorter delivery schedules among the aerospace vehicles and defense cluster players. Boeing has reduced its delivery time for the 737 from 15 to ten months.²⁸⁴ Longer-term supply contracts for planes will also smooth out ups and downs within the cluster and facilitate better labor deployment. In addition, fractional ownership of business aircraft may also help to cushion downturns. The Center for Economic Development and Business Research at WSU predicts that Wichita's economy will cycle more closely with the national economy.²⁸⁵

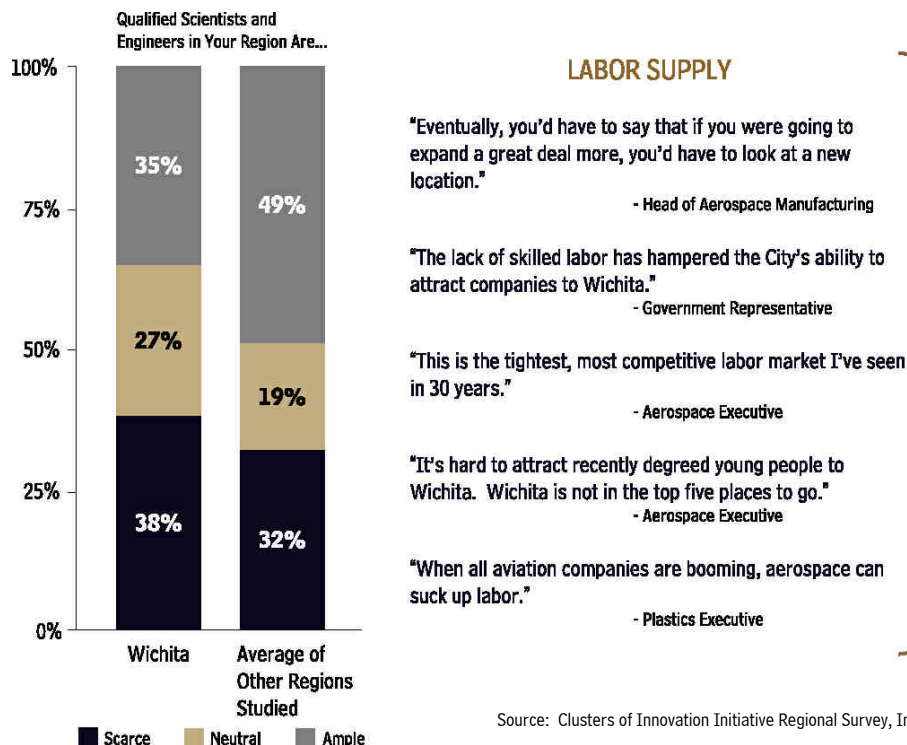
Quality and Quantity of Human Resources. Out of a list of 15 factors, community and business leaders overwhelmingly chose access to skilled labor as the number one barrier to firm expansion. Wichita has a particular problem with skilled labor. The percentage of available scientists and engineers is lower than the national average. Exhibit 64 summarizes commentary about the labor supply issue in the region and compares survey responses from Wichita executives to the other studied regions.

A related concern is the increasing cost of labor. If workers become scarce and expensive, there will be little reason to stay in Wichita, and it might make sense to move final assembly abroad. Of the five regions in the Clusters of Innovation Initiative, Wichita ranked second in terms of low availability of labor as a future threat to the region.²⁸⁶

The region needs a comprehensive workforce development strategy. To date, economic development efforts in Wichita have tended to focus on infrastructure, supporting the aviation industry, recruiting new firms, and improving quality of life. Except for the K-12 school bond vote, there has not been commensurate attention on a workforce development strategy. (A workforce development board does exist, but an integrated strategy has yet to emerge.) Initial plans for a state-of-the-art aerospace workforce facility and program, currently under discussion among the region's aerospace firms, the city of Wichita, and the Wichita Area Chamber of Commerce, are right on target and should be given full support by local and state economic development players.

Wichita State University should be a key component of any workforce initiative. WSU may be able to take a leading role in the aerospace workforce development initiative. In addition, WSU could investigate some of the aviation management programs suggested by cluster leaders. In the plastics cluster, a partnership with Pittsburgh State University could be highly desirable. University assets need to be expanded in other fields, such as advanced materials, production technology, and others where skills are sorely needed.

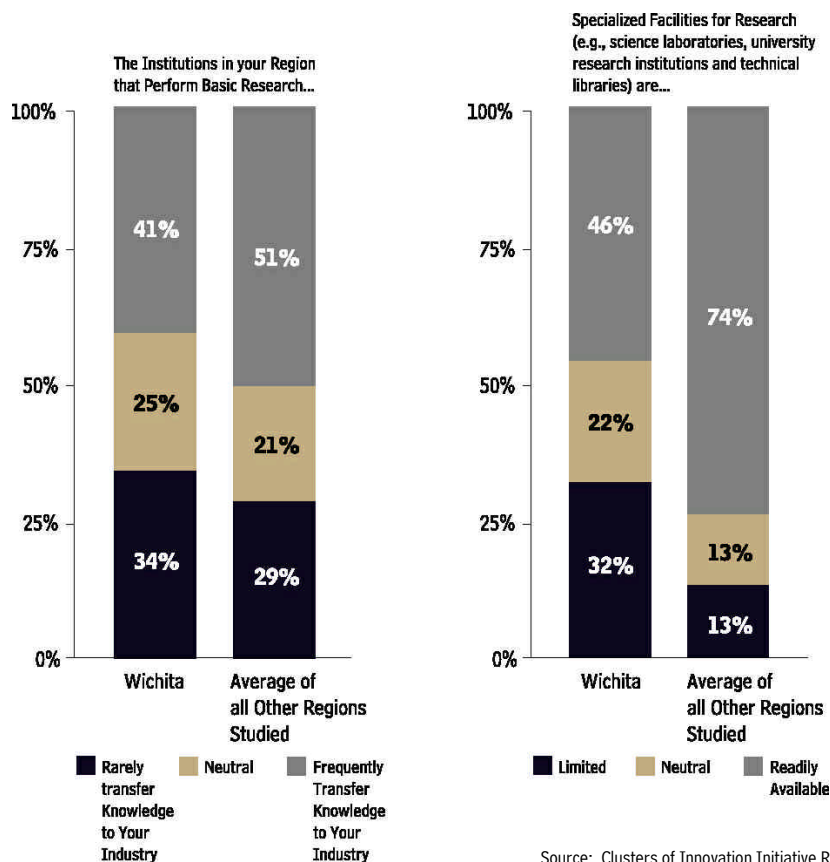
Exhibit 64. Wichita's Challenges: Limited Labor Supply



Low Rate of Innovation. Wichita's economy lags in research and development, a fundamental driver of competitiveness in the modern economy. Compared to all respondents participating in the Clusters of Innovation Initiative, Wichita's were less likely to report that specialized facilities for research were readily available and that research institutions frequently transferred knowledge (see Exhibit 65). Wichita's patent output is roughly half the national average on a per capita basis. Overall, federal and state funding for R&D is extremely low on a per worker basis as compared to the University of Kansas and Kansas State University.

Wichita's sole R&D facility, the National Institute for Aviation Research, is respected and plays an important role in helping the region's aerospace vehicles and defense anchor firms improve manufacturing processes, win certification, test materials, and address safety issues. However, the Institute lacks a national profile, has registered few patents, is not considered to be mission critical to the aerospace vehicle and defense manufacturers, has limited focus on commercialization of its findings, and does not regularly transfer technology to cluster entrepreneurs. According to interviewees, NIAR and WSU have not fostered an innovation culture where the faculties have the interest or motivation to commercialize ideas. Interviewees also mentioned that WSU does not share the same competitive and fast-paced culture as the aerospace vehicles and defense firms themselves. To be relevant to the industry, NIAR may need to adopt more of the culture of the firms it wants to support.

Exhibit 65. Wichita's Challenges: Low Rate of Innovation

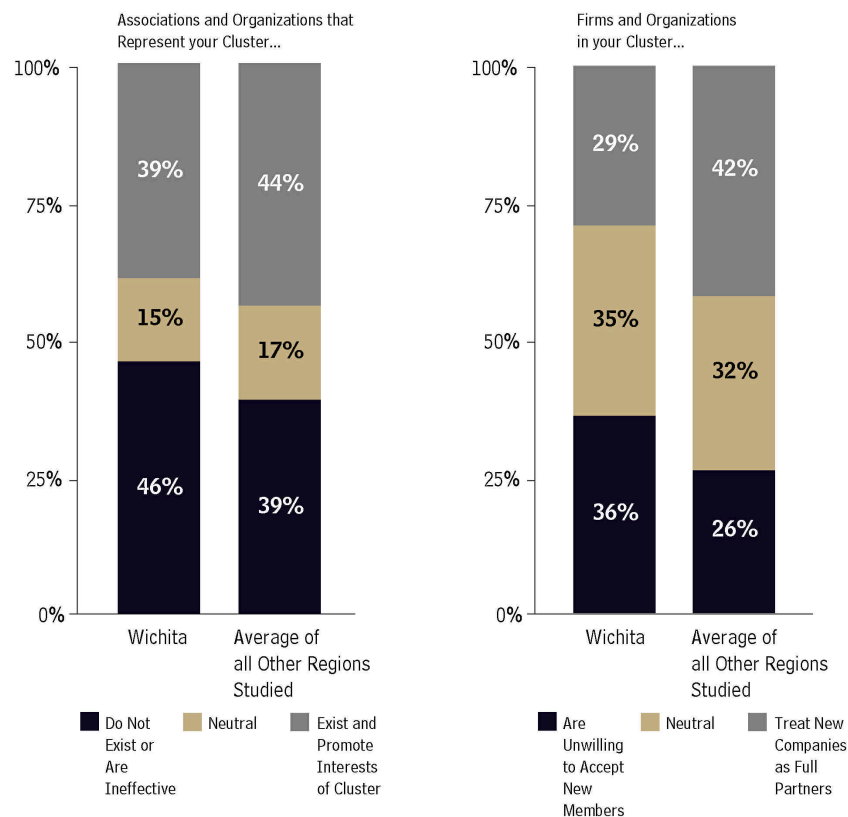


NIAR would benefit from more funding, which is notably limited from the federal government. Unfortunately, among the regions studied in this report, Wichita respondents were the least likely to want government to increase funding for university-based or specialized research centers during the next five years.²⁸⁷

Limited Cluster Thinking. Wichita has exhibited limited cluster mindedness. The case can be made within both established and emerging clusters. The aerospace vehicle and defense cluster is well developed, but has not taken full advantage of existing assets in the region or undertaken important collective efforts such as training. There is no umbrella cluster organization as in other locales. A high degree of competition within the general aviation business could account for the failure to take advantage of all cluster benefits.

To its credit, the city of Wichita recognized the importance of cluster development in the Diversified Economy committee of the 1997 Wichita Area Long Range Planning Task Force. The committee identified five other clusters: electronics, agricultural chemicals and equipment, fabricated material products, printing, and food processing.²⁸⁸ The Task Force recommended that the region's aircraft manufacturers and WSU work together to attract business involved in air services such as flight training, aircraft maintenance training, aircraft sales, and aircraft-related publications/media. The Task Force also noted that the region's aircraft manufacturers could support non-aircraft-related business such as light rail cars and recreational vehicles. These are all sound recommendations.

Exhibit 66. Wichita's Challenges: Collaborative Attitudes

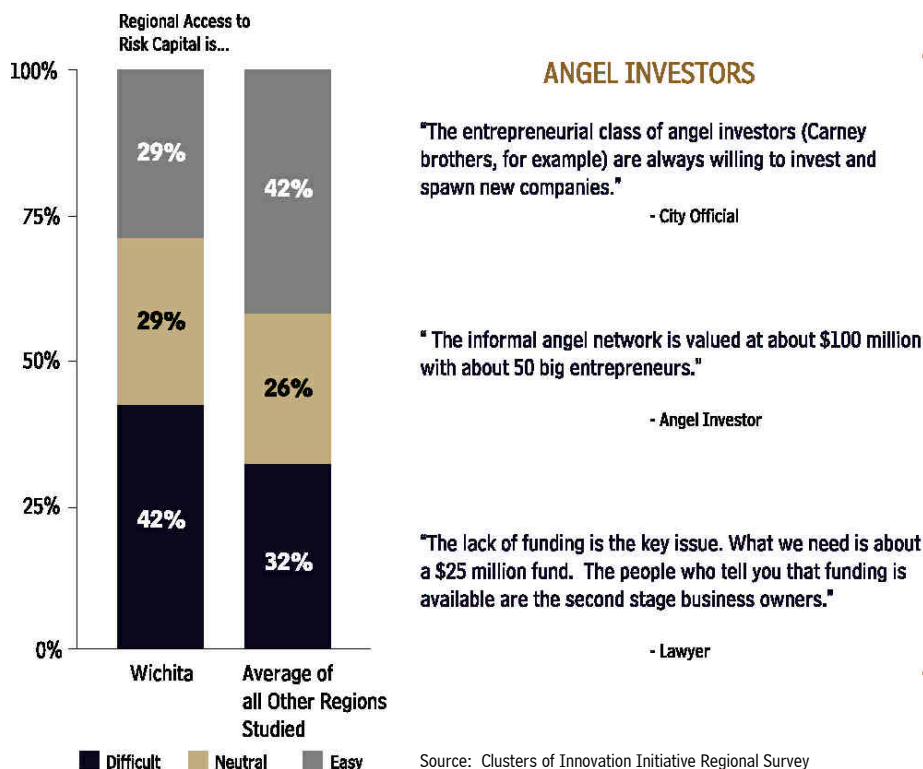


Source: Clusters of Innovation Initiative Regional Survey, Interviews

However, there has been limited action. There is still much that can be done to improve existing or nascent clusters in Wichita. The plastics cluster has capitalized even less than aircraft on existing advantages. Other large and growing clusters identified by the Cluster Mapping Project that did not make the Task Force's list include heavy construction services, motor driven products, heavy machinery, chemical products, building fixtures, equipment and services, agricultural products, distribution services, and power generation.

Few Institutions for Collaboration. Wichita has few institutions for collaboration, either crosscutting (e.g., university to private sector or among the manufacturing-oriented clusters) or cluster specific (e.g., aerospace vehicles and defense, plastics) institutions for collaboration. Compared to all respondents to the Clusters of Innovation survey, Wichita's survey respondents were less likely to have said that associations and organizations representing their cluster exist. For example, there is no umbrella organization for the aerospace vehicle and defense cluster. The Society for Plastics Engineers may not be the institution for collaboration to address the significant strategic issues within the plastics cluster. Wichita's respondents were also less likely to report that firms and organizations in their cluster treat new companies as equals (see Exhibit 66).²⁸⁹

Exhibit 67. Wichita's Challenges: Scarcity of Risk Capital



As reported in interviews, local firms benefit generally from their clusters (e.g., the concentration of aircraft manufacturers has created the deep pool of workers that now sustains them; the demand for plastics generated by the Coleman Company has created the fast-growing plastics cluster), but firms need to become more aware of the specific benefits of clusters and encouraged to contribute more to cluster-building initiatives.

Until recently, Wichita also offered few opportunities for new economy entrepreneurs to network, trailing other regions in the Clusters of Innovation question about university technology transfer offices.²⁹⁰ The Wichita Technology Corporation and the Business Investment Group (BIG) should play an even greater role in tying together entrepreneurs, capital, and the university. Unfortunately, no organization has attained the impact of San Diego's UCSD CONNECT, which has fostered that region's innovation ascendancy by connecting entrepreneurs, venture capitalists, and university researchers.

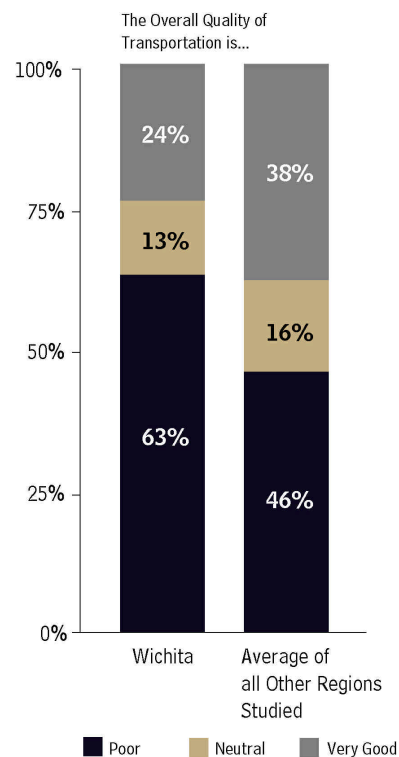
Scarcity of Risk Capital. The Wichita Company Knowledge Communications offers an example of a missed opportunity due to extremely low levels of formal venture capital (Exhibit 67 compares Wichita's survey responses to the other regions studied). This information technology company had to go outside of Wichita to obtain sufficient venture capital funding. While many of the employees are still based in Wichita, management moved to Dallas in order to be near their main capital provider, T. Boone Pickens. There are many businesses that would benefit from a larger supply of risk capital. The venture capital bill that was under consideration in the Kansas legislature in the spring of 2001 would add limited but crucial funding to Wichita's entrepreneurs.

Wichita has a potential asset in the form of its local angel investors (see Exhibit 67 for quotes from interviewees regarding the region's angel investors). Government, business leaders, and the Wichita Technology Corporation could sit down with the angels to build a coordinated risk capital strategy.

Weaknesses in Transportation Infrastructure. Wichita's physical infrastructure cannot adequately serve the future growth of the region. Many of those interviewed mentioned that poor air service has dissuaded businesses from moving to Wichita (see Exhibit 68, which compares Wichita's survey respondents' views about the quality of transportation infrastructure relative to other regions studied). John Ek, publisher of the *Wichita Business Journal*, said that more companies have left the region due to the lack of air travel options out of the Wichita airport than for any other reason.²⁹¹

The city should be credited for taking aggressive steps to dramatically improve air service in Wichita. Likewise, the city has acknowledged the importance of road improvements. A new road bill was passed in 1999 that will help local transportation needs. Road construction could lead to a minor public sector-led construction boom in the region.

Exhibit 68. Wichita's Challenges: Weaknesses in Transportation Infrastructure



Source: Clusters of Innovation Initiative Regional Survey

Lack of Consensus on a Community-wide Economic Strategy. Wichita articulated a plan to improve a number of important aspects of its business environment in its 1997 Long Range Planning Task Force. However, the region has yet to craft an overall vision and proceed to put it into action. As discussed at the June 28, 2001, presentation of report highlights by Professor Michael Porter, Wichita needs to “kick it up a notch.” The first step in setting a bold new strategy is to create a consensus about the key challenges facing the region.

NEW DIRECTIONS

For the last 80 years, Wichita has depended on a small set of homegrown, manufacturing-related businesses that were started by local entrepreneurs. These established businesses are critical to Wichita's prosperity. However, to stay competitive, the region must foster innovation and deepen the economy. To do this, the region needs to chart a bold course that assumes the offensive.

We have summarized some vital New Directions for Wichita in Exhibit 69. We develop these themes further in the Opportunities section that follows.

Take the Offensive. The region's economic development plans have tended to adopt defensive goals, such as preserving a scarce labor supply, withstanding cyclical downturns, and responding to crises. The alternative, offensive strategy is to proactively harness the many existing and potential advantages in Wichita and create new advantages. Some key assets need attention by economic development leaders, including WSU, specialized R&D facilities, interrelationships among current clusters, and more. Wichita has a history of innovation and bold moves. Wichita's original entrepreneurs went on the offensive to make Wichita an early location for air pilots and air fairs. Wichita can once again think big about its future.

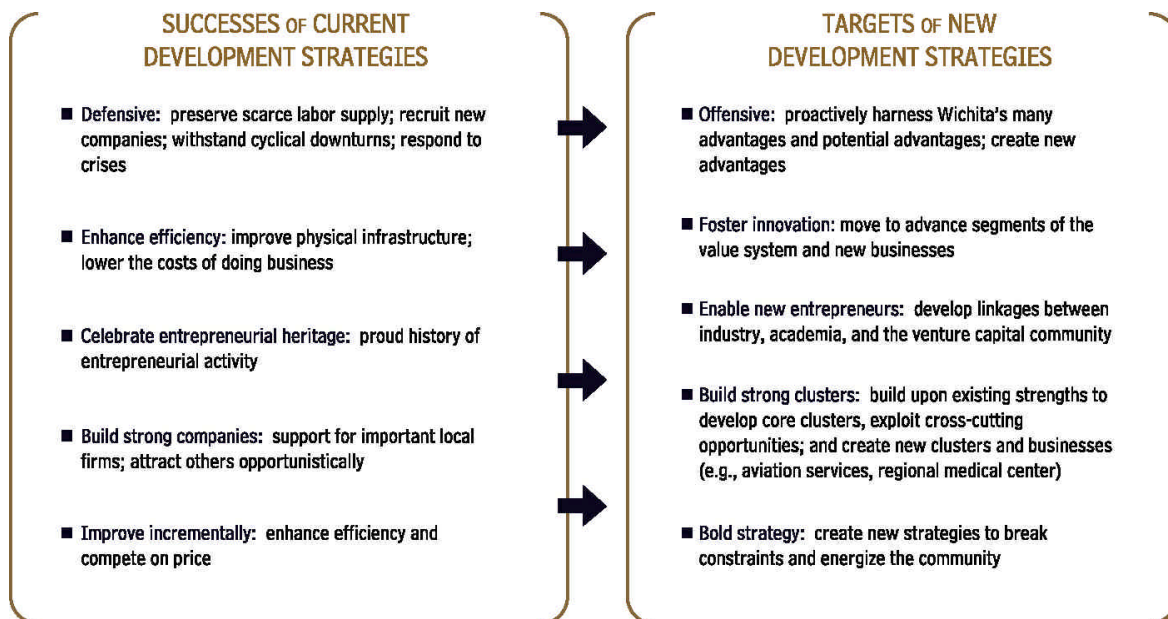
Upgrade the Sophistication of Wichita's Manufacturing Economy. Wichita has more than twice the national percentage of workers in the manufacturing sector. The region can be a center of advanced manufacturing in the United States. Past efforts to support manufacturing in the region have focused on enhancing efficiency by improving physical infrastructure, and lowering the costs of doing business. Increasingly, however, manufacturing businesses must embrace more advanced technologies to avoid becoming susceptible to wage competition. More knowledge-intensive products and processes, resulting from investments in research and development and protected by patents, will allow Wichita to protect its manufacturing base. For example, plastic products can become more complex, using more sophisticated manufacturing processes and raw materials.

Enable New Entrepreneurs. Wichita's entrepreneurial heritage in both manufacturing and services not only is responsible for its current prosperity, but has also instilled a pervasive risk-accepting attitude in the region, and populated it with experienced mentors who know how to create and build major successes. This attitude and experience are themselves differentiating assets, since many regions around the country and world do not exhibit the same spirit, and lack a similar legacy. Although the region has already created some organizations to capitalize on this legacy, Wichita can and should do more. In addition to the region's mythic entrepreneurs, other entrepreneurial assets include strong entrepreneurial attitudes, WSU's Center for Entrepreneurship, and the presence of the Wichita Technology Corporation. In addition, the region should increase access to risk capital, forge stronger ties to the university and its research/technology transfer offices, and create an amply funded and well-led institution for collaboration to specialize in helping entrepreneurs network and access available regional assets.

Build Clusters. The region has both attracted and produced a number of world-renowned companies over the last 80 years. Although this is certainly a worthy achievement, it does leave the region vulnerable to the fortunes of a handful of companies. Wichita should now turn to developing the clusters around these anchor companies. This would not only help these important anchors compete more successfully, it would also leverage the assets of the anchors to create new and innovative companies. Broadening the aerospace cluster and nurturing the plastics clusters are priorities. In addition, the region can exploit cross-cutting subclusters such as machine tools, metal processing, and production equipment²⁹² within the strong clusters of aerospace vehicles and defense, motor driven products and heavy machinery. Lastly, the region can develop new clusters where there seems to be some strong business activity such as the medical area and outdoor apparel.

Pursue Bold Strategies. The vast majority of Wichita's largest 20 clusters pay wages below the national average. The region must be careful not to trade on its comparative advantage of lower wages and essentially compete on price, a losing proposition today when other locations can produce the same product at even lower wage rates. Wichita cannot afford to improve incrementally—it must gather together the appropriate stakeholders, focus on innovation, and chart a bold course forward.

Exhibit 69. Wichita's Economic Vision: New Directions



OPPORTUNITIES

It is critical that Wichita address the threats mentioned above. The region can also leverage its assets in a manner that will elicit major impact due to the concentrated nature of Wichita's manufacturing-oriented employment base. Opportunities include broadening the aerospace vehicles and defense cluster, upgrading the plastics cluster, energizing other clusters, mounting a crosscutting manufacturing strategy, and pursuing some less obvious cluster opportunities (see Exhibit 70).

Expand Aerospace Cluster Beyond Aircraft Assembly. The aerospace vehicles and defense cluster is an obvious platform for economic development, and remains the priority. The opportunity is to use the strength inherent in the aircraft manufacturers to expand into related areas. Objectives should include developing research centers, strengthening the local supplier base, attracting higher-end technology-intensive makers of components, and moving into services.

Increasing the research and commercialization capabilities of the region will not only benefit existing aerospace companies, but will also spur the formation of start-ups, and help attract sophisticated suppliers such as composite manufacturers. NIAR is the sole aviation research center in the region. Its funding levels, particularly from the federal government, need to be increased. NIAR can also improve its patent activity. In addition, aerospace engineering at WSU should be improved, and other aviation related research institutions should be recruited to the area.

Increasing the local supplier base will facilitate communication between OEMs and their suppliers, and encourage innovation. Recruitment of cluster firms to the region must be continued, but with an emphasis on firms that supply more complex systems and materials. The aerospace vehicles and defense cluster's suppliers are mostly metal workers and machinists. Wichita lacks the presence of sophisticated input providers—the engine, avionics, aerospace software suppliers, composite manufacturers, and electro-mechanical equipment suppliers. Mike Pompeo, CEO of Thayer Aerospace, a local supplier, said: “The manufacturers all need high tech equipment and they go out of Wichita to get it. Wichita ought to think about bringing in sophisticated suppliers.”²⁹³

While local firms have a great interest in filling out the cluster, local government lacks a strategic recruitment strategy.²⁹⁴ Another difficulty with this complex supplier recruitment strategy, said Thayer's Pompeo, is that there is a limited labor force that specializes in areas related to some of the complex suppliers. While these are real challenges, it is important that they not become excuses for inaction. Wichita has tremendous assets in aircraft that more than offset these drawbacks. Moreover, an institution for collaboration that focuses on the aerospace cluster, something akin to the Montreal model, would be especially useful in helping all relevant parties share information and coordinate their efforts. Finally, strengthening the research and training capabilities of the region would increase its appeal to high-end makers of components.

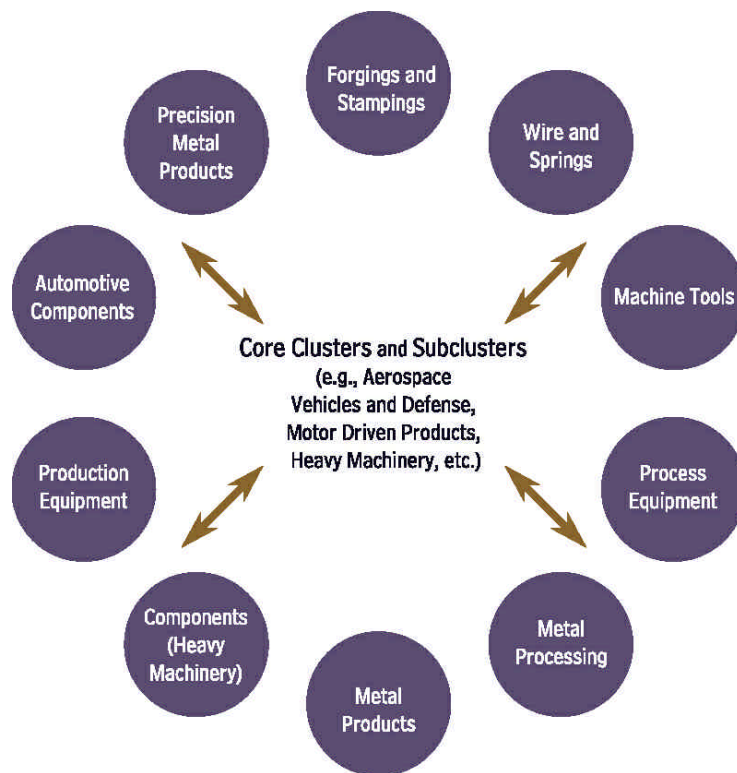
Lastly, the aerospace vehicles and defense cluster can explore crosscutting opportunities with the plastics cluster to improve sourcing of composites and branch out into other areas such as air services. The city of Wichita's Long Range Planning Committee on a Diversified Economy mentioned interesting extensions of the aerospace vehicles and defense cluster such as flight training, aircraft maintenance training, aircraft sales, and aircraft-related publications/media.

Upgrade the Plastics Cluster. The plastics cluster in Wichita has the potential to become a strong, vibrant cluster. It has the seventh highest share of national employment among the traded clusters analyzed in this report, and is the eleventh fastest growing in the region.²⁹⁵ It is also anchored by two major companies, Coleman and Rubbermaid. Currently, however, only a few subclusters are strong relative to other regions. Moreover, local firms are making relatively simple consumer products. The objective for the plastics clusters should be to create a true cluster with many firms in related and supporting industries, and to upgrade the sophistication of plastics products.

A key first step is for cluster members to form an institution for collaboration whose mission would be to identify all relevant assets in the region and promote linkages to enable members to access assets. Private sector anchor companies in particular, as well as city leaders, the Chamber of Commerce, MAMTC, and WTC should initiate the formation of such an organization. Initiatives for cluster development should include skill enhancement, research relationships with Pittsburgh State University and WSU, migration strategies to more complex products, linkages with plastics suppliers, management challenges, physical infrastructure issues particular to the plastics cluster such as transportation and related freight costs, international competition, and broadening the cluster by leveraging other clusters in the region such as chemicals and process equipment.

Develop Specific Clusters. Wichita has a number of large and growing clusters that have not received a great deal of attention. In addition to the aerospace vehicles and defense and plastics clusters discussed in this report, food processing, motor driven products, production technology, heavy machinery,

Exhibit 70. Wichita's Opportunities: Crosscutting Opportunities in Manufacturing



prefabricated enclosures, and oil and gas all have high levels of employment in several core subclusters and industries. These are clusters approaching critical mass that could be strengths of the region and help diversify away from aircraft.

To build out these clusters, leading companies need to coordinate with each other, government, and local training institutes to ensure an adequate supply of skilled labor. Companies must recognize the value of being in a strong cluster, and learn to support local start-ups in their field. The Chamber of Commerce and government agencies should coordinate with companies to target appropriate companies for recruitment.

Mount a Crosscutting Manufacturing Strategy. Many of the clusters and subclusters in which Wichita is strong are engaged in heavy manufacturing. Wichita has relatively high rankings in share of national employment in aerospace vehicles and defense (aircraft and parts industries), heavy machinery (construction machinery and farm machinery industries), motor driven products (refrigeration and heating in Wichita industries), power generation, and chemical products clusters. Moreover, metal manufacturing (broadly distributed over the clusters) and production technology (broadly distributed across the cluster) are also growing fairly well. There is an opportunity to leverage assets across clusters to build Wichita into a center of advanced manufacturing.

These clusters all deal in complex equipment and complex assembly, and as a consequence, they have similar needs. These include skills of workers, process technology, information needed, materials expertise, and service providers. Companies engaged in heavy manufacturing need to recognize that they are not only part of a cluster, but also part of a larger heavy manufacturing base. In concert with government, universities, and institutions for collaboration, these companies need to identify common needs, and work together to strengthen them.

Pursue New Opportunities. There are a number of interesting but less obvious business strengths in Wichita beyond the large and growing clusters mentioned above. Wichita already has more than 20 call centers in the region, and cluster activity is already evident. The Wichita Area Technical College (WATC) developed a certificate program for call center workers in response to the influx of call center operations in the region. Wichita also has a number of recognized medical facilities, such as the Via Christi Regional Medical Center, the Wesley Medical Center, and the Wichita Clinic. With planning and support, this small constellation of medical facilities could become a medical resource for the greater region. Wichita could also become a center for aircraft tourism. Wichita already boasts an air museum chronicling Wichita's role in the history of aircraft and air travel. Each of these opportunities and others could become a part of Wichita's new economic development strategy going forward.

End Notes

1. Michael E. Porter, Hirotaka Takeuchi, Mariko Sakakibara, *Can Japan Compete*, New York: Perseus Books (2000).
2. See Michael E. Porter, *The Competitive Advantage of Nations*, New York: The Free Press (1990).
3. For an expanded treatment, see Chapter 7 in Porter, M., *On Competition* (Harvard Business Review Books, Cambridge, 1998).
4. Michael E. Porter, Scott Stern, Council on Competitiveness, *The New Challenge to America's Prosperity: Findings from the Innovation Index*, Washington, D.C.: 1999.
5. In the case of Atlanta, the region is defined as the Atlanta MSA, plus three additional counties: Troup, Harris, and Muscogee, included to better capture the economic linkages in the Atlanta area.
6. By traded, we mean that the location of the firms in these clusters is not driven by the need to be near a specific natural resource, or by population concentration. Instead, these industries are located in a specific area for some reason related to the region's innovative capacity.
7. The 1992 Input-Output Accounts measure the share of economic value traded between industries.
8. Economic Areas (EAs) and Metropolitan Statistical Areas (MSAs) are defined by the U.S. Department of Commerce.
9. Information for this section was provided by Glenn W. Miller and Jimmy M. Skaggs, *Metropolitan Wichita: Past, Present, and Future*, (Wichita State University, 1978).
10. Information for this section was provided by *Borne on the South Wind*, Frank Joseph Rowe and Craig Miner, *Wichita Eagle* and *Beacon Publishing*, Wichita, 1994, interviews.
11. Based on MSA data.
12. U.S. Bureau of Labor Statistics.
13. U.S. Bureau of Labor Statistics.
14. U.S. Bureau of Labor Statistics.
15. U.S. Bureau of Labor Statistics.
16. Center for Economic Development and Business Research, WSU.
17. U.S. Bureau of the Census.
18. Bureau of Economic Affairs.
19. MSA data, broad industries.

20. Hospitality and tourism, textiles, sporting and leather goods, distribution services, and power generation.
21. Association for Applied Community Researchers, Fourth Quarter 1999. Includes grocery items, housing, utilities, transportation, health care, and miscellaneous goods and services.
22. Economic Research Institute (ERI), 2000 Geographic Reference Report.
23. Source: ERI Geographic Reference Report.
24. MSA data, broad industries.
25. For a detailed explanation of this productivity measure see Appendix 3.
26. These numbers all exclude SIC 7363, help supply services (temp agencies), which skew the index up dramatically in each region.
27. MSA data.
28. International Trade Administration.
29. U.S. Patent and Trademark Office.
30. Cluster Mapping Project, MSA data, broad industries.
31. Cluster Mapping Project, MSA data, broad industries.
32. MSA data.
33. Source: PWC Money Tree Database. Note: PWC Money Tree Database does not track all venture capital funding.
34. Cluster of Innovations Regional Survey and interviews.
35. MSA data.
36. MSA data.
37. Interview with Tim Witsman, August 2, 2000.
38. While at WSU, Jabara was an active consultant and advisor (he sat on the board of LearJet for 16 years) to many of the aerospace vehicles and defense companies at a time when academics were not likely to work with the business community. Today, Jabara runs his Jabara Investment with his son. Jabara calls himself a merchant banker, involving himself in hotel, real estate and other big deals in the Wichita area. Jabara was the accounting professor and fraternity sponsor for Pizza Hut founders Frank and Dan Carney and many of their friends. Today, 25 of his students of that time are now Pizza Hut franchise millionaires and still living in Wichita.
39. Interview with Fran Jabara, August 2, 2000.
40. Interview with Tom Devlin, September 19, 2000.
41. Interview with Allen Bell, June 8, 2001.
42. Interview with Fran Jabara, August 2, 2000.
43. "Is Wichita an 'Entrepreneurial Capital' - and if so, why?" *Wichita Business Journal*, November 26, 1999.
44. "Pizza Hut Franchise Association Says There's No Place Like Home," *Wichita Business Journal*, March 3, 1999.
45. The Kansas Department of Human Resources, Labor Market Information Services and the U.S. Department of Labor, Bureau of Labor Statistics.
46. Jobs in traded industries pay about \$13,000 more per year than jobs in non-traded industries.
47. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Economic Area data.
48. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industries for the Economic Area.

49. EA data, narrow industries.
50. Industries appear in more than one cluster. One consequence of this is that employment totals of several clusters double-count some workers. To solve this problem, the CMP identified narrow industries. All industries are narrow industries in one cluster, and one cluster only. In addition, many industries are broad industries in other clusters. For example, analytical instruments is a narrow industry in the analytical instruments cluster and is a broad industry in several other clusters, including aerospace vehicles and defense.
51. Interviews.
52. Interview with John Ek, August 3, 2000.
53. Interview with Fran Jabara, August 2, 2000.
54. Interview with J.V. Lentell, August 2, 2000.
55. Interview with John Rolfe, June 14, 2001.
56. Narrow industries.
57. ERI Geographic Reference Report.
58. Interview with Pam Doonan, September 18, 2000.
59. Clusters of Innovation Initiative Regional Survey.
60. Interview with Allen Bell, June 26, 2001.
61. Clusters of Innovation Initiative Regional Survey.
62. Clusters of Innovation Initiative Regional Survey.
63. "Flying in Formation 1997 Engineering Survey," Research Center, 1997.
64. Interview with Janet Nickel Harrah, August 1, 2000.
65. *Wichita Business Journal*, "E-Biz 2000" supplement, p. 32.
66. Bureau of Labor Statistics.
67. ontheFRONTIER analysis.
68. Interview with WSU's Joe Kleinsasser.
69. *U.S. News and World Report* web site.
70. "Population and Employment Forecast Sedgwick County, Kansas: 2000 - 2030," Center for Economic Development and Business Research, July 1997.
71. U.S. Bureau of Labor Statistics.
72. "Population and Employment Forecast Sedgwick County, Kansas: 2000 - 2030," Center for Economic Development and Business Research, July 1997.
73. Clusters of Innovation Initiative Regional Survey.
74. NCES CCD "Agency" Database and NCES CCD "State" Database and for 1997-98 & 1998-99 State of KS Department of Education statistics.
75. Wichita USD 259 Public Schools.
76. Redwood, Anthony and Krider, Charles. "Kansas Economic Development Study: Findings, Strategy and Recommendations," Institute for Public Policy and Business Research, University of Kansas, June, 1986.

77. Clusters of Innovation Initiative Regional Survey.
78. Interview with Mike Biggs, September 20, 2000.
79. Interview with Tom Devlin, September 19, 2000.
80. Interview with Ken Fisher, August 3, 2000.
81. The \$1.6 million was leveraged by \$11.5 million in external venture capital funding not recorded by PWC Money Tree. Interviews with WTC.
82. "Tech Investment Bill Would Ease Budget Bite," Stephen Roth, *Business Journal*, February 23, 2001.
83. Interview with Rich Bendis, August 2, 2000.
84. Interview with Mike Biggs, September 20, 2000.
85. Interview with Tom Devlin, September 19, 2000.
86. IPOCentral, Hoover's Online.
87. The increase in federal R&D expenditure/worker seen in 1997 and 1998 is explained by corrections made to the NSF WebCASPAS report by WSU. Corrections were not made in prior years. Skip Loper, Director of WSU's Office of Research Administration, said that one could expect similar expenditure/worker from 1991-1996 as seen in 1997 and 1998 if the corrections had been made over the 1991-1996 period.
88. NSF WebCASPAS Database System, U.S. Bureau of Labor Statistics.
89. Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century, KTEC, 2000, p. 8.
90. NSF WebCASPAS Database System, U.S. Bureau of Labor Statistics.
91. Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century, KTEC, 2000, p. 8.
92. Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century, KTEC, 2000, p. 40.
93. Office of Research Administration, Wichita State University.
94. Clusters of Innovation Initiative Regional Survey.
95. Clusters of Innovation Initiative Regional Survey.
96. McConnell Air Force base.
97. "Best Practices of State Sponsored Seed and Venture Capital Programs and Alternatives to Direct State Funding," prepared by Economic Innovation International, Inc, December 1998.
98. Kansas, Inc.
99. "Best Practices of State Sponsored Seed and Venture Capital Programs and Alternatives to Direct State Funding," prepared by Economic Innovation International, Inc, December 1998.
100. In 1997, the state prioritized six clusters for special attention: aviation; manufacturing, administrative service centers; value added agriculture; call centers; and plastics.
101. Miller and Skaggs, 1978.
102. This is an adapted list of six clusters identified by the Kansas Department of Commerce in 1997. *Wichita Business Journal*, February 11, 2000.
103. Interview with John Rolfe, September 19, 2000.

104. To execute these priorities, the state and local government offer economic incentives such as industrial revenue bonds (IRBs), training incentives to new or expanding companies, property tax exemptions, enterprise zones, inventory tax exemptions, "high performance" incentive programs, a foreign trade zone covering Sedgwick County, foreign trade show assistance, and an income tax for research and development. Source: Wichita Area Chamber of Commerce.
105. The Business Investment Group (BIG), stimulated by the region's 1997 Long Range Planning Task Force, exists to help diversify the economy by making investments in promising new firms.
106. Interview with John Ek, August 3, 2000.
107. "Chamber Refocuses Eco-Development Strategies," *Wichita Business Journal*, February 11, 2000.
108. Interview with community leader, August 3, 2000.
109. Clusters of Innovation Initiative Regional Survey.
110. Clusters of Innovation Initiative Regional Survey.
111. "Wichita, Kansas, Area Chamber of Commerce Receives Contract Extension," Dion Lefler, *Wichita Eagle*, February 15, 2001.
112. In addition to Mayor Bob Knight, the Economic Development Advisory Group includes the following members: Dr. Don Beggs, President, WSU; Michael Biggs, Member of Klenda, Mitchell, Austerman & Zuercher, LLC; C.Q. Chandler, IV, President, Intrust Bank; Bill Hanna, Vice Chairman, Koch Industries; Ron Holt, President, KG&E; Charlie Johnson, President, Cessna Aircraft Co.; Phi Neff, CEO, Willis of Kansas; Marilyn Pauly, President, Bank of America, KS; Bill Phillips, President, Coleman Co.; Leroy Rheault, President, Via Christi; Paul Tobia, Plant Manager, Vulcan Chemical; Hansel Tookes, President & CEO; Raytheon Aircraft Co.; Jeff Turner, VP, General Manager, Boeing Wichita; Tom G. Winters, Chairman, Sedgwick County Commissioners; Jim Ziegler, VP General Manager, Bombardier Learjet.
113. *Wichita Business Journal*, "E-Biz 2000" supplement, p. 30.
114. Interview with community leader.
115. Clusters of Innovation Initiative Regional Survey.
116. Clusters of Innovation Initiative Regional Survey.
117. Interview with Fran Jabara, August 2, 2000.
118. Except where noted, discussion of the aerospace vehicles and defense cluster is based on the Wichita Economic Area.
119. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industry data.
120. Narrow industry data.
121. According to the General Aviation Manufacturers Association, general aviation is "all civil aviation activity except that of scheduled air carriers. General aviation includes business transportation, air charter, air taxis, personal and recreational flying, emergency medical evacuation, agricultural flying, traffic and aerial observation and flight training."
122. Wichita Area Chamber of Commerce.
123. MSA data.

124. MSA data. "Aerospace Vehicles and Defense Remains Wichita's Largest Employer," *Business and Commercial Aviation*, May, 1999, p 44.
125. Center for Economic Development and Business Research, WSU.
126. Wings Over Kansas website.
127. Information in this section was provided by *Borne on the South Wind*, Frank Joseph and Craig M. Miner, 1994.
128. Interview with Fran Jabara, August 2, 2000.
129. Allied Signal Aerospace Vehicles and Defense Report, Market Environment & Aircraft Production Forecast, February 1999.
130. "Clipping the Aviation Industry's Wings: The Growing Manpower Shortage," Wings Over Kansas.com.
131. General aviation's dramatic growth followed the passage of the General Aviation Revitalization Act of 1994.
132. Senator Pat Roberts, Advisory Committee on Science, Technology and Future, July 31, 2000, p.3.
133. Rowe and Miner, p. 151 and 155.
134. Economic Impact of Boeing Wichita: On the Wichita and Kansas Economies, March 1998, CEDBR.
135. Wings Over Kansas website, interviews.
136. Rowe and Miner,, p. 137.
137. "Raytheon Aircraft to Eliminate 450 White-collar Jobs," *New York Times*, April 4, 2001.
138. Wings Over Kansas website, interviews.
139. Wings Over Kansas website, company documents, interviews.
140. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School.
141. Narrow industries.
142. Broad industries, interviews.
143. Broad industries.
144. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industries.
145. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industries.
146. Interview with John Holding, May 17, 2001.
147. Interview with Randy Nelson, April 5, 2001.
148. Interview with Tom Salama, April 8, 2001.
149. Interview with John Holding, May 17, 2001.
150. Interview with Richard Mahoney, April 14, 2001.
151. Interview with Randy Nelson, April 5, 2001.
152. Interview with Ed Brown, April 6, 2001.

153. The strong economy of the last decade is partly responsible for the dramatic growth of business aircraft, but manufacturers' ability to better understand customer preferences can also be viewed as an innovation. However, the manufacturers cannot claim the most important marketing innovation, fractional air service. Independent air service operators such as Executive Jet are responsible for the success of fractional air service. Moody's estimates that fractional ownership accounts for 30% of all current demand for general aviation aircraft. ("Moody's Predicts Strong OEM Performance, But Expresses Overcapacity Concerns," *Weekly of Business Aviation*, 26-Feb-2001)
154. Interview with Craig Miner, June 8, 2001.
155. Interview with Jerry McDougal, June 8, 2001. The Transportation Research Board is a non-profit agency set up under the National Research Council.
156. Interview with Craig Miner, June 8, 2001.
157. Interview with Heidi Wood, June 12, 2001
158. Interview with Mike Pompeo, June 11, 2001.
159. Interview with Heidi Wood, June 12, 2001
160. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industries.
161. Interview with Jeff Turner, August 3, 2000.
162. Interview with Tom Salama, April 8, 2001.
163. "Raytheon Invests More in Composite Manufacturing Technology," *Wichita Business Journal*, December 15, 2000.
164. Interview with Randy Nelson, April 4, 2001.
165. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Broad industries. Data for many of the industries in the Wichita Economic Area's aerospace vehicles and defense cluster is unavailable.
166. Narrow industries.
167. Broad industries.
168. Clusters of Innovation Initiative Regional Survey.
169. Interview with Doug Mahin, July 31, 2000.
170. Interview with John Moore, September 20, 2000.
171. Interview with Chris Cherches, August 4, 2000.
172. Interview with Richard Danforth, July 31, 2000.
173. Interview with Linda Jackson, July 31, 2000.
174. Interview with Linda Guerra, December, 14, 2000.
175. "Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century," KTEC, 2000, p. 87.
176. Interview with Doug Mahin, July 31, 2000.
177. Interview with John Moore, September 20, 2000.
178. Sheree Utash, Director of SSEC.

179. NIAR materials.
180. "Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century," KTEC, 2000, p. 90.
181. "Kansas Strategic Technology Cluster Assessment and a Plan for the 21st Century," KTEC, 2000, p. 82.
182. Peer reviewer, sponsored by KTEC, spring 2001.
183. Clusters of Innovation Initiative Regional Survey.
184. Peer review, NIAR, sponsored by KTEC, Spring 2001.
185. Interview with Jeff Turner, August 3, 2000.
186. Interview with Doug Mahin, July 31, 2000.
187. Peer review summary letter, May 21, 2001.
188. During the 1988-1997 period, the research subcluster of the Wichita aerospace vehicles and defense contributed no more than 2% of the patents to the cluster during any one year.
189. Peer review, sponsored by KTEC, spring 2001.
190. Peer review, sponsored by KTEC, spring 2001.
191. Interview with community leader, January 19, 2001.
192. Interview with industry executive, August 28, 2000.
193. Interview with technology transfer expert, August 28, 2000.
194. Interview with community leader, November 9, 2000.
195. Interview with Jeff Turner, August 3, 2000.
196. Interview with John Moore, September 20, 2000.
197. Peer reviewer, sponsored by KTEC, spring 2001.
198. Interview with Jim Ziegler, January 15, 2001.
199. Interview with Dr. Ramesh Agarwal, September 3, 2000.
200. Interview with Doug Mahin, July 31, 2000.
201. Clusters of Innovation Initiative Regional Survey.
202. The balance of firms within this industry is composed of electromechanical, electronic component, instrument, modification, interior design, engine components, structural components, fiberglass and composites, and avionics firms. The 121 firms do not include Raytheon, Cessna, Boeing and Bombardier. This list does not include firms in the search and navigation equipment industry.
203. Interview with Ron Brunton, April 4, 2001.
204. Interview with Tom Salama, April 8, 2001.
205. Interview with Brad Muer, June 12, 2001.
206. Interview with Jerry McDougal, June 8, 2001.
207. Interview with Craig Miner, June 8, 2001.
208. Clusters of Innovation Initiative Regional Survey.
209. Interview with Jeff Turner, August 3, 2000.
210. Interview with Jim Ziegler, January 15, 2001.

211. Interview with John Moore, September 20, 2000.
212. Interview with supplier, December 14, 2000.
213. Aerospace vehicles and defense supplier.
214. Interview with Jim Rundell, December 13, 2000.
215. Interview with Elaine Hannah, September 20, 2000.
216. "Cessna Charts a Supply Chain Flight Strategy," *Purchasing*, September 7, 2000, p. 42.
217. "Crane Aerospace vehicles and defense parts center joins aviation 'cluster,'" *Wichita Business Journal*, December 1, 2000.
218. Interview with Randy Nelson, April 4, 2001.
219. Interview with Tom Salama, April 8, 2001.
220. "Top Law Firms in Wichita Focus on Giving Clients Best Service," *Wichita Business Journal*, September 14, 1999.
221. Interview with Ed Brown, April 6, 2001.
222. "Associated Advertising Agency lands two aviation-related accounts," *Wichita Business Journal*, August 18, 2000.
223. Interview with J.V. Lentell, August 23, 2000.
224. Interview with Linda Guerra, December 14, 2000.
225. Rowe and Miner, p. 130.
226. Rowe and Miner, p. 131.
227. Rowe and Miner, p. 227.
228. General Aviation Manufacturers Association.
229. "GA Manufacturers See Early Success With Statute Of Repose In Court, In Business," *Weekly of Business Aviation*, 10-Mar-1997.
230. General Aviation Manufacturers Association Materials.
231. Public Citizen, Press Statement.
232. "Boeing to Ask Wichita, Kan., Council for \$41 Million in Bonds for Upgrades," Molly McMillin, *Wichita Eagle*, October 15, 2000.
233. Rowe and Miner, p. 205.
234. Interview with Jeremy Artus, December 21, 2000.
235. Clusters of Innovation Initiative Regional Survey.
236. Clusters of Innovation Initiative Regional Survey.
237. Interview with Dwight Henry, December 15, 2000.
238. Interview with Doug Mahin, July 31, 2000.
239. Interview with Jeremy Artus, September 21, 2000.
240. Clusters of Innovation Initiative Regional Survey.
241. Clusters of Innovation Initiative Regional Survey.
242. Except where noted, discussion of the plastics cluster is based on the Wichita Economic Area.
243. Information for this section is drawn mostly from company interviews.
244. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School. Narrow industries.

245. Narrow industries.
246. Broad industries.
247. Narrow industries.
248. Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School.
249. Narrow industries.
250. Interview with Ken Fisher, August 3, 2000.
251. This section relies on broad industry data. Data for many of the industries in the Wichita Economic Area's plastics cluster is unavailable.
252. Broad clusters.
253. Clusters of Innovation Initiative Regional Survey.
254. Clusters of Innovation Initiative Regional Survey.
255. Clusters of Innovation Initiative Regional Survey.
256. Clusters of Innovation Initiative Regional Survey.
257. Interview with Norlan Ferguson, April 5, 2001.
258. Interview with Ken Fisher, August 3, 2000.
259. Clusters of Innovation Initiative Regional Survey.
260. The Polymer Research Center meets quarterly with NIAR but has yet to work with them on a project.
261. Interview with Steven Sutherland, September 20, 2000.
262. Interview with Phil Helstead, April 5, 2001.
263. Interview with Yeow Ng, May 18, 2001.
264. Clusters of Innovation Initiative Regional Survey.
265. With 95 cumulative patents during the 1994 - 1998 period, the Coleman Company was the top patenting company in the Wichita Economic Area. Source: Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School.
266. Interview with Ken Fisher, August 3, 2000.
267. Interview with Lauren Worley, April 5, 2001.
268. Clusters of Innovation Initiative Regional Survey.
269. Interview with Norlan Ferguson, April 5, 2001.
270. Clusters of Innovation Initiative Regional Survey.
271. Clusters of Innovation Initiative Regional Survey.
272. Interview with Ken Fisher, August 3, 2000.
273. Interview with Norlan Ferguson, April 5, 2001.
274. Clusters of Innovation Initiative Regional Survey.
275. Clusters of Innovation Initiative Regional Survey.
276. Clusters of Innovation Initiative Regional Survey.
277. Interview with Delbert Demaree, March 13, 2001. The decline in membership of the SPE has been occurring

more dramatically in areas outside of Wichita.

- 278. Clusters of Innovation Initiative Regional Survey.
- 279. Clusters of Innovation Initiative Regional Survey.
- 280. Clusters of Innovation Initiative Regional Survey.
- 281. Clusters of Innovation Initiative Regional Survey.
- 282. Interview with Allen Bell, September 27, 2000.
- 283. Ross C. DeVol, "America's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas," Milken Institute.
- 284. Paul, Proctor, "Lower Cost Drive Next-Generation 737," *Aviation Week and Space Technology*, December 16, 1996, p. 68-71.
- 285. "Population and Employment Forecast Sedgwick County, Kansas: 2000 - 2030," CEDBR, July 1997.
- 286. Clusters of Innovation Initiative Regional Survey.
- 287. Clusters of Innovation Initiative Regional Survey.
- 288. These cluster names are taken from the Wichita Area Long Range Planning Task Force and do not refer to clusters identified by the Cluster Mapping Project, Institute for Strategy & Competitiveness, Harvard Business School.
- 289. Clusters of Innovation Initiative Regional Survey.
- 290. Clusters of Innovation Initiative Regional Survey.
- 291. Interview with John Ek, August 3, 2000.
- 292. Other crosscutting subclusters include: forgings and stampings, wire and springs, process equipment, metal products, components (heavy machinery), automotive components, and precision metal products.
- 293. Interview with Mike Pompeo, June 11, 2001.
- 294. Interview with John Rolfe, May 26, 2001.
- 295. Narrow industries.
- 296. These proportions are calculated at the national level. Any given county, however, will not perfectly mirror the U.S. economy in terms of the proportion of types of firms within a given NAICS code. We calculate a productivity index for 110 4-digit SIC industries in Wichita; 69 of these contain data from fractions of a NAICS industry.
- 297. Data for some SIC industries is an aggregation of data from several NAICS industries. In Wichita, some SIC industries depend on data from one or more NAICS industry for which the sales/receipts/shipments data is suppressed. Because suppression occurs when there are few firms in a NAICS code, this problem should not significantly skew the figures, so we report the productivity index based on the data available.