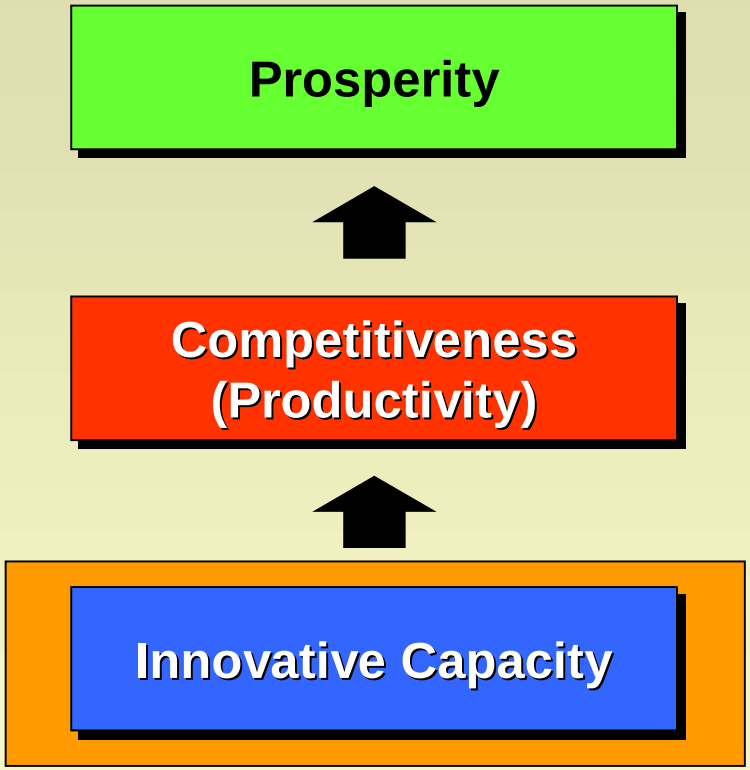
Professor Michael E. Porter, Harvard University
Monitor Group
ontheFRONTIER
Council on Competitiveness

CLUSTERS of INNOVATION:
Regional Foundations of U.S. Competitiveness

CLUSTERS OF INNOVATION INITIATIVE

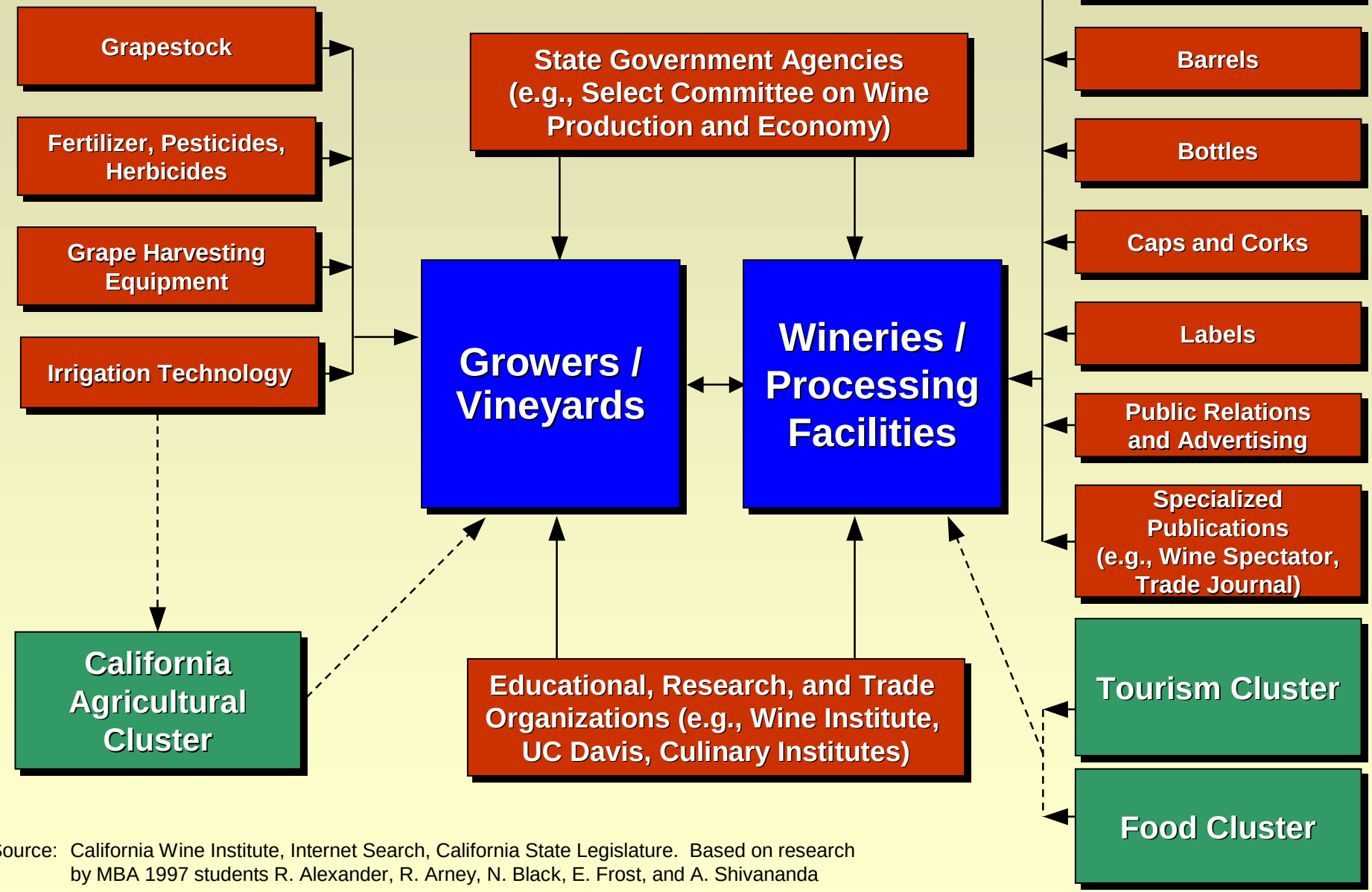
NATIONAL CLUSTERS OF INNOVATION MEETING
Washington, D.C. December 13, 2001

Innovation and Productivity Growth



- The most important sources of prosperity are **created** not inherited
- Productivity does not depend on **what** industries a region competes in, but on **how** it competes
- The prosperity of a region depends on the productivity of **all** its industries
- Innovation is vital for long-term increases in productivity

The California Wine Cluster



Source: California Wine Institute, Internet Search, California State Legislature. Based on research by MBA 1997 students R. Alexander, R. Arney, N. Black, E. Frost, and A. Shivananda

Clusters of Innovation Initiative Objectives

To enhance innovation in regional economies by:

- Understanding the composition of regional economies
- Understanding how clusters develop
- Understanding how innovation arises
- Developing lessons from regional case studies that inform key decision makers; and,
- Developing a methodology, process, and data infrastructure that can be utilized widely across America

Unique Data Sources

Cluster Mapping Project Data

- Consistent performance measures, 1990–1999
  - Employees
  - Wages
  - Establishments
  - Patents
- Systematic data on regional clusters, industries, and patenting
  - Empirically derived cluster linkages
  - Evolution of clusters over time
- Comparative data at multiple levels of geography
  - County
  - MSA
  - Economic area
  - State

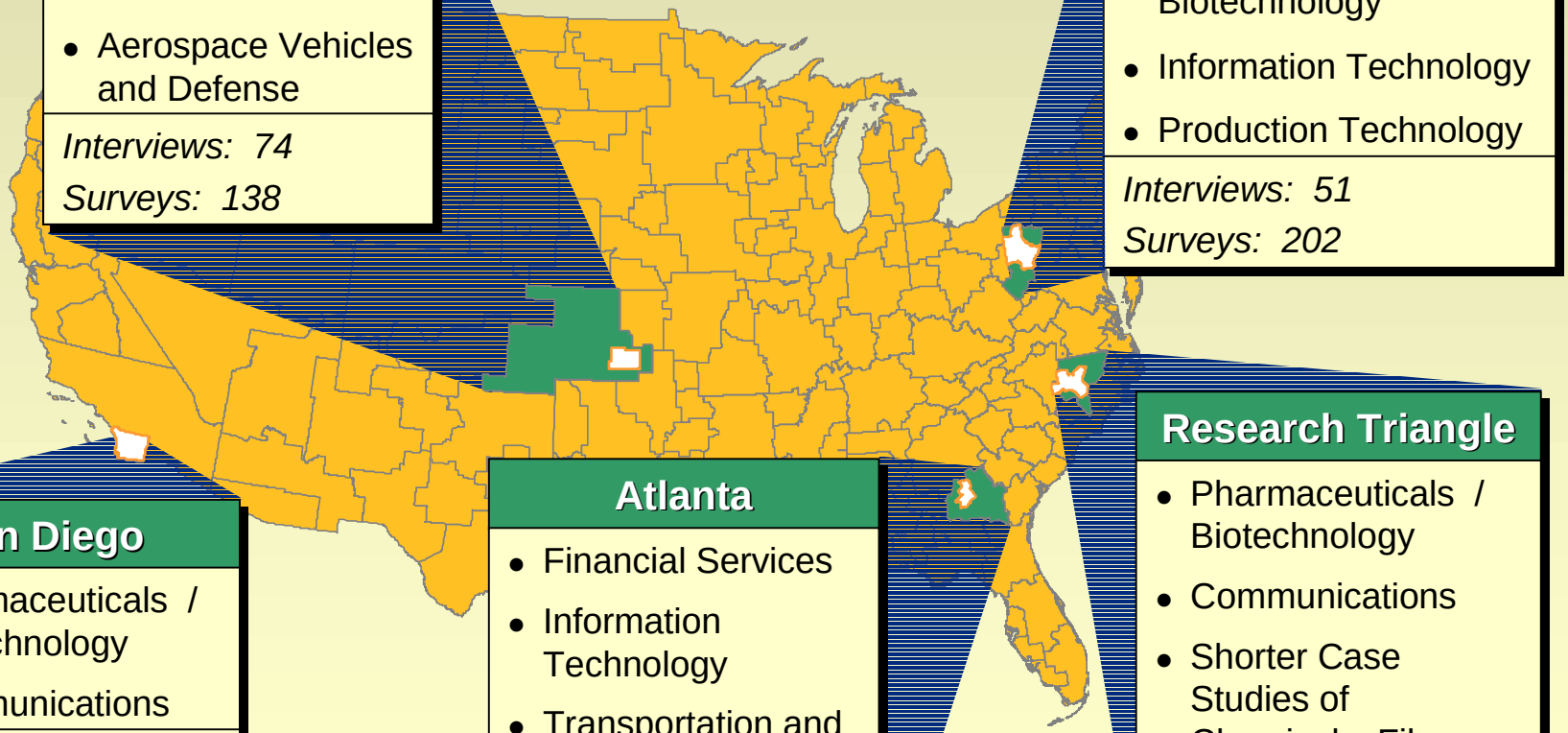
Surveys

- Surveys (1,025)
  - Both paper and electronic
  - Measure numerous aspects of business and regional cluster performance in a consistent matter that allows quantification

Interviews

- Interviews (264)
  - Access the knowledge and expertise of regional leaders
  - Assess numerous aspects of business environment and cluster development at a qualitative level
  - Provide nuance to other data sources
  - Help identify unique lessons, challenges, and opportunities

Regions and Clusters Studied



Wichita

- Plastics
- Aerospace Vehicles and Defense

Interviews: 74
Surveys: 138

Pittsburgh

- Pharmaceuticals / Biotechnology
- Information Technology
- Production Technology

Interviews: 51
Surveys: 202

San Diego

- Pharmaceuticals / Biotechnology
- Communications

Interviews: 49
Surveys: 232

Atlanta

- Financial Services
- Information Technology
- Transportation and Logistics

Interviews: 43
Surveys: 202

Research Triangle

- Pharmaceuticals / Biotechnology
- Communications
- Shorter Case Studies of Chemicals, Fibers

Interviews: 47
Surveys: 251

Economic Area
Metropolitan Statistical Area

Special thanks to . . .

- Council on Competitiveness
- National Steering Committee
- Regional Advisors
- Institute for Strategy and Competitiveness
- Monitor Group
- onthe*FRONTIER*
- Survey Respondents and Interviewees

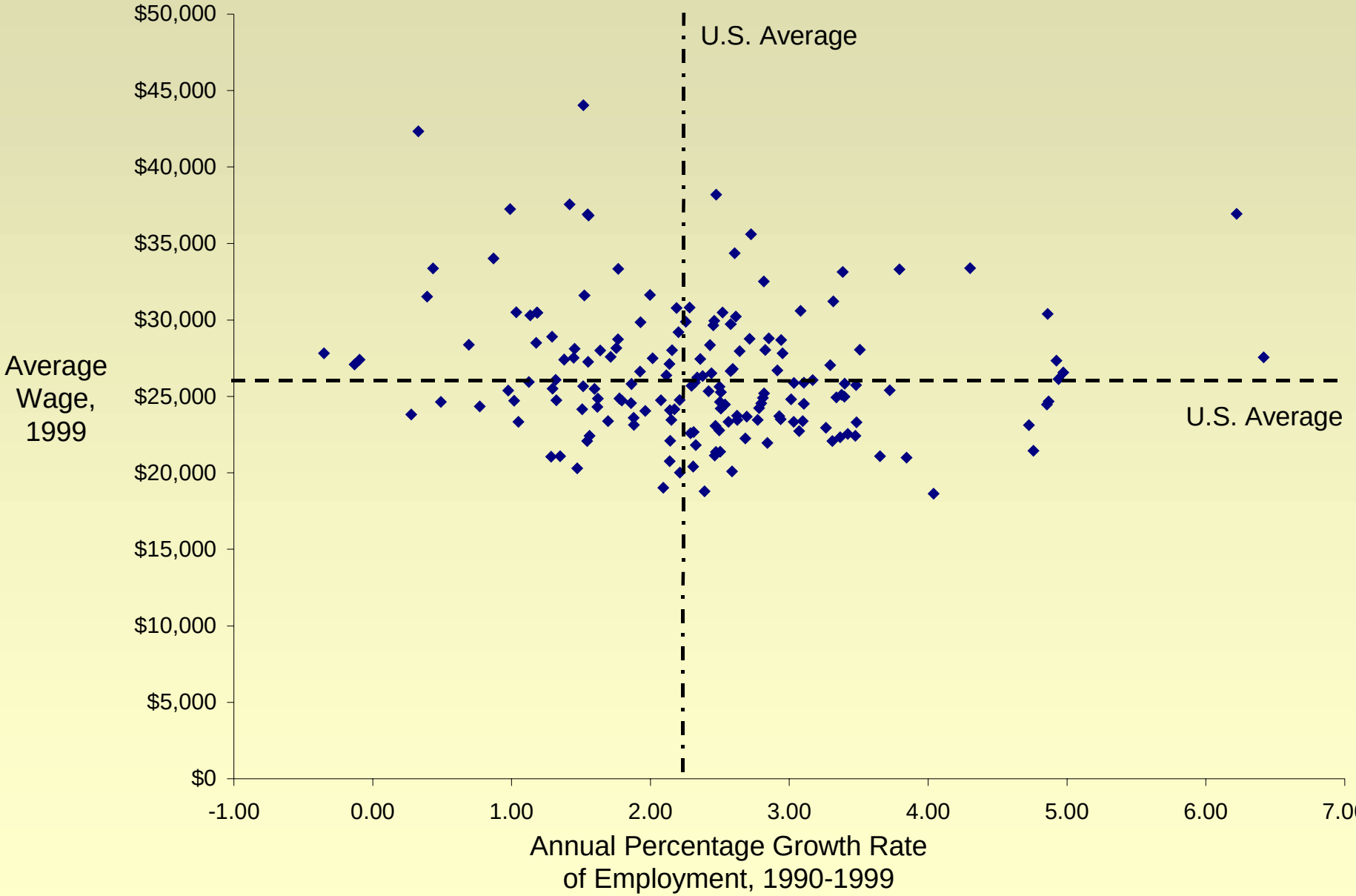
Over 1,300 participants

Agenda

- **The Economic Performance of Regions**
- The Composition of Regional Economies
- The Evolution of Regional Economies
- The Determinants of Regional Competitiveness and Innovative Capacity
- Clusters
- The Development of Clusters
- Creating and Implementing a Regional Economic Strategy
- Action Agendas for the Public and Private Sectors

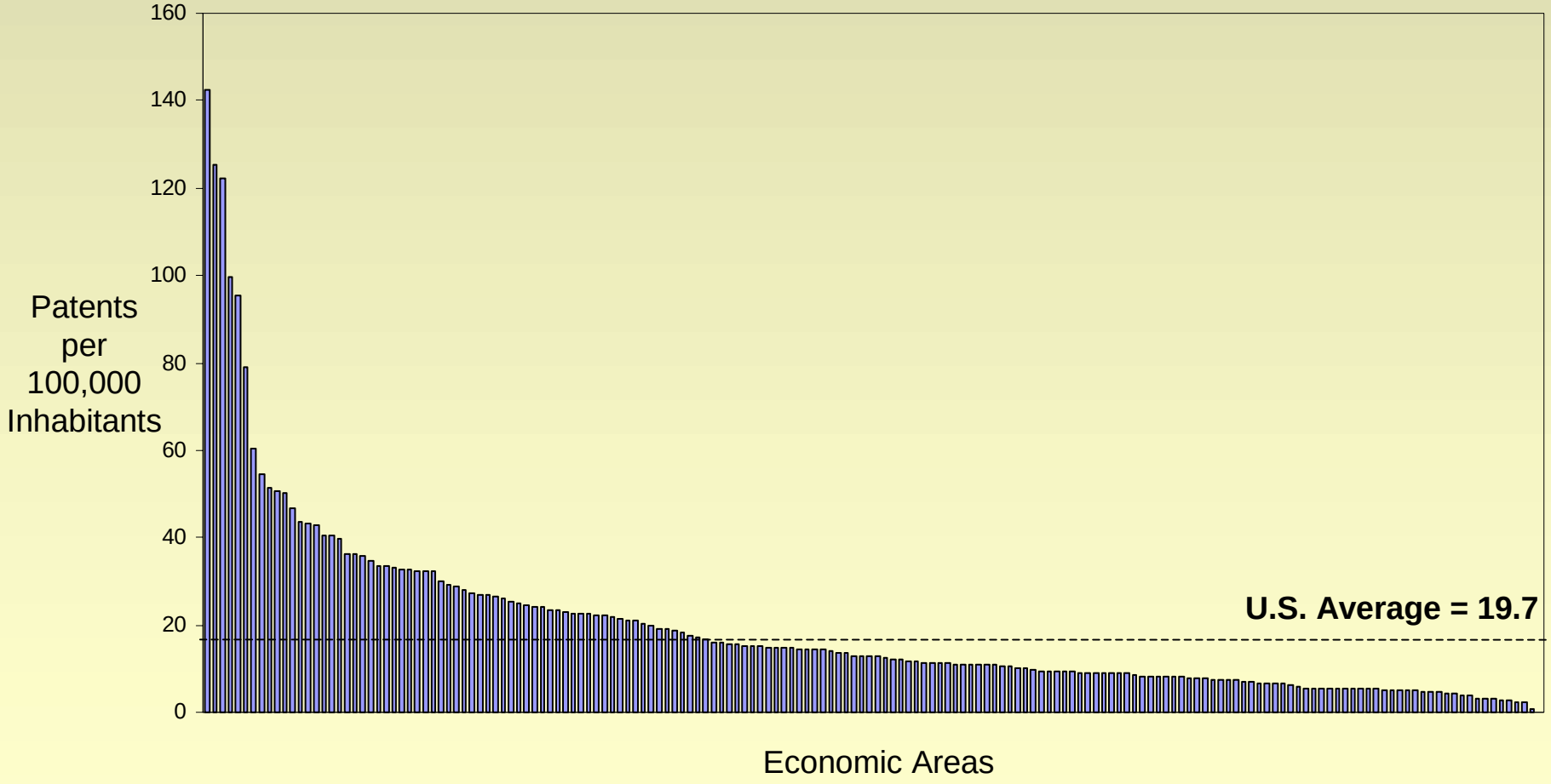
Average Wages and Employment Growth

U.S. Economic Areas



Innovation Performance Across Regions

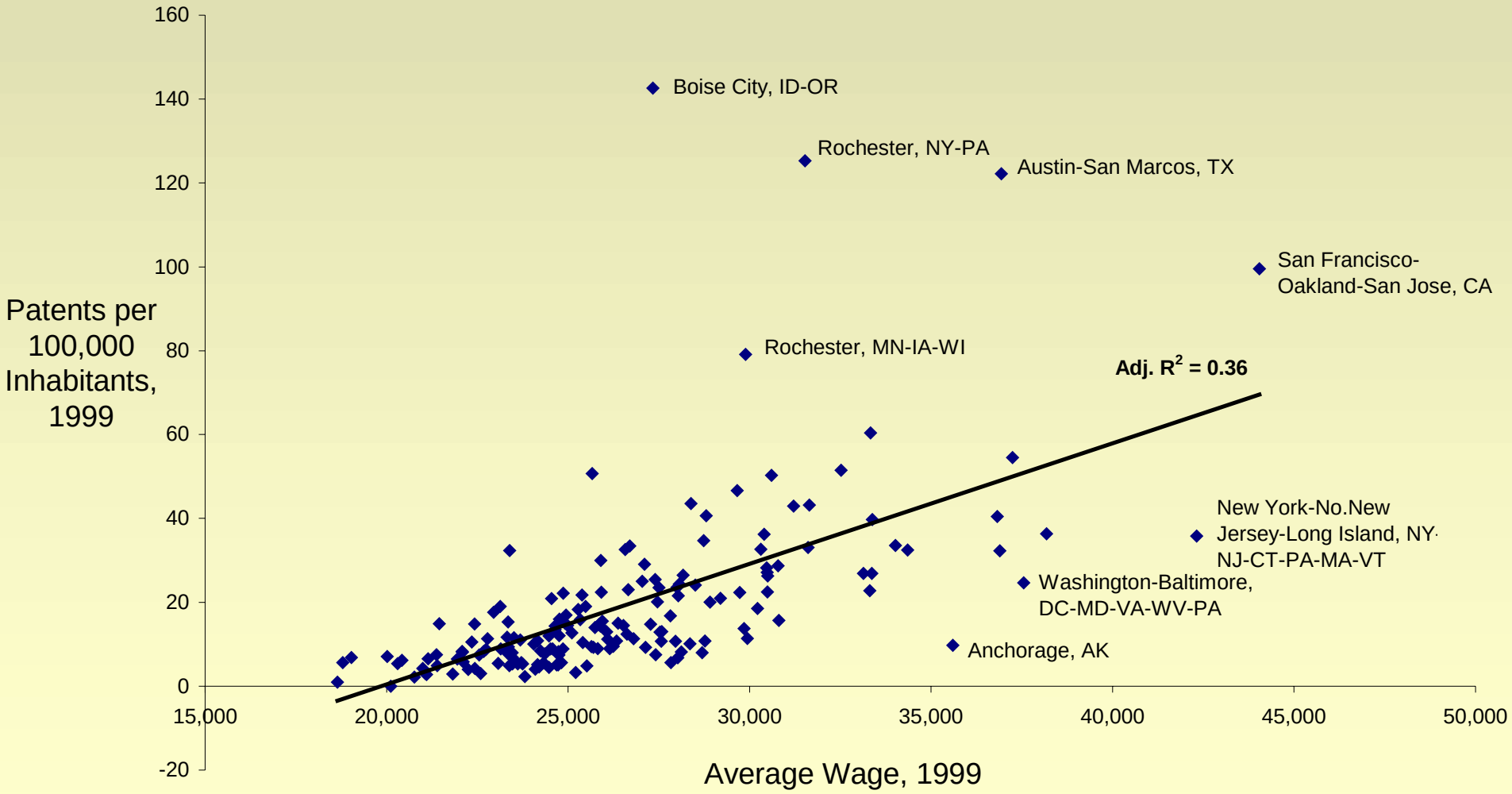
Patents per Capita, 1998



Note: There are 172 Economic Areas in the United States
Source: Cluster Mapping Project, Harvard Business School

Innovation and Prosperity

Patents per Inhabitant vs. Average Wages, U.S. Economic Areas, 1998



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

Economic Performance Measures

Overall Economy

Employment Growth
- Rate of employment growth

Unemployment
- Percentage of persons unemployed

Average Wages
- Payroll per person

Wage Growth
- Growth rate of payroll per person

Cost of Living
- Cost of living index

Exports
- Value of manufactured and commodity exports per worker

Innovation Output

Patents
- Number of patents and patents per worker

Establishment Formation
- Growth rate of establishments

Venture Capital Investments
- Value of venture capital invested

Initial Public Offerings
- Number of initial public offerings

Fast Growth Firms
- Number of firms on the Inc. 500 list

Atlanta Overview

Economic Performance

Employment Growth

- Annual employment growth from 1991–2001 in Atlanta MSA was 3.2% vs 1.9% for the US

Unemployment

- Unemployment rate (2.8% in 2000) was below the US and Georgia for the last decade

Average Wages

- Atlanta average wages in 1999 were $35,380 vs. $32,110 for the US

Wage Growth

- Average wage growth in Atlanta was 4.5% from 1990–1999 vs. 4.0% for the US

Cost of Living

- Atlanta cost of living is 10 to 20% higher than the US average

Exports

- 14.4% annual growth rate of Atlanta exports from 1993–1999 was nearly twice the national average

Innovation Output

Patents

- Patenting is low (4.7/10,000 employees), verses the national average of 6.3; growth is well above the US metro average

Establishment Growth

- Number of (traded cluster) establishments grew 9.0% annually from 1990 to 1999, 4 times the US average

Fast Growth Firms

- Strong growth in both INC 500 and Gazelle Firms over past 5 years

Venture Capital Investments

- VC investments over $2.6 billion from 1995–2000, but Atlanta's share of total national VC funding still trails other comparative regions

Initial Public Offerings

- IPOs increasing, but at rate below other high-growth regions

Source: Bureau of Labor Statistics; Bureau of Economic Analysis; International Trade Administration; U.S. Patent and Trademark Office; Price Waterhouse Cooper Money Tree; Hoover's IPO Central; Inc. Magazine; Fast Forward, Inc., Baker Thompson Associates

Economic Performance Indicators

Overview of the Pittsburgh Metro Area

Economic Performance

Employment

- Annual employment growth rate between 1991–2001 in the Pittsburgh MSA 0.3% vs. 1.9% for the U.S.

Unemployment

- Unemployment rate in the Pittsburgh MSA of 4.3% in 2001 vs. 4.4% for U.S.

Population

- The population of the Pittsburgh MSA is decreasing at 0.3% annually between 1990–1999 vs. 1.0% growth for the U.S.

Wages

- Average wage in the Pittsburgh MSA of $32,365 in 1999, vs. $32,711 for the U.S.; annual growth of wages equaled the U.S. growth rate

Exports

- Exports per worker in the Pittsburgh MSA were $3,416 in 1999 vs. $5,212 for the U.S.

Innovation Output

Patents

- 7.0 patents per 10,000 workers in the Pittsburgh MSA in 1999 vs. 6.3 for the U.S.; 1.3% annual growth in the MSA vs. 4.7% in U.S. from 1990–1999

Fast Growth Firms

- Pittsburgh had 0.8% of the firms on the Inc 500 between 1991–2000 vs. 0.9% of the U.S. employment

Venture Capital Investments

- VC investments of $301 per worker in Pittsburgh in 2000 vs. $387 for the U.S.

Initial Public Offerings

- Pittsburgh had 0.4 IPOs per 100,000 workers in the past 10 years, well below benchmarked regions

Establishment Growth

- The number of establishments in Pittsburgh grew 0.5% annually between 1990–1999, vs. 1.4% for the U.S.

Patents by Organization
Research Triangle MSA, 1995–1999

	Organization	Patents Issued from 1995 to 1999
1	International Business Machines Corporation	495
2	Ericsson, Inc.	325
3	Becton, Dickinson and Company	128
4	**North Carolina State University**	**128**
5	**Duke University**	**127**
6	**University of North Carolina — Chapel Hill**	**124**
7	Square D Company	48
8	Novartis	46
9	ABB Power T&D Company, Inc.	44
10	Alcatel Network Systems, Inc.	43
11	Mitsubishi Semiconductor America, Inc.	41
12	Lord Corporation	36
13	Kennametal, Inc.	29
14	Rhone-Poulenc, Inc.	29
15	Telefonaktiebolaget LM Ericsson	28
16	Caterpillar, Inc.	26
17	Cree Research, Inc.	26
18	E.I. DuPont De Nemours and Company	26
19	**MCNC**	**25**
20	Raychem Corporation	24
21	Reichhold Chemicals, Inc.	24
22	American Sterilizer Company	21
23	Siemens Energy and Automation, Inc.	21
24	Northern Telecom Limited	20
25	**Research Triangle Institute**	**20**

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

Patents by Organization
Wichita, EA, 1994–1998

Company	Patents Issued: 1994–1998
Coleman Company	95
Symbios Logic Inc.	20
Hay & Forage Industries	14
Wescon Products Company	12
Boeing Company	11
AT&T Global Information Solutions Company	10
Koch Engineering Co., Inc.	10
St. Francis Research Institute	**6**
Vulcan Materials Company	6
Cessna Aircraft Company	5
NCR Corporation	5
Tweco Products, Inc.	4
Via Christi Research, Inc.	**4**
Case Corporation	3
Pizza Hut	3
Beech Aircraft Corporation	2
Koch Industries, Inc.	2
Metal Fab Inc.	2
Uniflow Conveyor, Inc.	2
Turbochef, Inc.	2
Balco / Metalines, Inc.	2
Legg Company, Incorporated	2
The Bradbury Company, Inc.	2
The Women's Research Institute	**2**
Great Plains Manufacturing Incorporated	2

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

Patents by Universities

Rank	University	Total Patents, 1995–1999
1	University of California	1,585
2	Massachusetts Institute of Technology	605
3	University of Texas	444
4	Wisconsin University	339
5	Stanford University	335
6	California Institute of Technology	299
7	Johns Hopkins University	275
8	Cornell University	266
9	University of Pennsylvania	253
10	State University of New York	217
11	University of Michigan	209
12	Iowa State University	208
13	Michigan State University	200
14	Columbia University	196
15	University of Minnesota	180
16	University of Washington	173
17	Harvard University	164
18	University of North Carolina	154
19	Washington University	151
20	Duke University	139
21	University of British Columbia	137
22	North Carolina State University	129
23	University of Nebraska	122
24	University of Utah	121
25	Penn State University	116

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

Agenda

- The Economic Performance of Regions
- **The Composition of Regional Economies**
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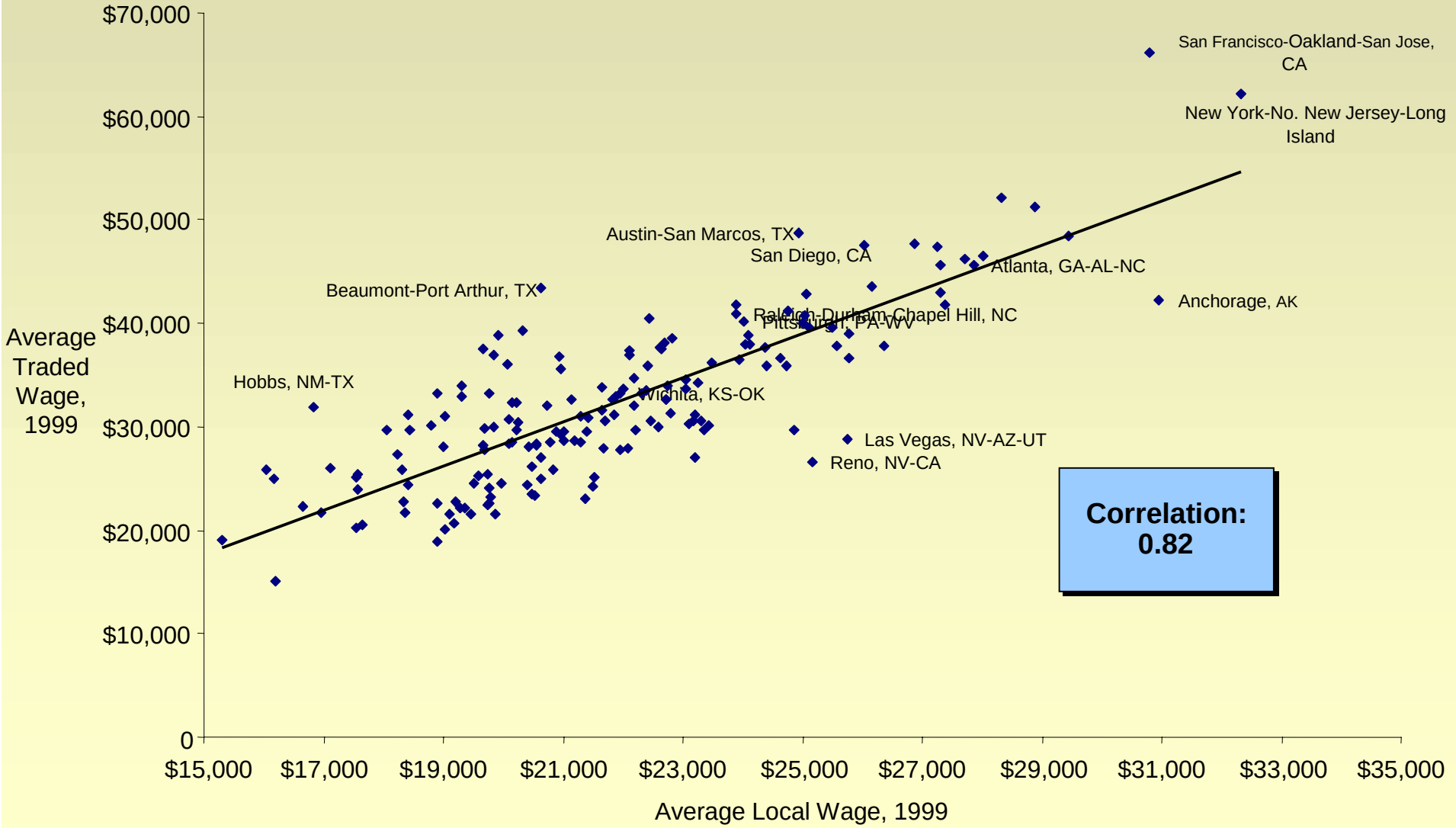
Composition of Regional Economies
United States

	Traded Clusters	Local Clusters	Natural Resource-Driven Industries
Share of Employment	32.1%	67.1%	0.8%
Employment Growth, 1993 to 1999	2.5%	2.8%	-0.1%
Average Wage	$41,678	$26,049	$31,264
Relative Wage	134.0	83.8	100.5
Wage Growth	5.0%	3.8%	2.5%
Relative Productivity	144.1	79.3	139.5
Patents per 10,000 Employees	20.48	1.38	6.40
Number of SIC Industries	592	241	46

Note: 1999 data, except relative productivity which is 1997 data, and patents data which is 1998 data
Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Economic Importance of Traded Clusters

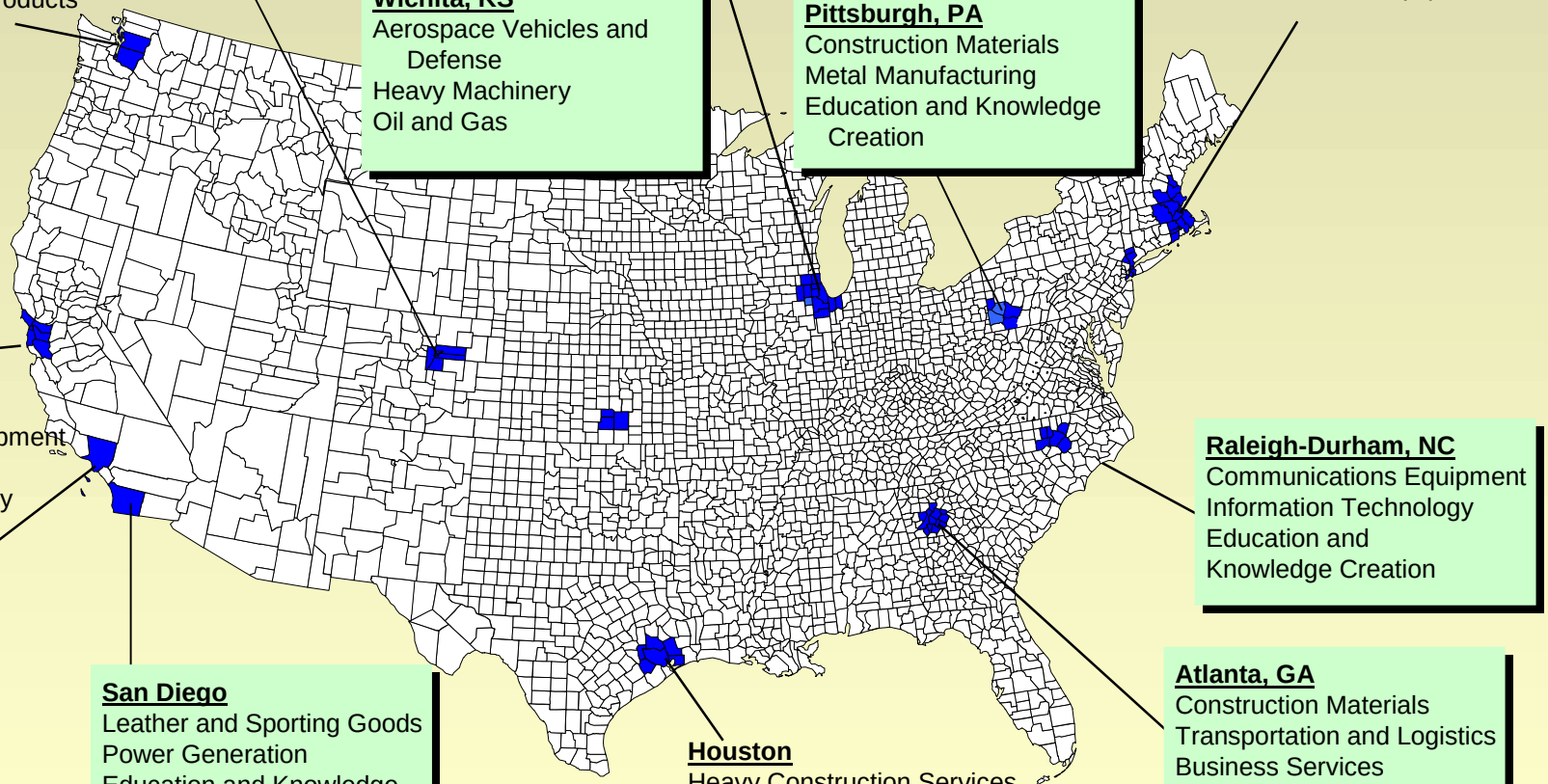
Traded vs. Local Wages by Economic Area, 1999



The Composition of Regional Economies

Specialization of Regional Economies

Select Geographic Areas



Denver, CO
Leather and Sporting Goods
Oil and Gas
Aerospace Vehicles and Defense

Chicago
Communications Equipment
Processed Food
Heavy Machinery

Boston
Analytical Instruments
Education and Knowledge Creation
Communications Equipment

Seattle-Bellevue-Everett, WA
Aerospace Vehicles and Defense
Fishing and Fishing Products
Analytical Instruments

Wichita, KS
Aerospace Vehicles and Defense
Heavy Machinery
Oil and Gas

Pittsburgh, PA
Construction Materials
Metal Manufacturing
Education and Knowledge Creation

San Francisco-Oakland-San Jose Bay Area
Communications Equipment
Agricultural Products
Information Technology

Raleigh-Durham, NC
Communications Equipment
Information Technology
Education and Knowledge Creation

Los Angeles Area
Apparel
Building Fixtures, Equipment and Services
Entertainment

San Diego
Leather and Sporting Goods
Power Generation
Education and Knowledge Creation

Houston
Heavy Construction Services
Oil and Gas
Aerospace Vehicles and Defense

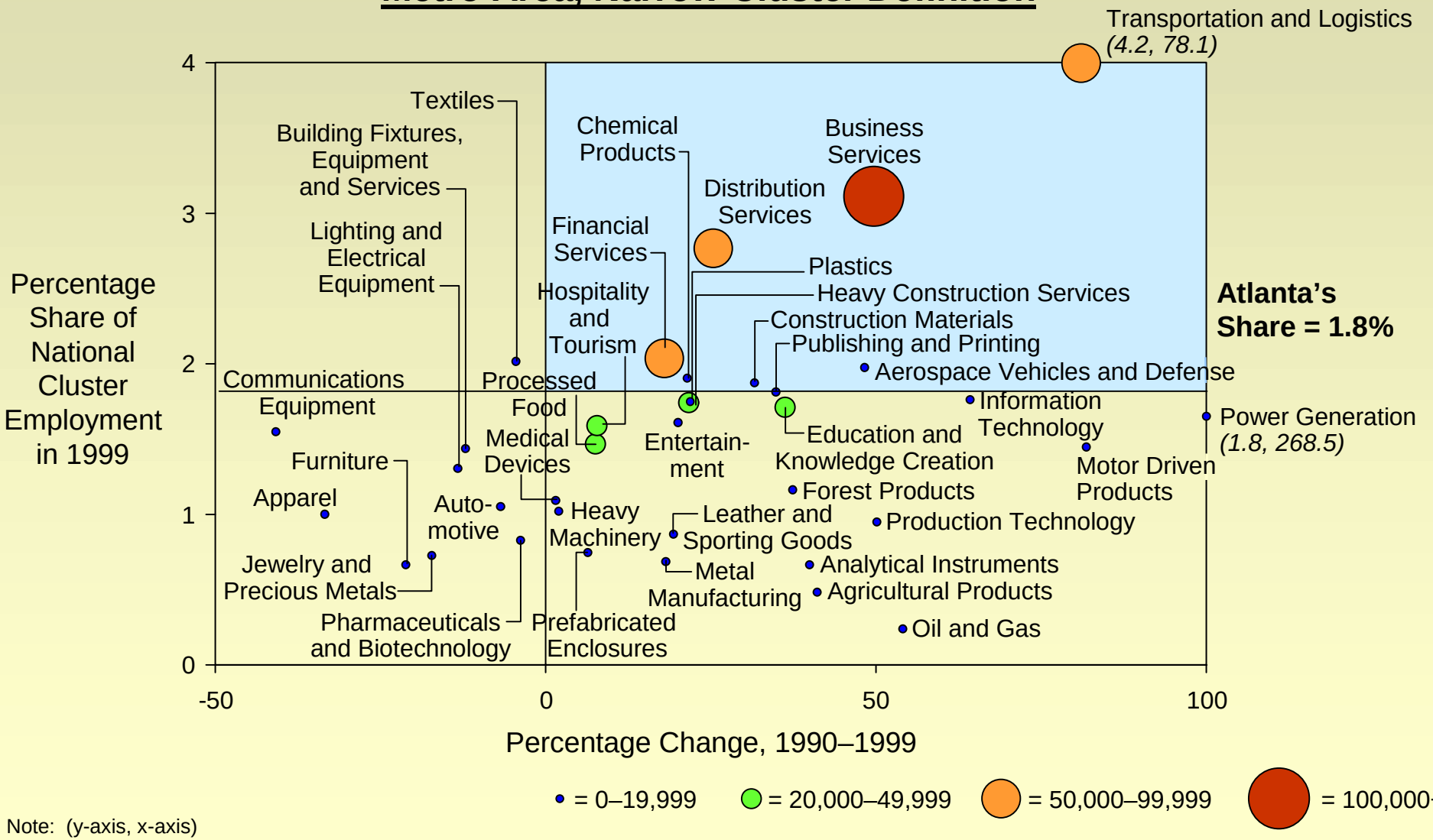
Atlanta, GA
Construction Materials
Transportation and Logistics
Business Services

Note: A geographic area can be either a Metropolitan Area (MSA, PMSA, CMSA or NECMA) or Economic Area as defined by the Bureau of the Census and Bureau of Economic Analysis, respectively. Clusters are the three highest ranking clusters in terms of share of national employment.

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

Specialization of the Atlanta Economy

Traded Clusters by Relative Size and Growth Rate, Metro Area, Narrow Cluster Definition



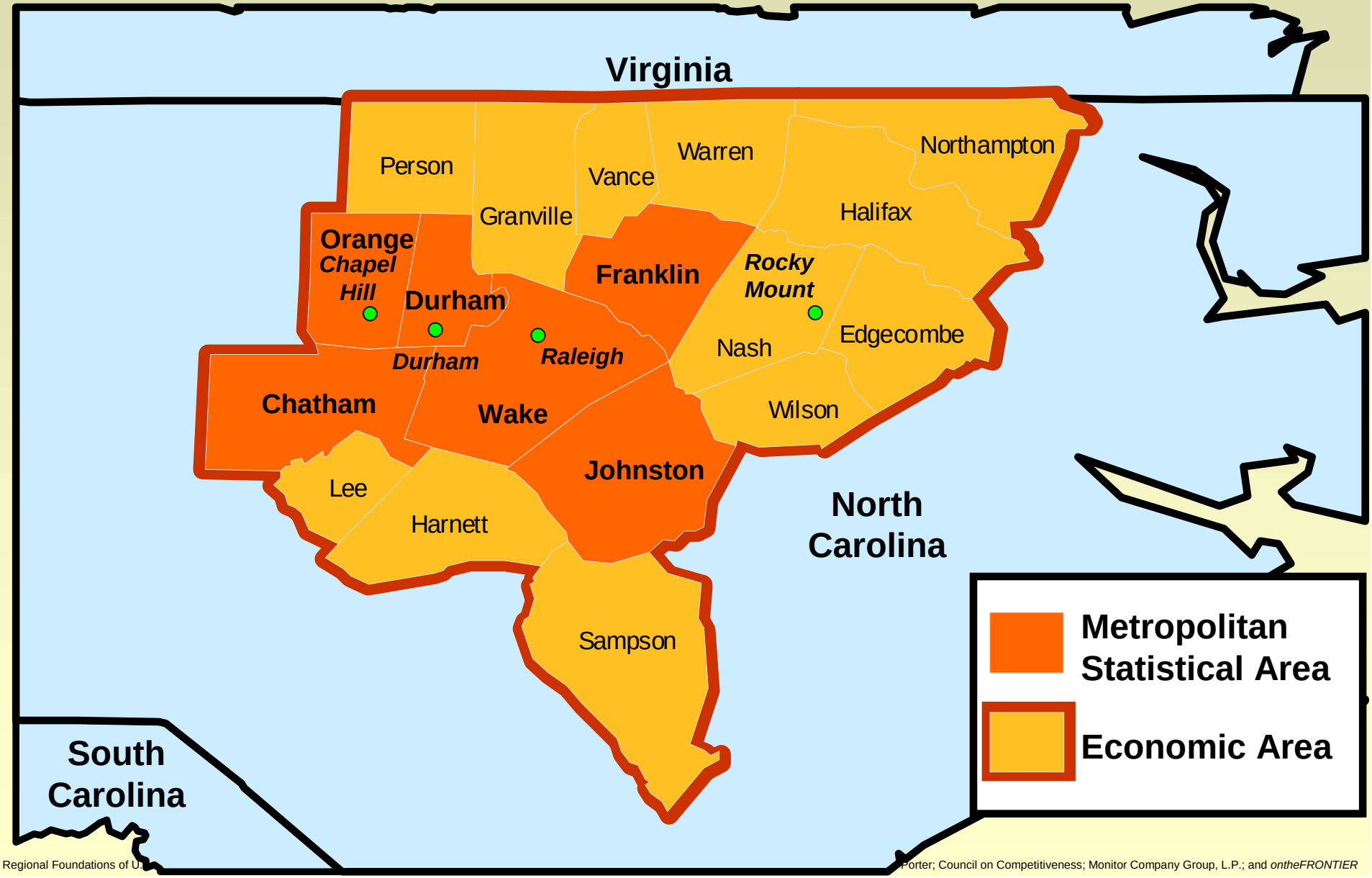
Note: (y-axis, x-axis)

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

The Composition of Regional Economies

Raleigh-Durham-Chapel-Hill

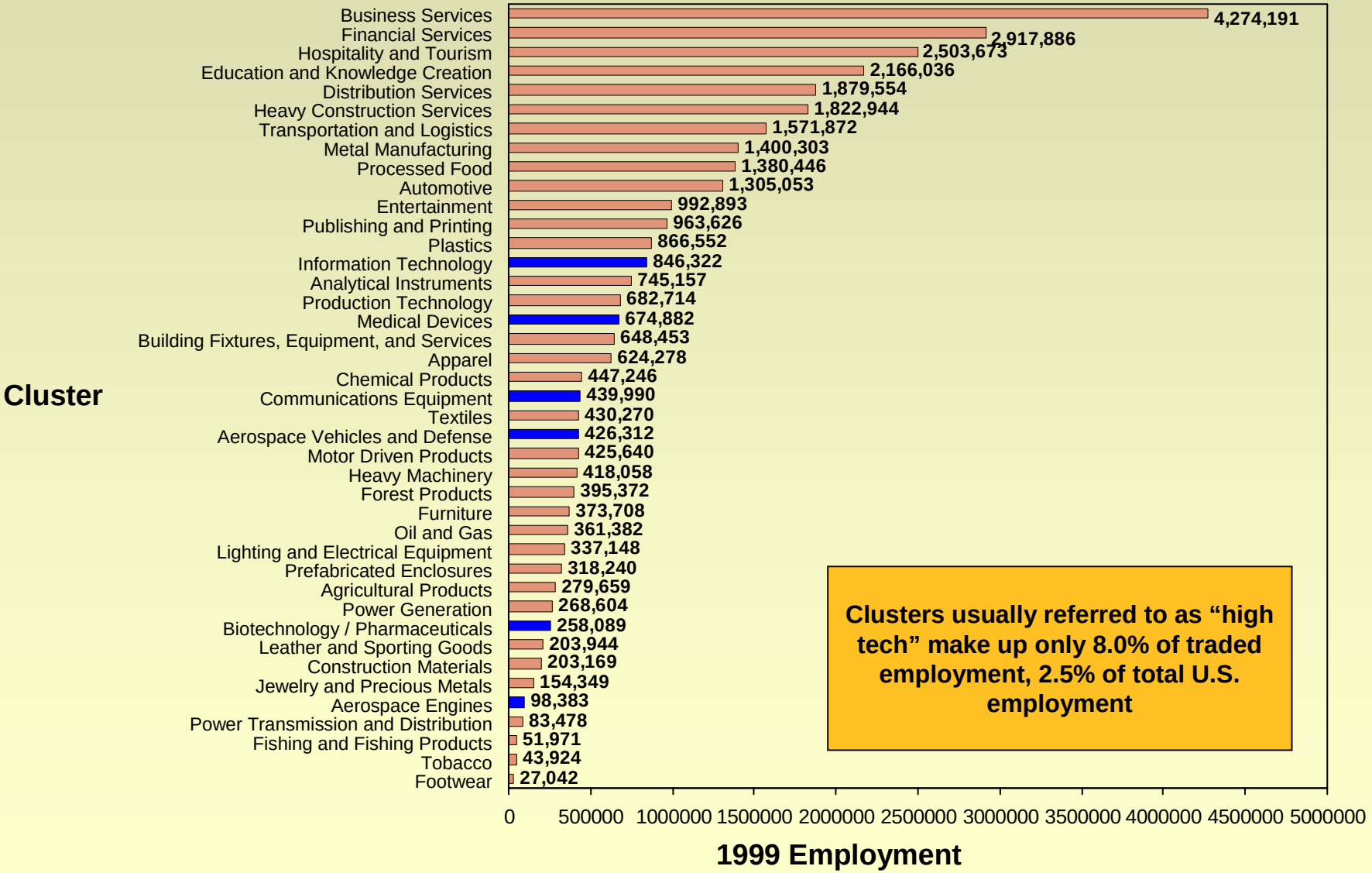
Metropolitan Statistical Area (MSA) and Economic Area (EA)



Regional Foundations of U… Porter; Council on Competitiveness; Monitor Company Group, L.P.; and *ontheFRONTIER*

Total Employment in Traded Clusters

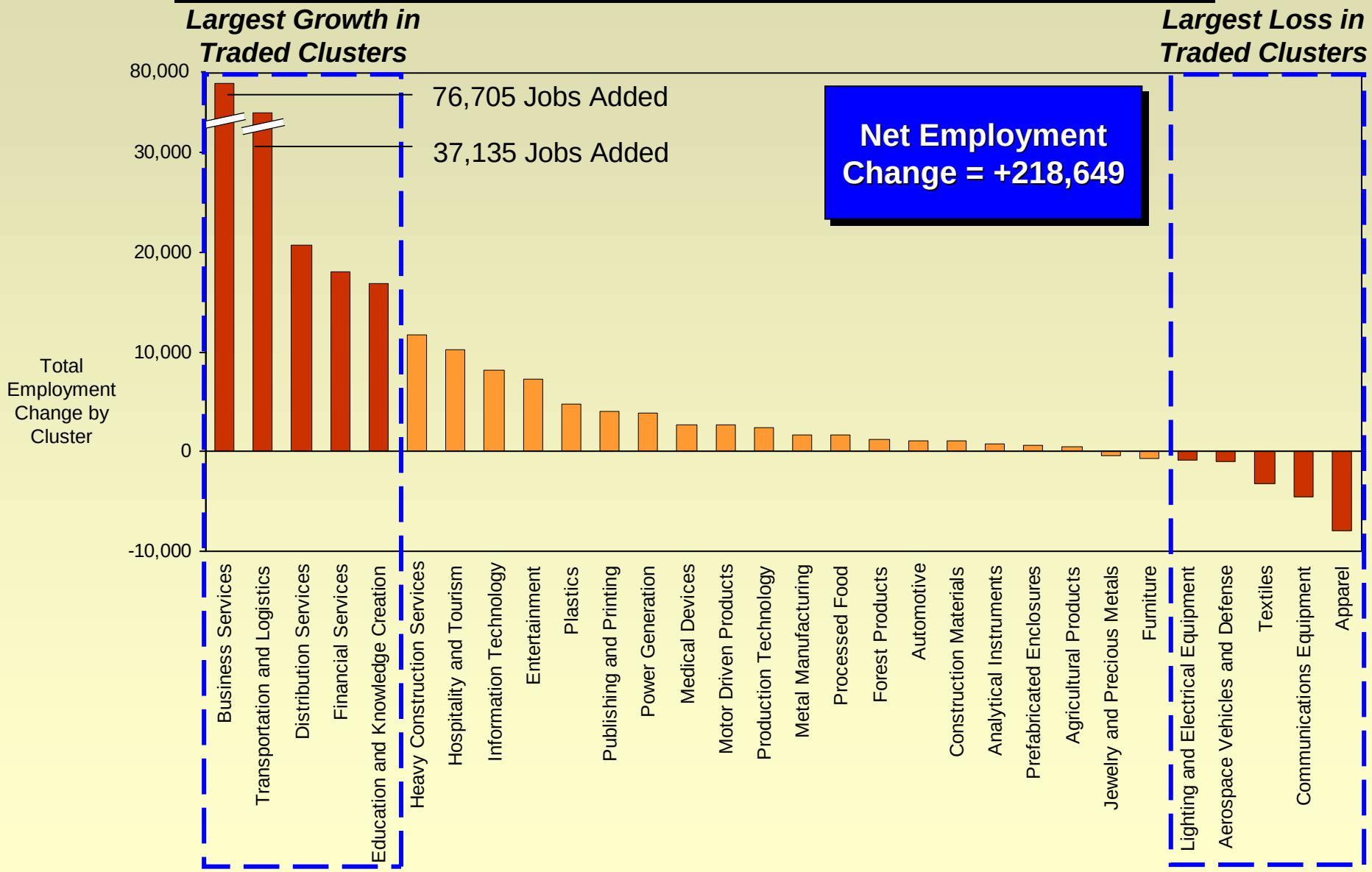
United States



The Composition of Regional Economies

Atlanta Metro Area

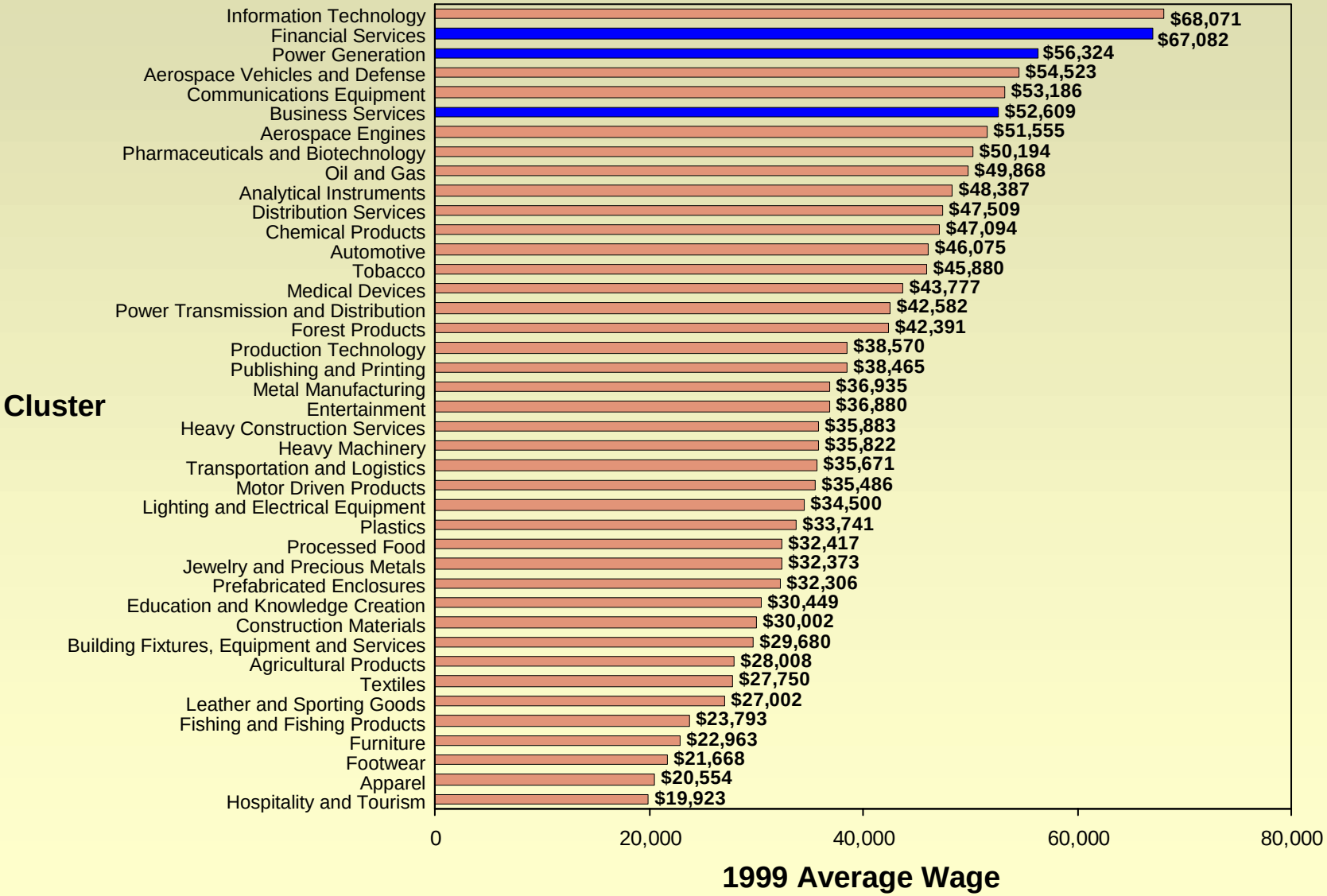
Job Creation by Cluster, 1990–1999, Narrow Cluster Definition



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

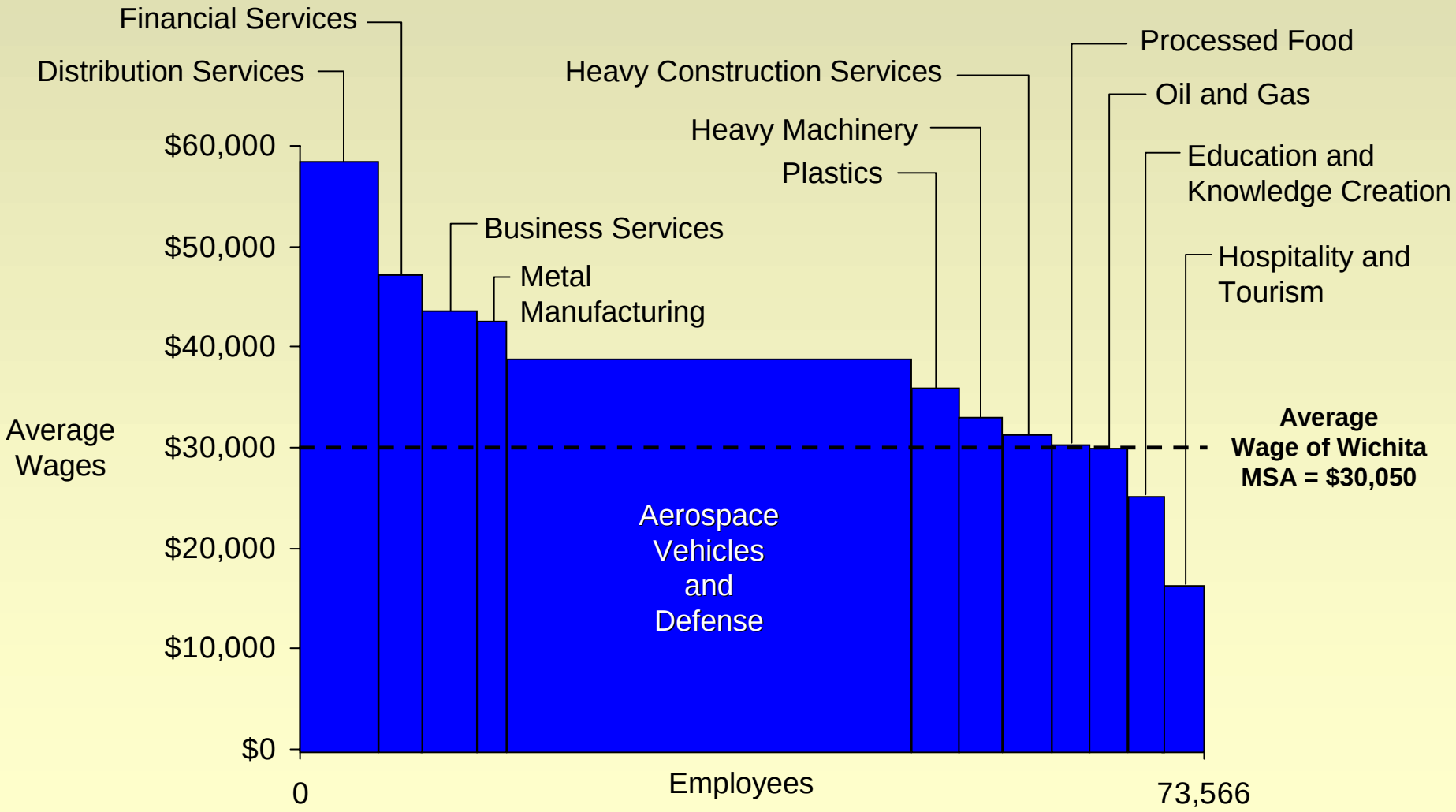
Average Wages in Traded Clusters

United States



Wichita's Leading Clusters by Employment

Average Wages MSA, Narrow Cluster Definition, 1998



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

Implications

- **Defining the right region**
  - Regions tend to follow political jurisdictions in defining the economic region
  - A broader geographic definition widens opportunities and brings constituencies together
- **Building a strategy**
  - Successful regions build on their unique assets and strong clusters
  - Strength then spreads to additional clusters over time
- **Clusters of clusters**
  - Focus on a few clusters exposes a regional economy to the booms and busts
  - Regional strategy should encompass a wide range of clusters, and be attentive to clusters that overlap
- **Widen innovative capacity to many clusters**
  - "High-tech" accounts for a small percentage of a regional economy
  - To meaningfully increase overall regional prosperity, innovative capacity must be built in many clusters

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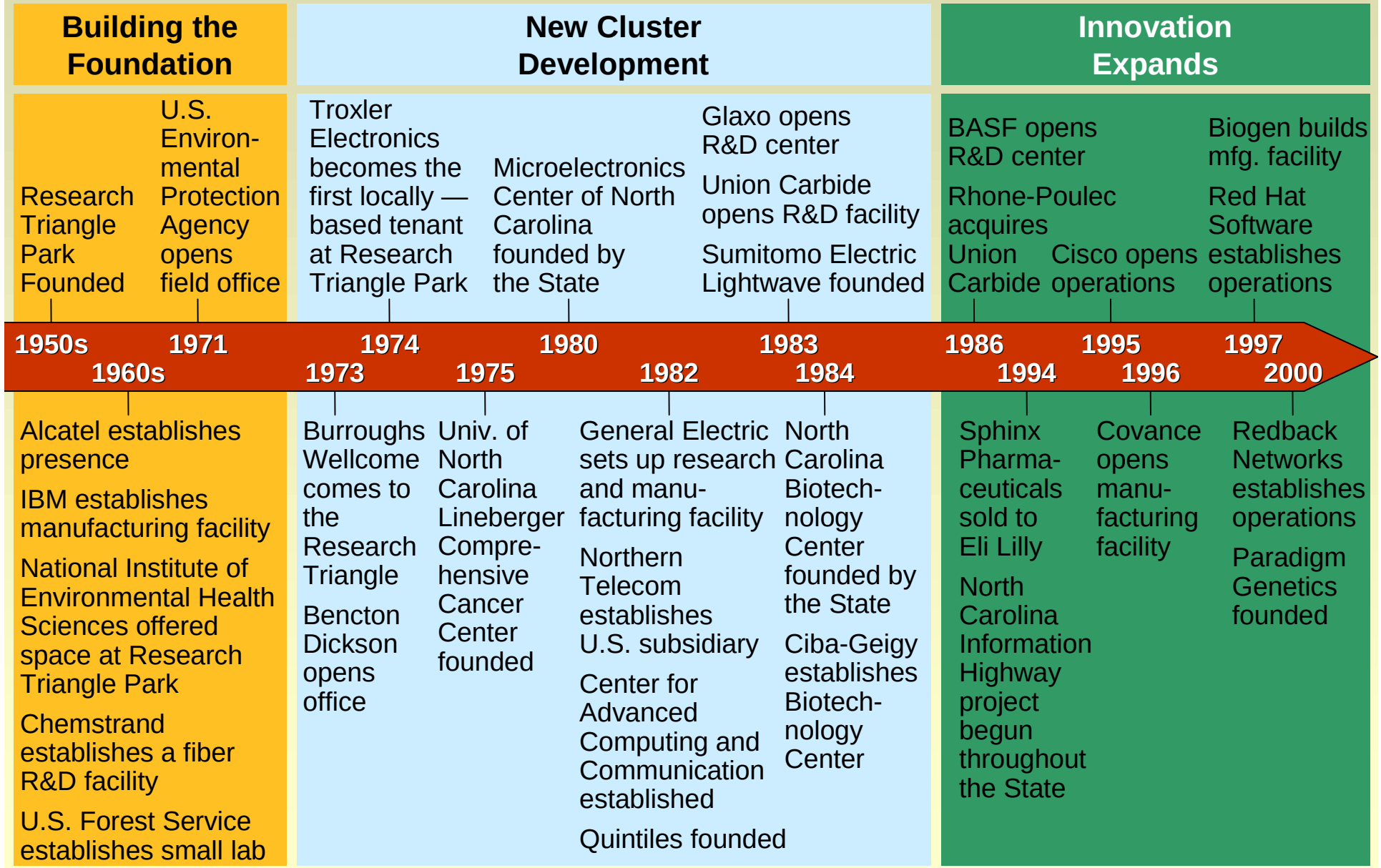
The Evolution of Regional Economies

Four Decades of Development in Research Triangle

Timeline of the Regional Economy



The Evolution of Regional Economies

Pittsburgh Economic Development

Timeline

Innovation in Manufacturing

1868 — Westing-house invents the airbrake as one of over 360 patents

1873 — Andrew Carnegie opens Edgar Thompson Works; prototypes Bessemer Converter successfully

1888 — Charles Hall discovers inexpensive process for smelting aluminum; basis for Alcoa

1901 — U.S. Steel goes public at $1.4 Billion

Carnegie Institute opens

University of Pittsburgh founded

Manufacturing Retrenchment

1950 — U.S. mills expand with old, blast furnace technology and fall behind foreign rivals

1959 — Pittsburgh supplies 60% of U.S. steel market

Fourth steel strikes in 15 years, at 116 days, sends firms to Europe to source steel

1973 — Management agrees to steel salaries at 2x the mfg wage companies

Carnegie Mellon begins computer curriculum

1984 — Chevron buys Pittsburgh based Gulf

University of Pittsburgh's Dr. Starzl and Dr. Bahnson perform world's first double transplant operation

Pittsburgh Tech Council formed

1985 — Westinghouse buys Unimatics Robotics

Carnegie Mellon develops Robotics Institute

1986 — USX 6 month strike; 150,000 jobs lost since 1970s.

Westinghouse begins major downsizing

Pittsburgh Super-computing Center established

New Cluster Development

1992 — Carnegie Mellon opens computer school;

U of Pitt opens Center for Biotech and Bioengineering

1993 — Steel firms back at tech parity with foreign firms; moving to specialty steel

Union starts collaborative Negotiation

Rockwell, Raytheon, Hugh Ball, Lockheed, GE close local facilities

1994 — Seagate, Rand research locate in Pittsburgh

1996 — UPMC opens Center for Biomedical Informatics

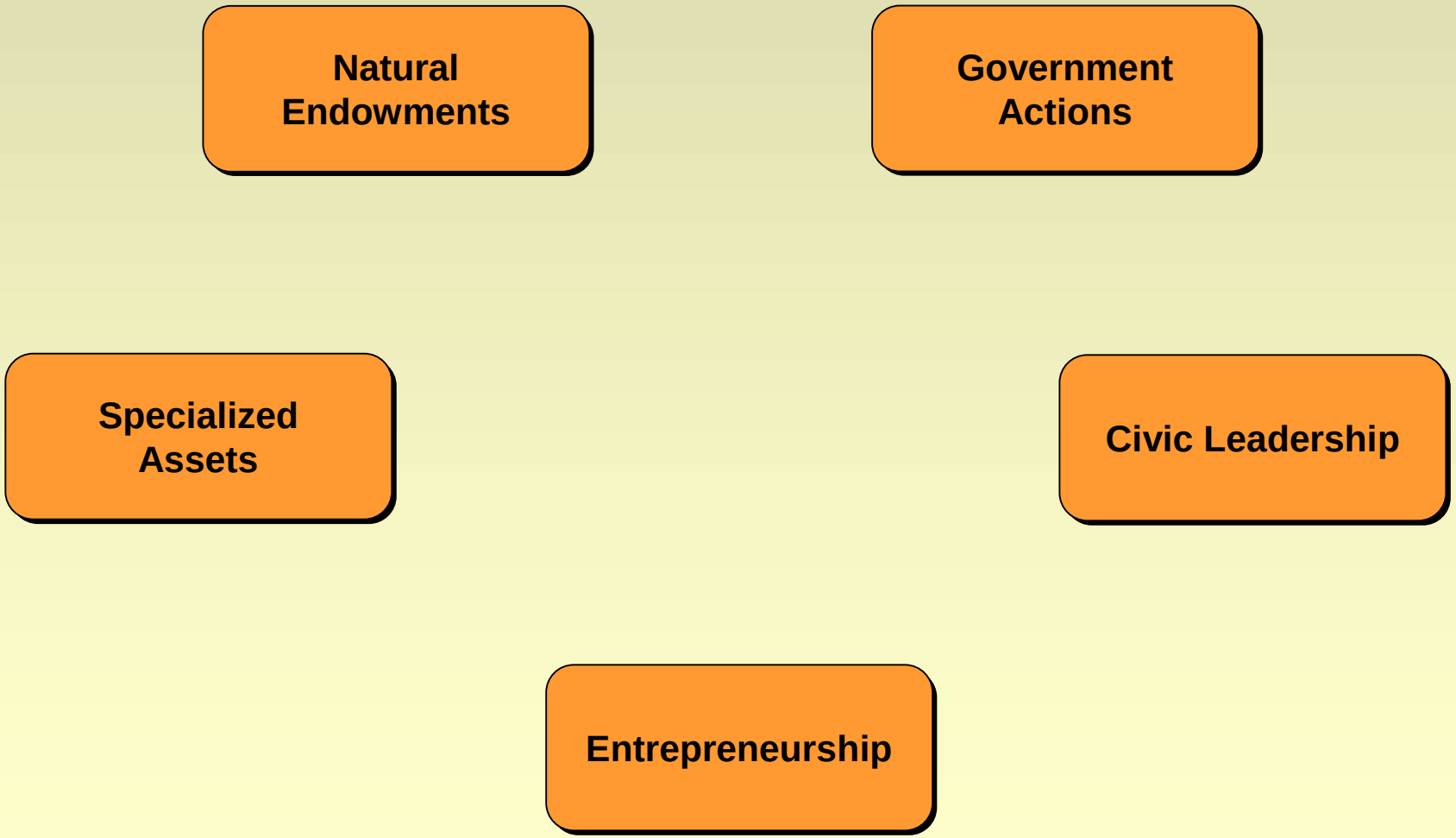
1997 — Carnegie Mellon, U of Pittsburgh professors spin-off firms such as FORE Systems; Tissue Infomatics, Automated Healthcare Robotics

1998 — VC funding over $500 million in 5 years;

2000 — Digital Greenhouse begins

ittsburgh as 8 ortune 00 firms – remain om 19 in 970

Key Influencing Factors



Institutions for Collaboration

Selected Institutions for Collaboration in Pittsburgh

Private Sector

- Pittsburgh Regional Alliance
- Cluster Specific Organizations — i.e., SPIRC
- Pittsburgh Technology Council
- Pittsburgh Biomedical Development Corporation
- Industrial Research Center for Manufacturing
- Advanced Manufacturing Network
- Regional Industrial Development Authority

Joint Private / Public

- Pittsburgh Digital Greenhouse
- Pittsburgh World Trade Center
- Governor's Action Team
- Allegheny Conference on Community Development

Informal Networks

- Carnegie Mellon University Alumni
- University of Pittsburgh Alumni
- Duquesne University Alumni
- Angel investor community

Public Sector

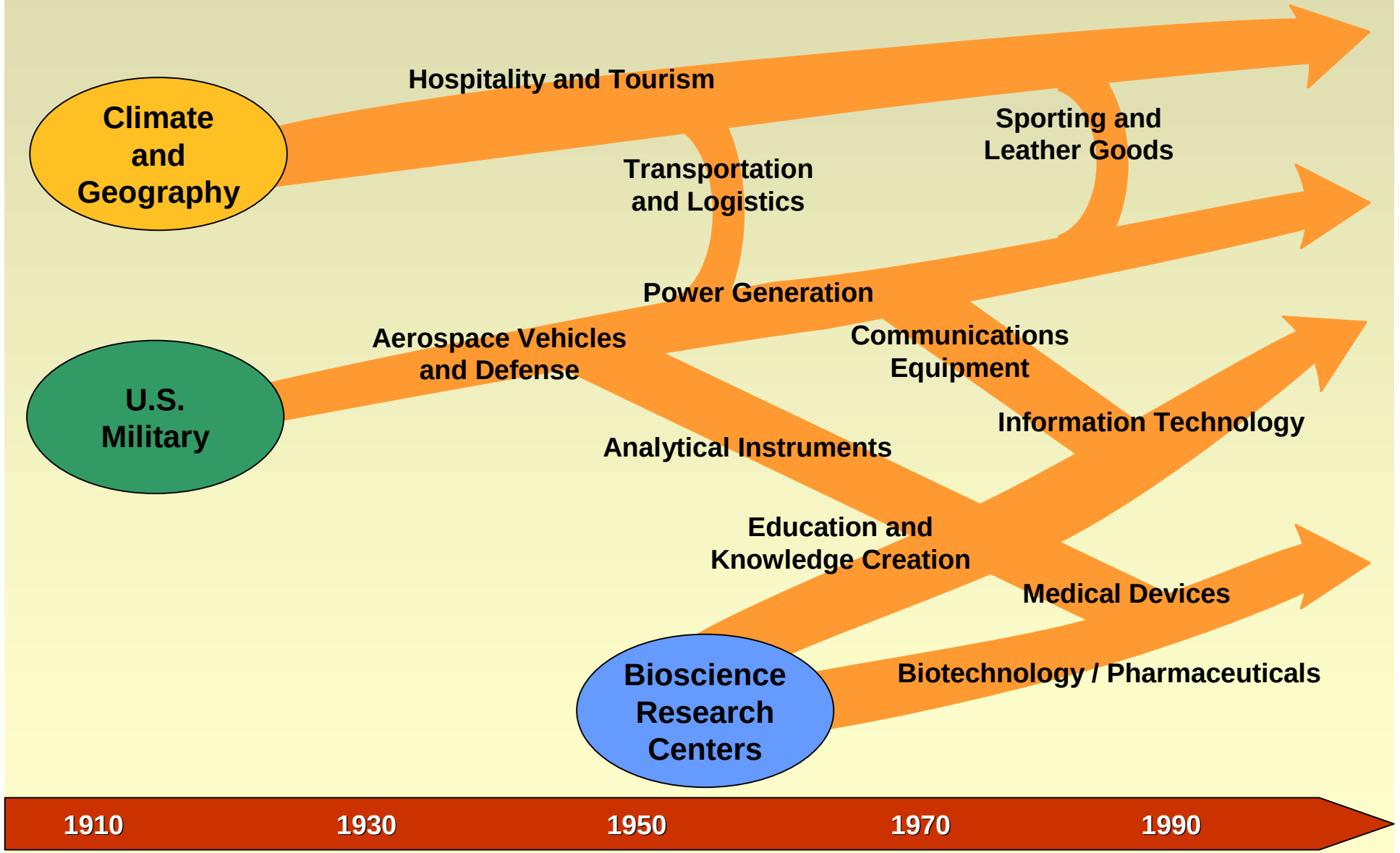
- Small Business Administration
- Center for Economic Development
- Small Business Development Center
- Allegheny Working Together Consortium
- SWPA Regional Development Council
- Innovation Works

Source: Interviews, Organization's Websites

The Evolution of Regional Economies

- Building strong regional economies takes decades
- Key influencing factors include
  - Natural endowments
  - Government actions
  - Civic leadership
  - Entrepreneurship
  - Specialized assets
- Institutions for collaboration play in important role in building regional economies
- Regional development involves some inheritance and serendipity, but also purposeful action
- Successful regions leverage their unique mix of assets to build specialized clusters

The Military, Climate, and Research in San Diego



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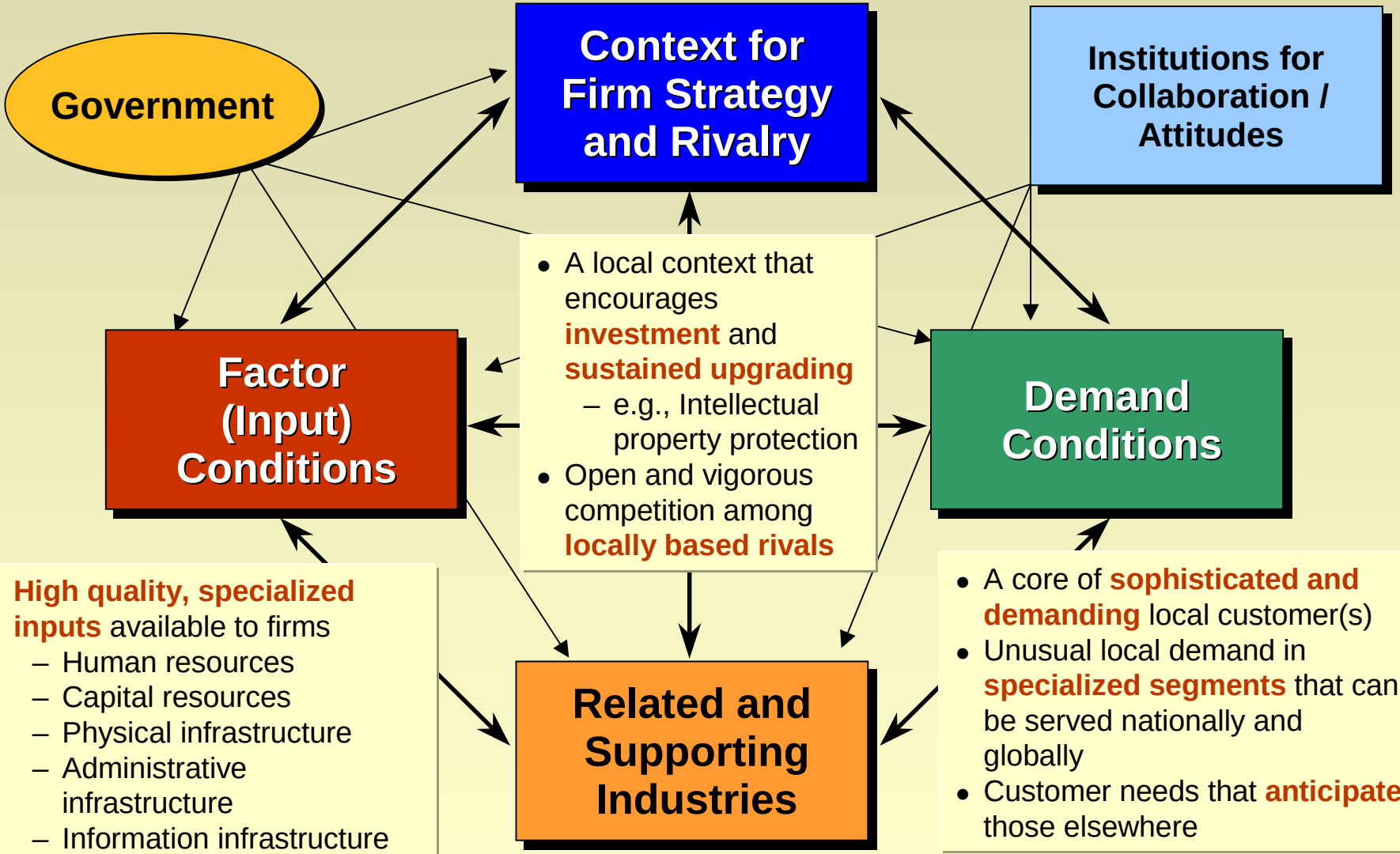
The Determinants of Regional Competitiveness and Innovative Capacity

Productivity and the Regional Business Environment



- A local context that encourages **investment** and **sustained upgrading**
  - e.g., Intellectual property protection
- Open and vigorous competition among **locally based rivals**

- **High quality, specialized inputs** available to firms
  - Human resources
  - Capital resources
  - Physical infrastructure
  - Administrative infrastructure
  - Information infrastructure
  - Scientific and technological infrastructure
  - Natural resources

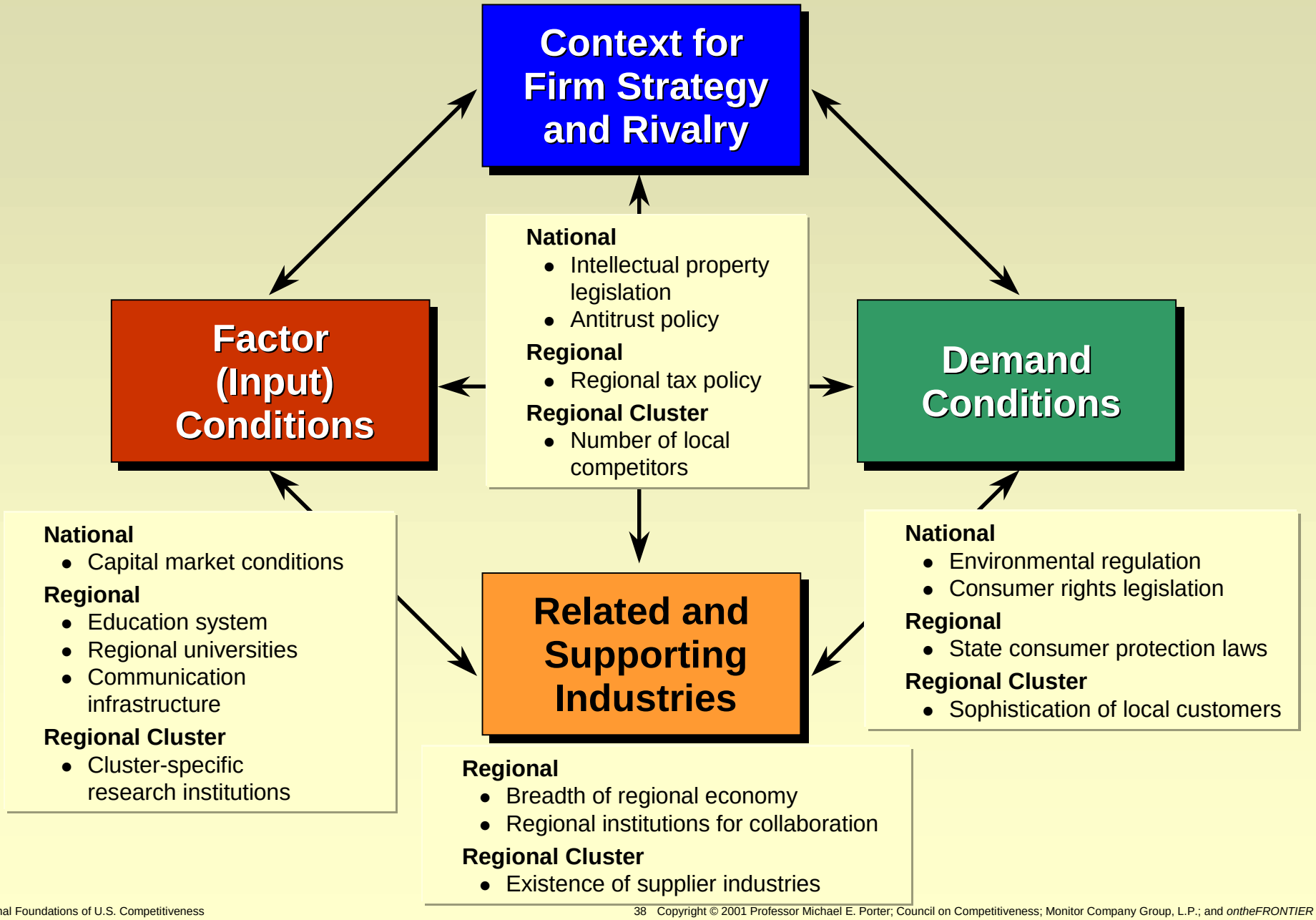
- A core of **sophisticated and demanding** local customer(s)
- Unusual local demand in **specialized segments** that can be served nationally and globally
- Customer needs that **anticipate** those elsewhere

- Availability of capable, locally based **suppliers** and firms in **related fields**
- Presence of **clusters** instead of isolated industries

ouncil on Competitiveness; Monitor Company Group, L.P.; and *ontheFRONTIER*

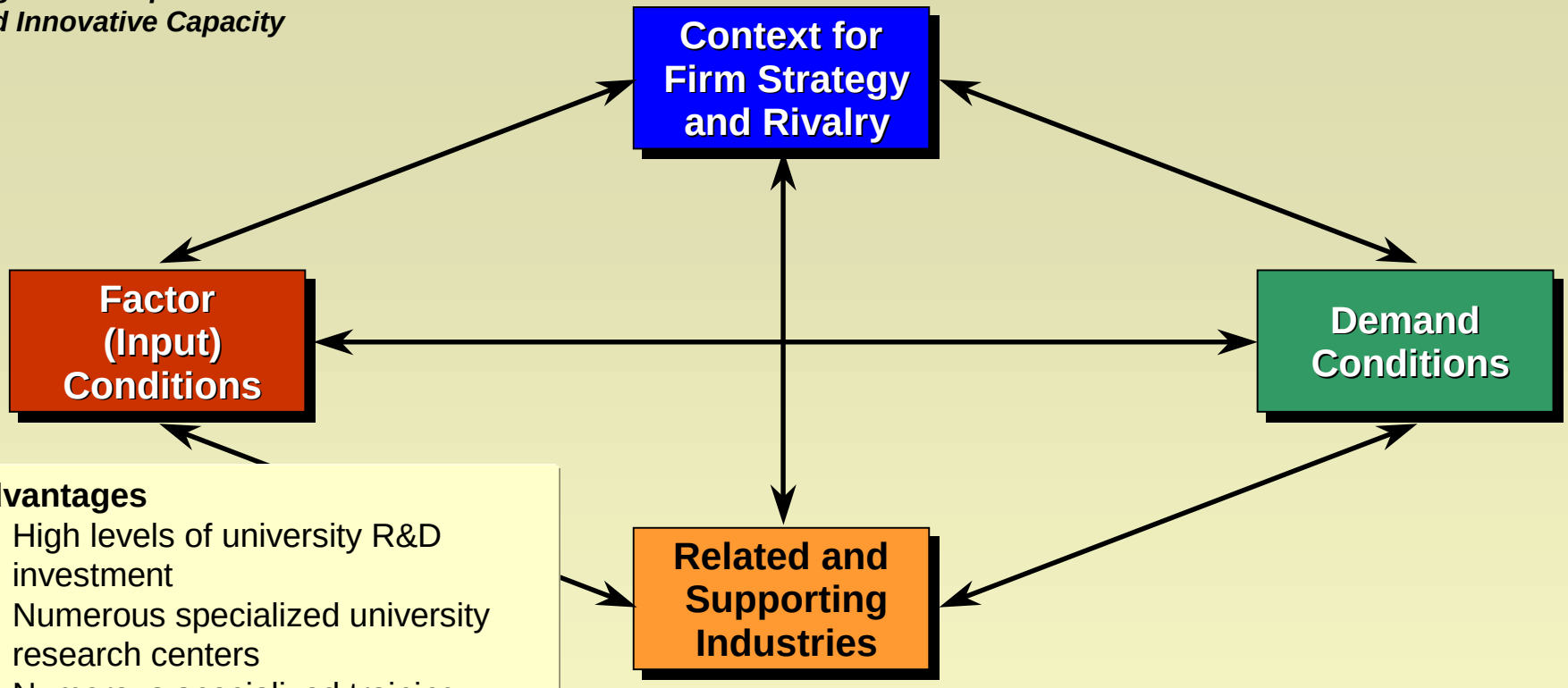
The Determinants of Regional Competitiveness and Innovative Capacity

Productivity and the Regional Business Environment



Pittsburgh's Competitive Position

The Determinants of Regional Competitiveness and Innovative Capacity



Advantages

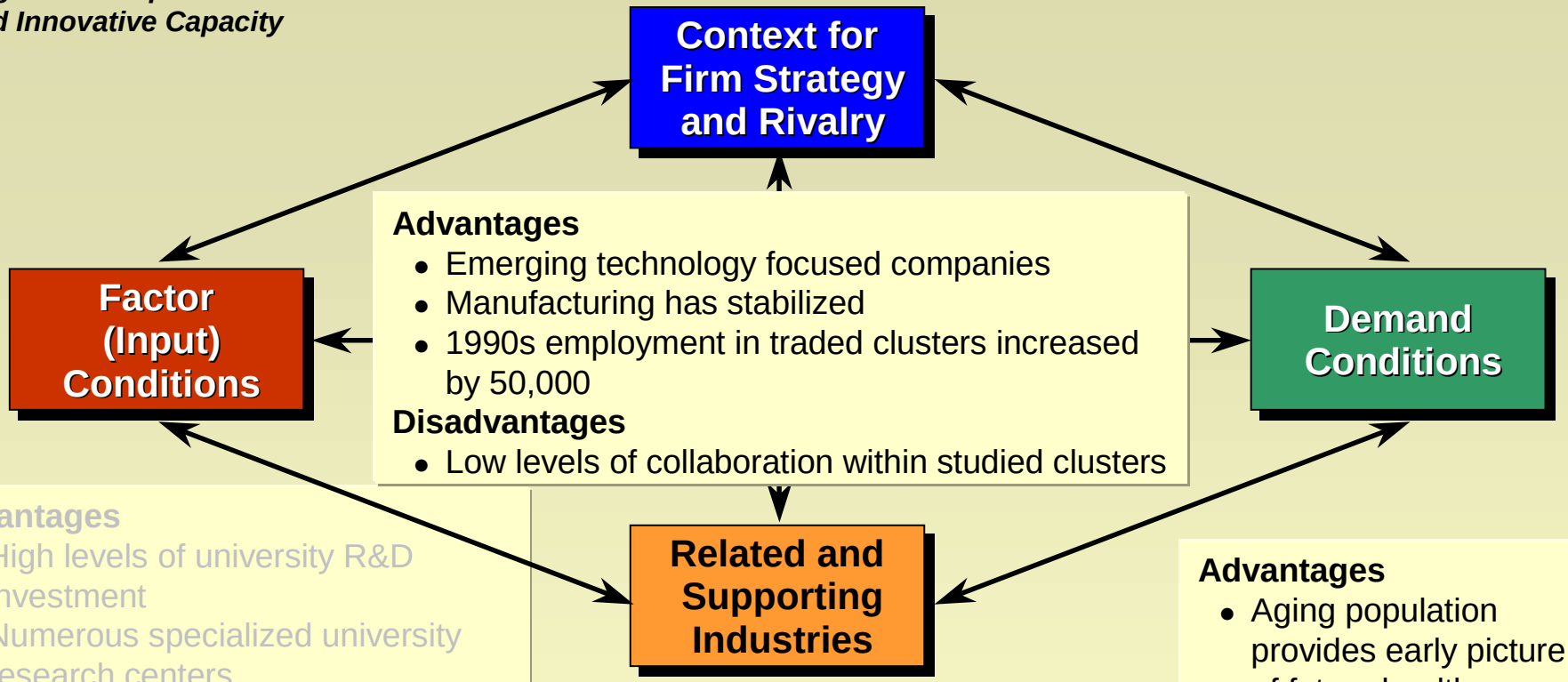
- High levels of university R&D investment
- Numerous specialized university research centers
- Numerous specialized training institutions
- Large pool of scientists, engineers, and technicians
- New airport

Disadvantages

- Declining Corporate R&D
- Traffic congestion in the metro area
- Old physical infrastructure
- Difficulty retaining younger workers
- Challenging environment for entrepreneurship

Pittsburgh's Competitive Position

The Determinants of Regional Competitiveness and Innovative Capacity



Advantages
- Emerging technology focused companies
- Manufacturing has stabilized
- 1990s employment in traded clusters increased by 50,000

Disadvantages
- Low levels of collaboration within studied clusters

Advantages
- High levels of university R&D investment
- Numerous specialized university research centers
- Numerous specialized training institutions
- Large pool of scientists, engineers, and technicians
- New airport

Disadvantages
- Declining Corporate R&D
- Traffic congestion in the metro area
- Old physical infrastructure
- Difficulty retaining younger workers
- Challenging environment for entrepreneurship

Advantages
- Traditional clusters have established suppliers, legal firms, etc.

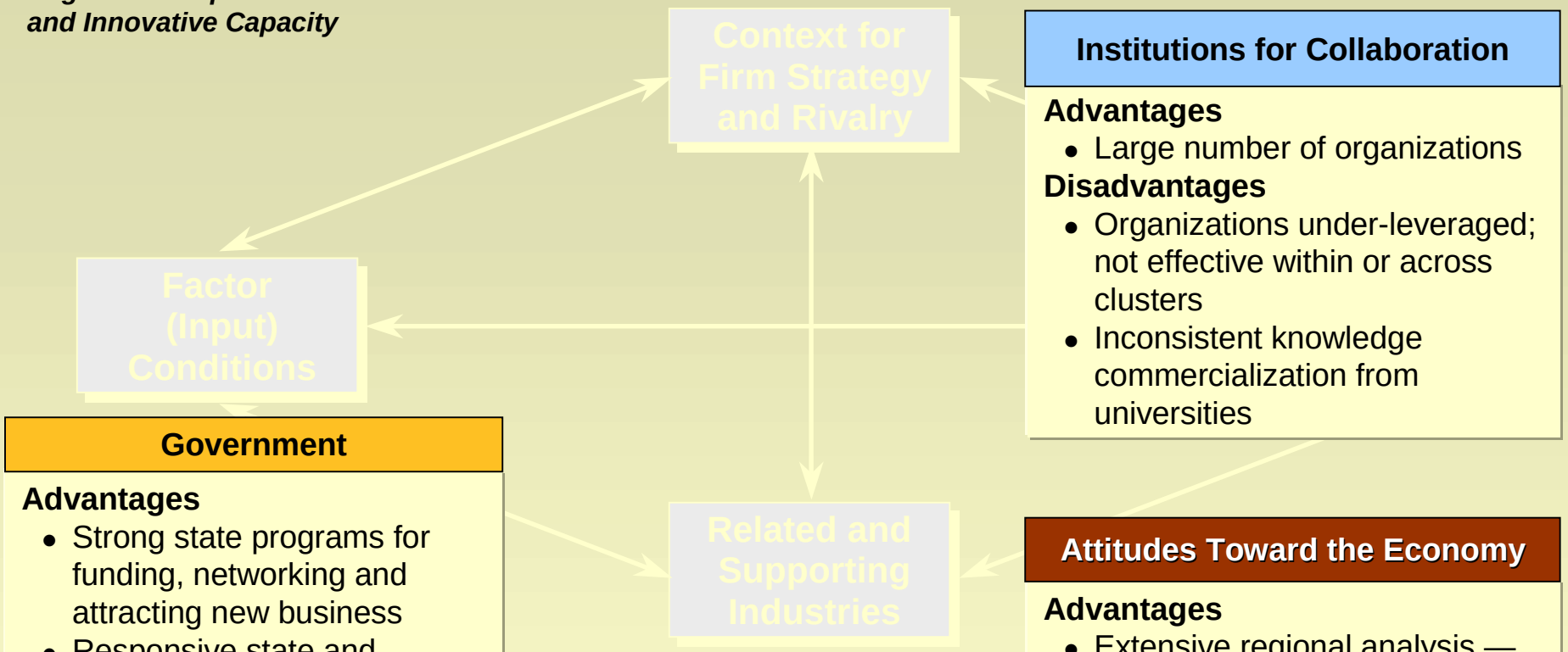
Disadvantages
- Emerging clusters have relatively weak local supporting organizations

Advantages
- Aging population provides early picture of future health care needs of U.S.

Disadvantages
- Infrequent contact and learning from local customers
- Local demand not perceived to be an advantage

The Determinants of Regional Competitiveness and Innovative Capacity

Pittsburgh's Competitive Position



Institutions for Collaboration

Advantages
- Large number of organizations

Disadvantages
- Organizations under-leveraged; not effective within or across clusters
- Inconsistent knowledge commercialization from universities

Government

Advantages
- Strong state programs for funding, networking and attracting new business
- Responsive state and regional government
- High levels of federal funding for R&D in the region

Disadvantages
- Fragmented local government
- Local government focused on needs of established companies

Attitudes Toward the Economy

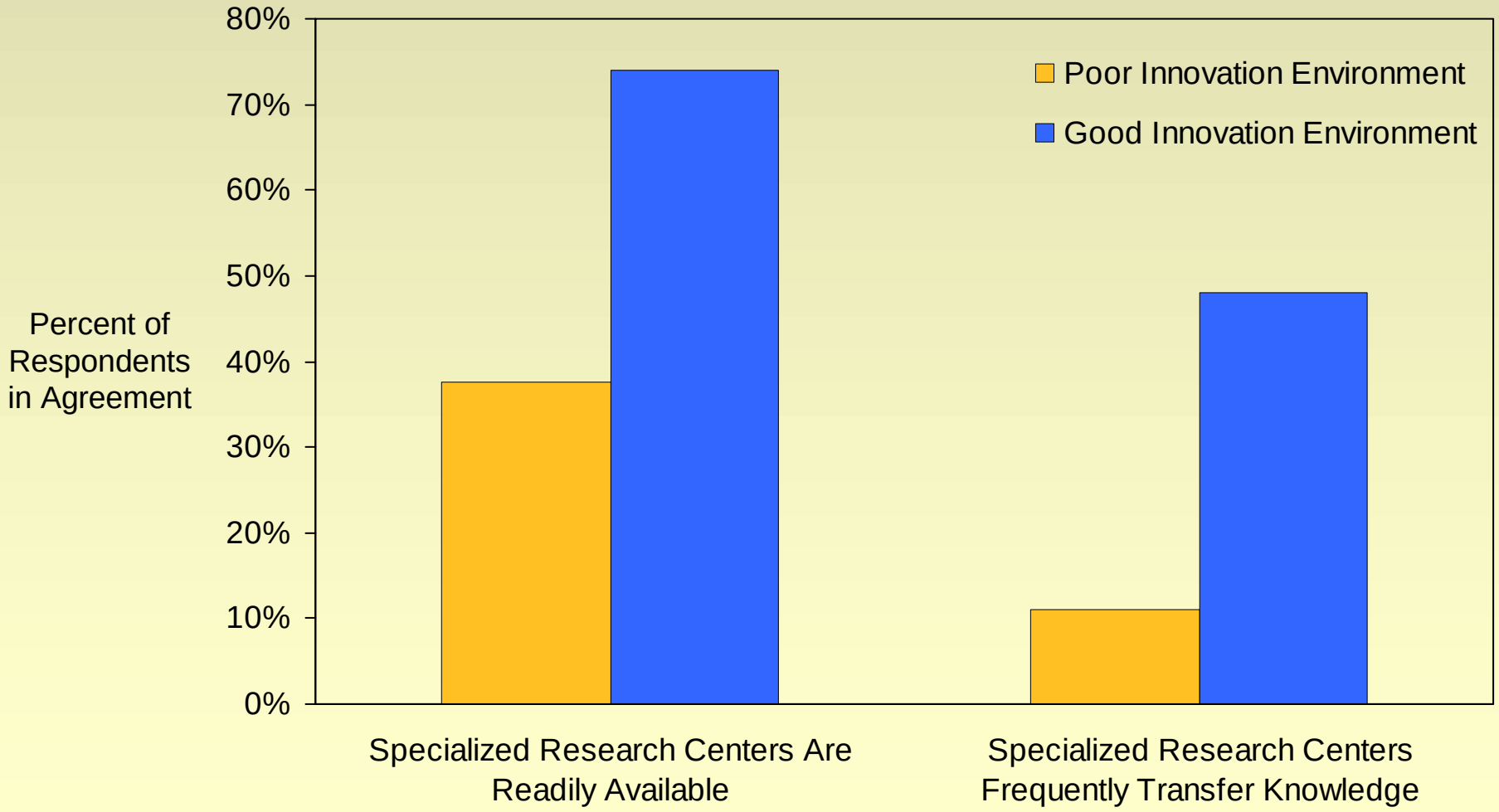
Advantages
- Extensive regional analysis — over 25 reports in four years
- Positive views on the value of competition

Disadvantages
- Fragmented leadership with varying agendas
- Attitudes for collaboration are parochial within and across clusters — inhibit cluster building activity

The Determinants of Regional Competitiveness and Innovative Capacity

- A strong physical and information infrastructure is a baseline requirement to establish and sustain a prosperous regional economy
- A strong K–12 educational system is important for developing local talent and attracting outside talent
- Universities and specialized research centers are the driving force behind innovation in nearly every region

Role of Specialized Research Centers
Good vs. Poor Innovation Environments



Source: Clusters of Innovation Initiative Regional Survey

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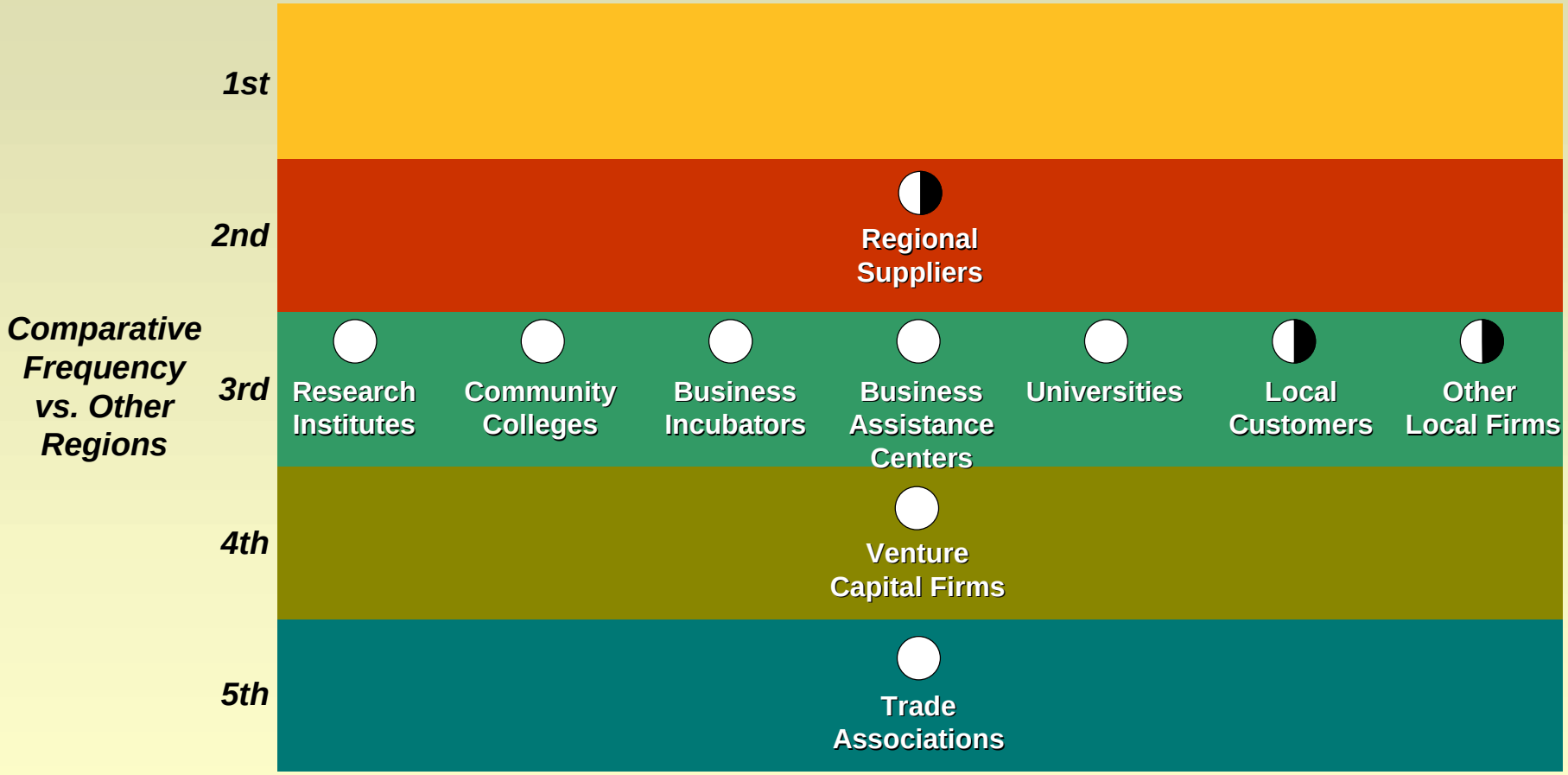
- Mechanisms for commercialization are essential if innovation is to translate to economic success

Strength of Linkages, Research Triangle Region

Commercialization of Technology



Research Triangle Firms' Use of These Institutions for Commercialization

- **Rare Use** — Less than 50% said sometimes or frequently influenced commercialization
- **Occasional Use** — Between 50%–80% said sometimes or frequently influenced commercialization
- **Frequent Use** — Greater than 80% said sometimes or frequently influenced commercialization

Note: August 2001, *n=116.* Source: Clusters of Innovation Initiative Regional Survey

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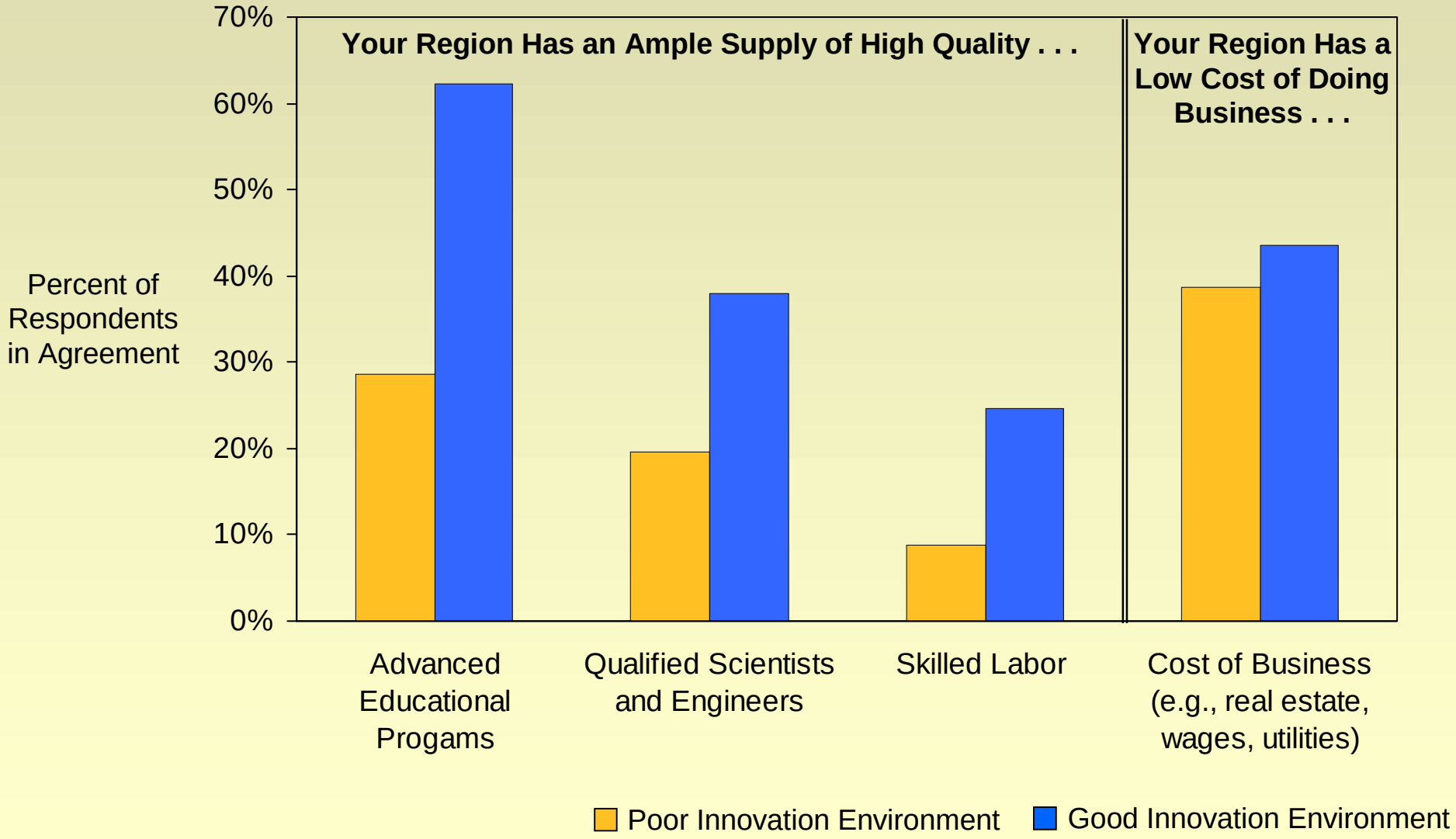
- Specialized talent and training are more important than abundant labor

Role of Specialized Talent and Training
Good vs. Poor Innovation Environments



Source: Clusters of Innovation Initiative Regional Survey

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- Specialized talent and training are more important than abundant labor
- Poor coordination among local jurisdictions impedes efforts to improve the business environment

Coordination Among Local Governments

Representative Interview Quotes

Atlanta

"The Metro Atlanta local government system is fragmented. There is still a lot of in-fighting. Counties fight against each other rather than working together."

– Financial Services Executive

Pittsburgh

"One of the major barriers to Pittsburgh's economic prosperity is the high number of municipalities — we have 131 in Allegheny County, which were never coordinated."

– Economic Development CEO

Research Triangle

"The Research Triangle is comprised of three main regions with three different cultures, and three different styles of government, whereas Charlotte is hierarchical, with a single corporate culture where a few individuals can make things happen."

– University Leader

San Diego

"Regional government is weak and ineffective with regard to the planning and implementation of regional development."

– Biotechnology Executive

Source: Clusters of Innovation Initiative Regional Interviews

The Determinants of Regional Competitiveness and Innovative Capacity

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- Government can have a significant influence on the business environment, both positively and negatively

The Determinants of Regional Competitiveness and Innovative Capacity

Government's Impact on the Determinants of Regional Productivity

San Diego

Element of the Diamond	Federal Government	State Government	Local Government
Factor Inputs	(+) High levels of R&D funding (SPAWAR, NIH), both past and present (+) Defense cuts released talent for high-tech start-ups	(+) Founded UCSD (+) Funds San Diego State University, and Community Colleges (+) Increasing funds for engineering school (–) Energy policies deter building of new capacity (–) Average K-12 education (–) CA Coastal Commission regulations discourage facilities expansion	(+) Zoned Torrey Pines Mesa for research (+) Provided land on favorable terms (e.g., Salk, General Atomics) (–) Lack of coordination and leadership prevents maintenance and improvements of infrastructure (e.g., roads, schools, airport)
Demand Conditions	(+) U.S. Navy is a sophisticated customer of wireless technology	(–) State FDA regulations different from Federal FDA regulations	
Related and Supporting Industries			
Context for Firm Strategy and Rivalry	(+) Defense cuts refocused firms on civilian markets	(–) Inadequate state and local tax incentives to encourage R&D investment	

The Determinants of Regional Competitiveness and Innovative Capacity

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- Government can have a significant influence on the business environment, both positively and negatively
- Regions face the need for strategic transitions, as success at one strategy creates the need for a new strategy

San Diego's Economic Vision

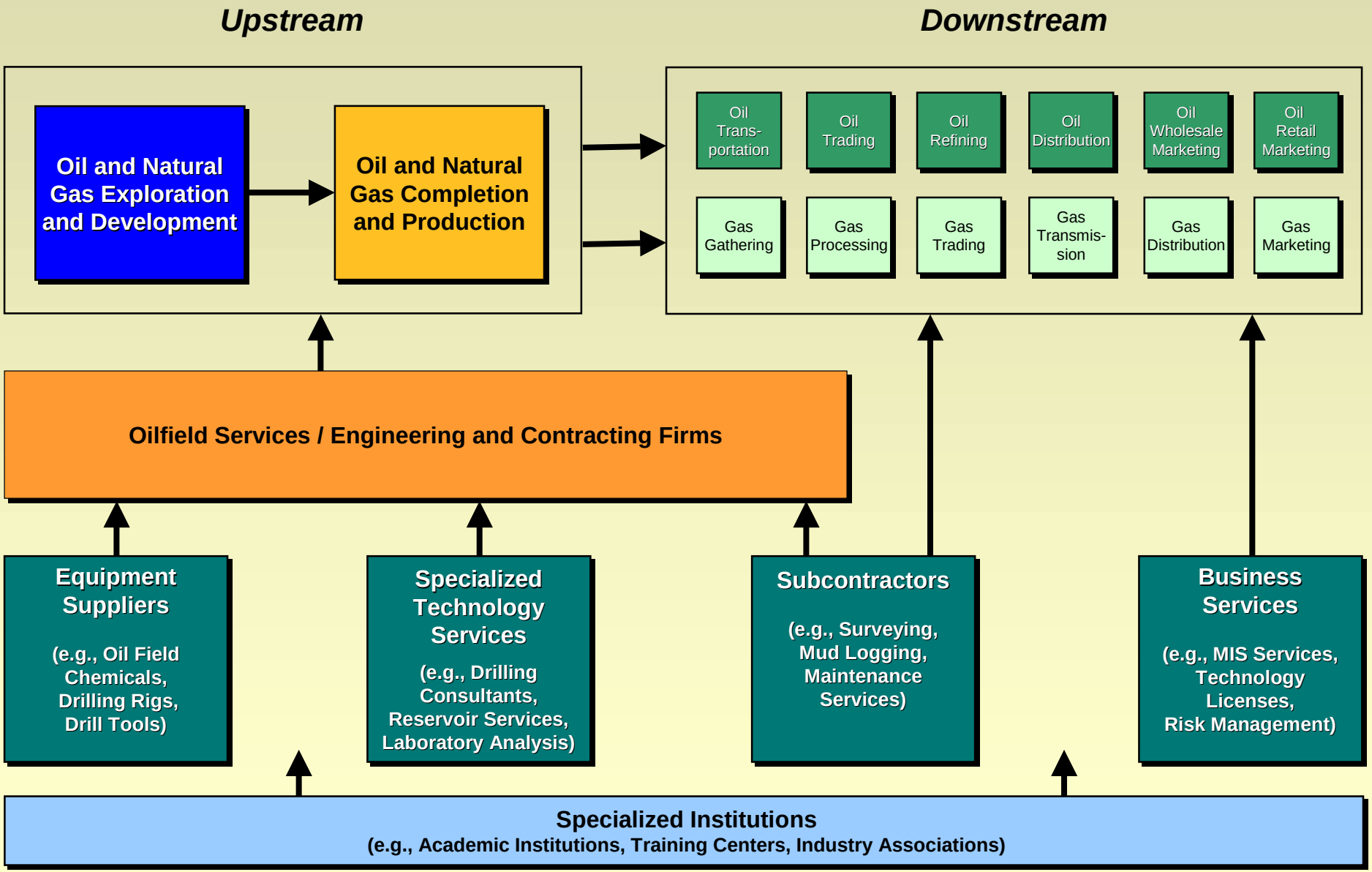
New Directions

Elements of Current Development Strategies	Targets of New Development Strategies
• **Jobs:** Increase employment in selected clusters	• **Wages:** Increase wages across all clusters
• **Research:** Develop strong research capabilities	• **Entire Value Chain:** Develop strength in all aspects of the business
• **Government and Non-Commercial Organizations:** Attract and leverage noncommercial organizations	• **Companies:** Grow, attract, and support companies
• **Growth of "High-Tech" Clusters:** Concentrate efforts and resources on supporting specific clusters	• **Foster Innovative Capacity across ALL Clusters:** improve the innovation environment in a wide array of San Diego clusters

Agenda

- The Economic Performance of Regions
- The Composition of Regional Economies
- The Evolution of Regional Economies
- The Determinants of Regional Competitiveness and Innovative Capacity
- **Clusters**
- The Development of Clusters
- Creating and Implementing a Regional Economic Strategy
- Action Agendas for the Public and Private Sectors

The Houston Oil and Gas Cluster



Clusters and Innovation

Clusters Increase Productivity / Efficiency

- Efficient **access** to specialized inputs, employees, information, institutions, and "public goods" such as training programs and training institutions
- Ease of **coordination** across firms
- Rapid **diffusion** of best practices
- Ongoing, visible **performance comparisons** and strong incentives to improve vs. local rivals

Clusters Stimulate and Enable Innovations

- Better ability to perceive **innovation opportunities**
- Presence of multiple suppliers and institutions to assist in **knowledge creation**
- Ease of **experimentation** given locally available resources

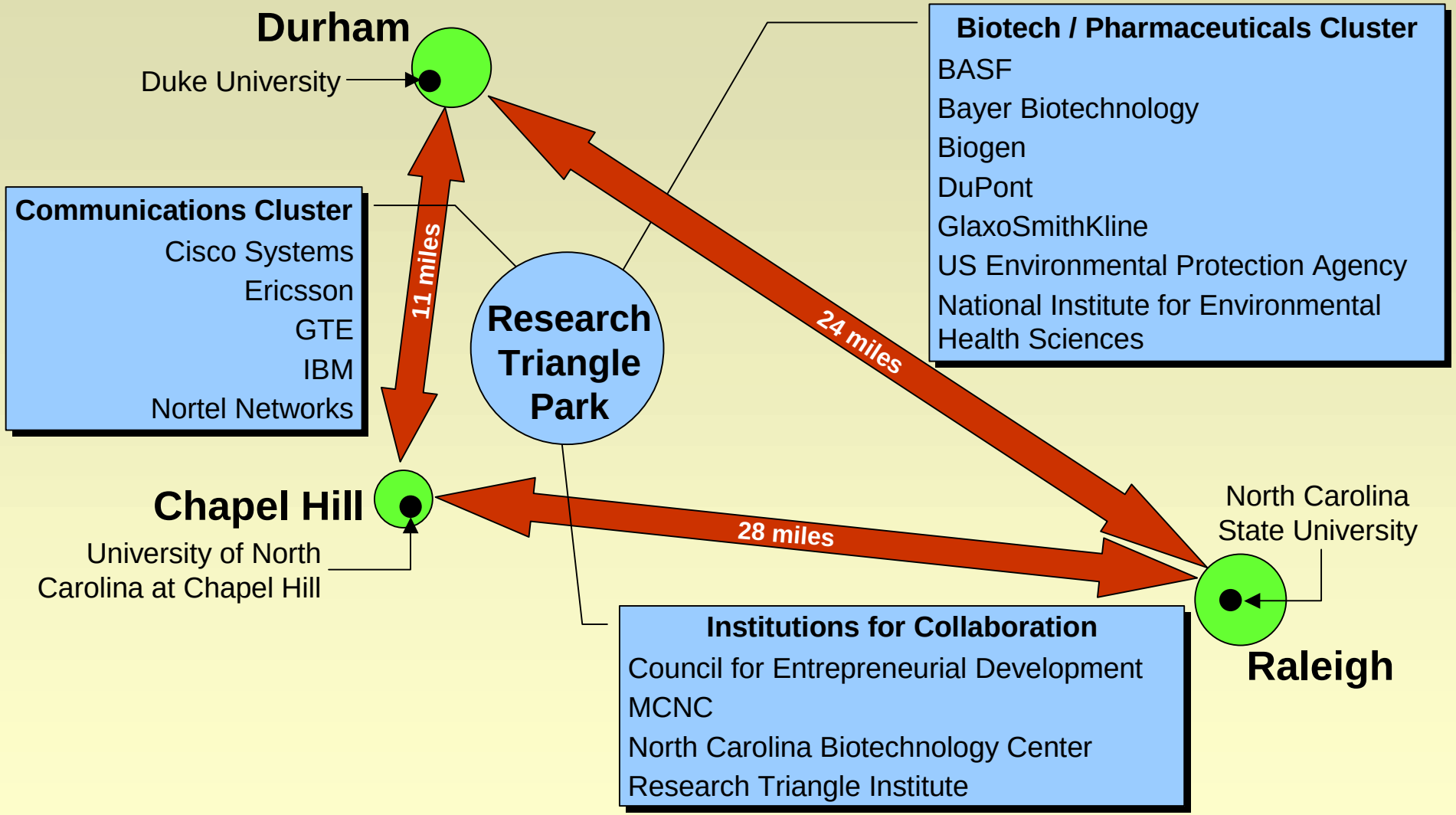
Clusters Facilitate Commercialization

- Opportunities for **new companies** and **new lines of established business** are more apparent
- Lower **barriers to entry** into cluster related businesses because of available skills, supplies, etc.

Competition is fundamentally enhanced by **externalities / linkages** across firms, industries, and associated institutions

Proximity

Research Triangle Park, North Carolina



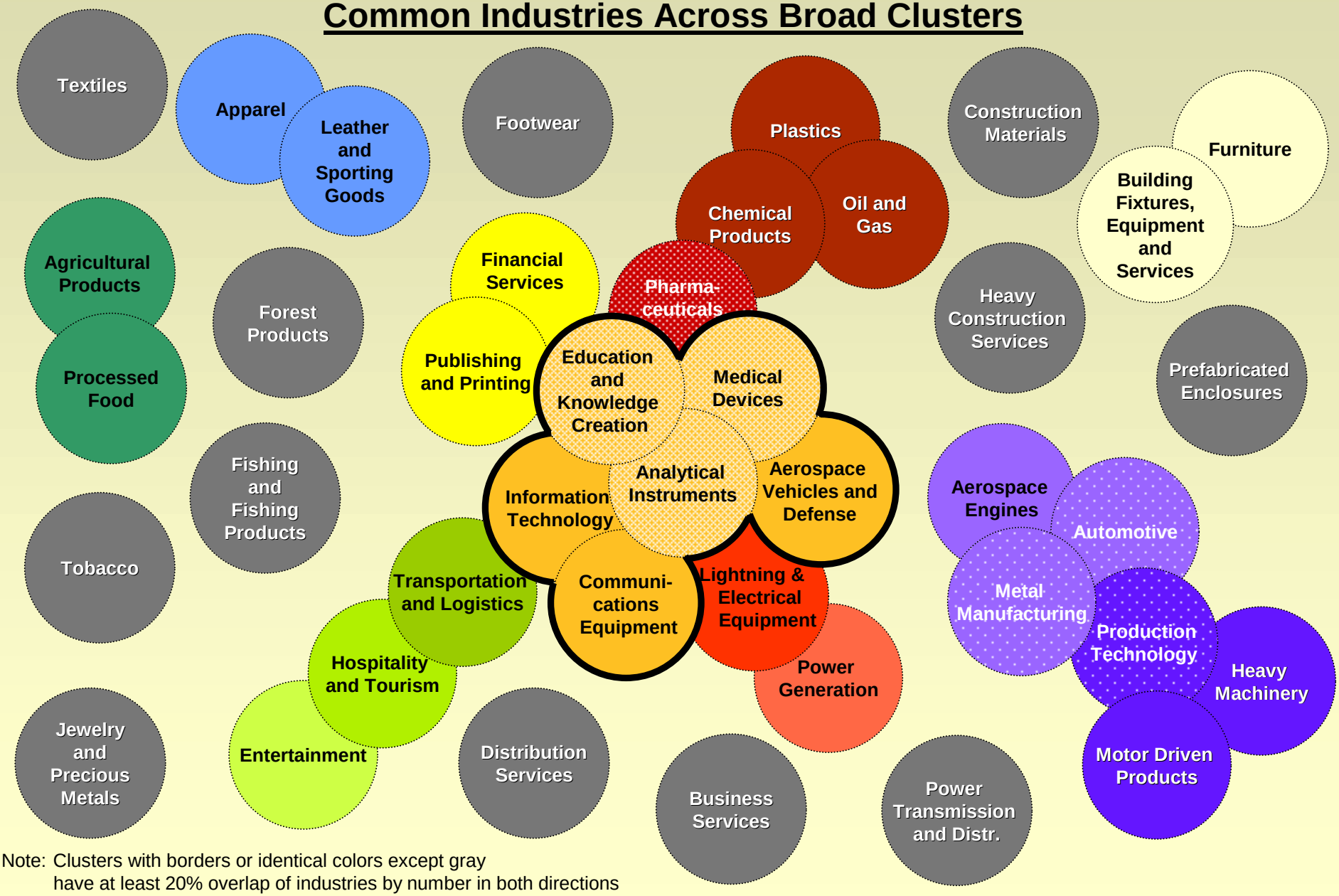
Research Triangle Park encompasses 150 organizations employing approximately 45,000 people within 7,000 acres

Source: Research Triangle Foundation

Clusters

Cluster Overlap in the United States Economy

Common Industries Across Broad Clusters



Note: Clusters with borders or identical colors except gray have at least 20% overlap of industries by number in both directions

Communications Cluster

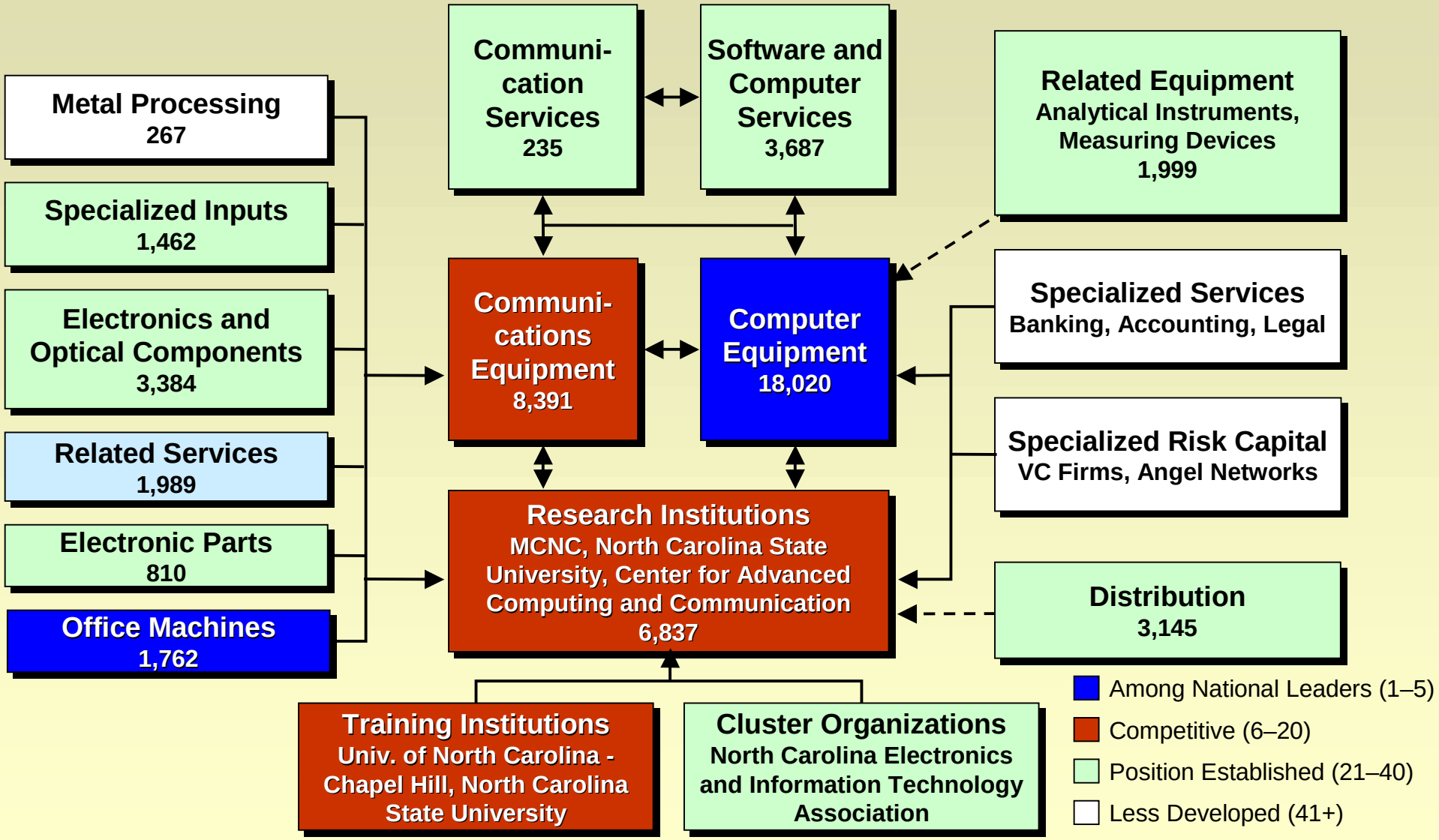
Leading EAs by Total Employment, Narrow Cluster Definition

	Economic Area	1999 Total Employ-ment	Employ-ment CAGR 1990–1999	1999 Average Wages	Patents per 1,000 Employees 1998	CAGR of Patents 1990–1998	Establish-ments CAGR 1990–1999
1	San Francisco-Oakland-San Jose, CA	45,400	4.6	$114,474	27.6	10.6	6.3
2	Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	41,857	-0.9	$66,121	8.7	5.9	4.8
3	Chicago-Gary-Kenosha, IL-IN-WI	41,168	-2.3	$32,147	8.5	9.6	1.0
4	New York-N. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	38,583	-3.5	$49,901	22.7	10.6	1.8
5	Los Angeles-Riverside-Orange County, CA-AZ	33,410	0.0	$55,858	12.4	5.8	1.5
6	Dallas-Forth Worth, TX-AR-OK	30,217	3.8	$57,546	12.9	9.1	2.5
7	**Raleigh-Durham-Chapel Hill, NC**	**11,616**	**0.6**	**$57,255**	**10.9**	**18.9**	**0.9**
8	Washington-Baltimore, DC-MD-VA-WV-PA	10,076	2.2	$59,462	21.4	5.1	4.5
9	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	10,048	-1.8	$50,831	10.0	4.8	2.2
10	Fort Wayne, IN	8,798	0.2	$29,257	1.1	6.9	3.3
11	Phoenix-Mesa, AZ-NM	8,571	-3.0	$59,564	26.2	16.7	3.7
12	Atlanta, GA-AL-NC	8,007	-5.3	$45,199	2.2	17.5	4.9
13	Miami-Fort Lauderdale, FL	7,034	-1.9	$30,072	14.5	5.4	6.8
14	Rochester, NY-PA	6,897	0.3	$41,809	23.7	5.6	2.3
15	San Diego, CA	6,660	2.0	$43,243	24.4	7.3	3.8

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

Competitive Position

Communications Cluster, Research Triangle EA



Note: Employment numbers are given inside boxes were available

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

Select Subcluster Cluster Rankings in Wichita

Share of National Employment, Economic Area, 1998

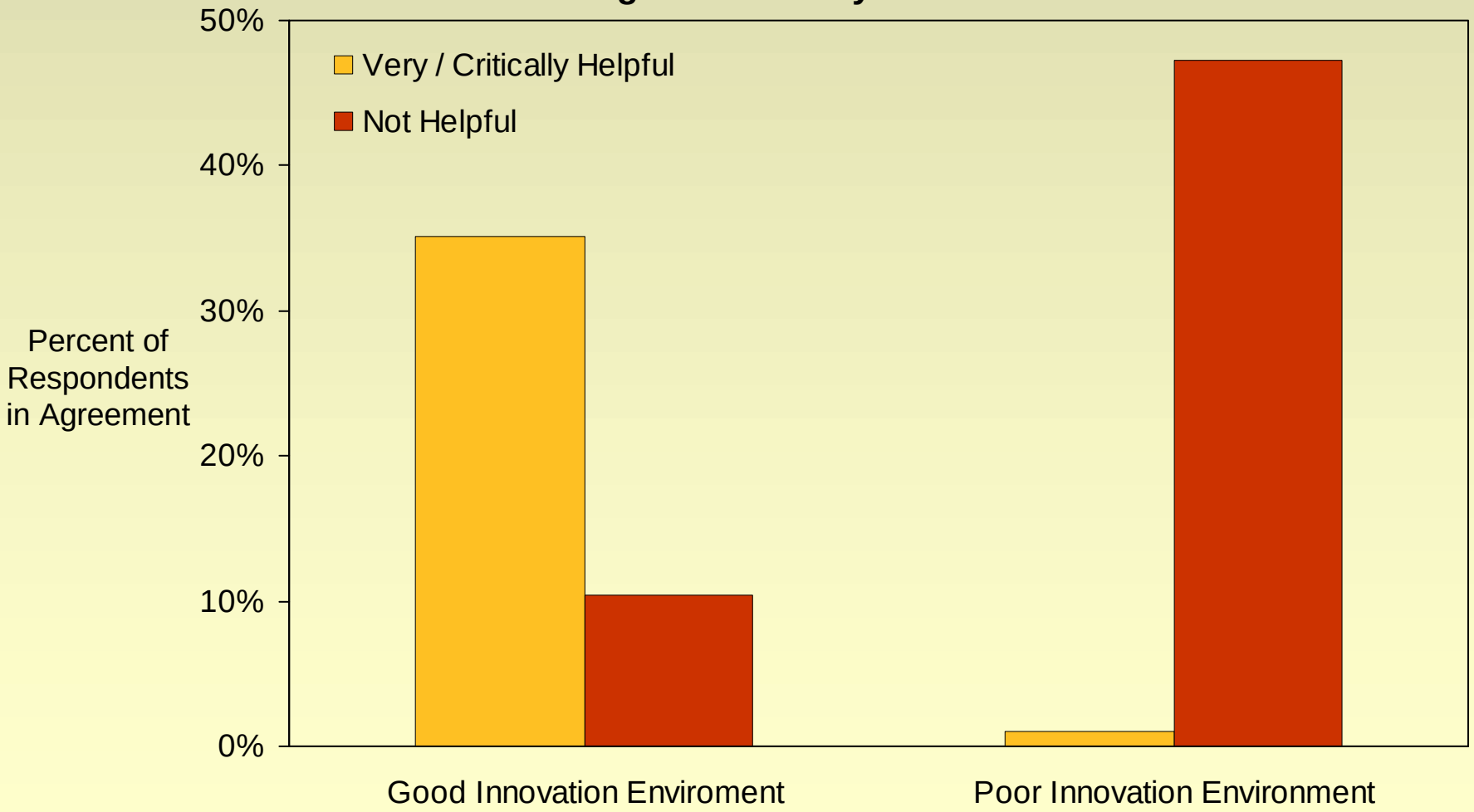
Cluster	Subcluster	National Ranking
Aerospace Engines	Aircraft Engines and Engine Parts	16
Aerospace Vehicles and Defense	Aircraft	4
Heavy Machinery	Construction Machinery	22
	Farm Machinery	3
	Mining Machinery	22
	Equipment and Parts	24
Lighting and Electrical	Electric Lamps	8
	Batteries	8
Motor Driven Products	Appliances	27
	Specialized Pumps	12
	Motorized Vehicles	29
Oil and Gas	Oil and Gas Machinery	12
Prefabricated Enclosures	Mobile Homes	28
	Trucks and Trailers	30
	Elevators	14
Production Technology	Process Equipment and Subsystems	43
	Production Machinery	16
	Transportation Equipment	44
Textiles	Specialty Components	32

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

Cluster-Specific Institutions for Collaboration

Select Survey Results

Valuable Contacts and Information Received by Start-up Companies from Regional Industry or Cluster Councils . . .



Source: Clusters of Innovation Initiative Regional Survey

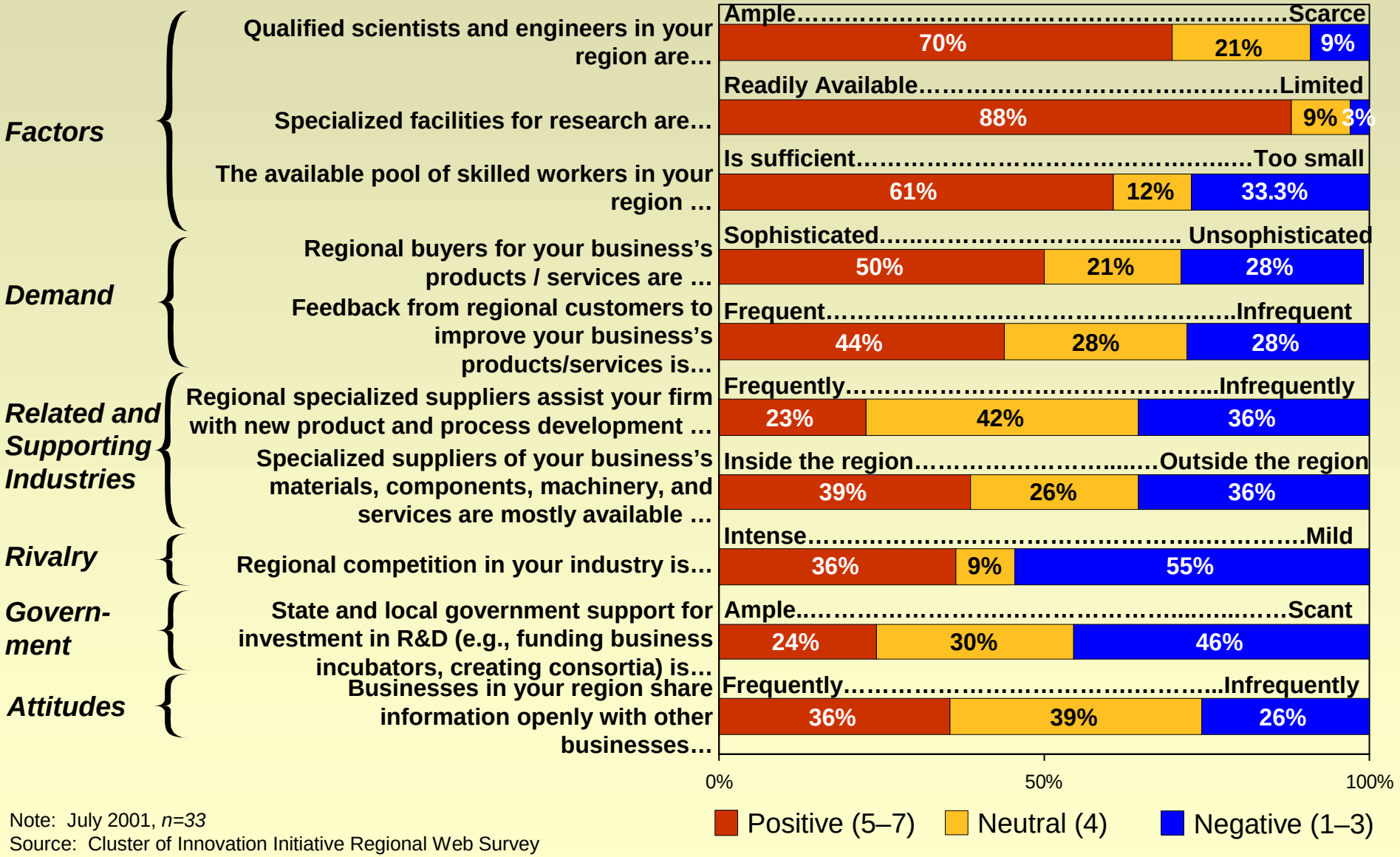
Research Triangle Communications Cluster
Innovation Environment-Summary

Element of Diamond	Assets	Challenges
Basic and Specialized Factor Inputs	• Relatively large pool of communications related scientists, engineers and technicians • Many research divisions of major communications firms (e.g., Cisco Systems, Ericsson)	• Insufficient marketing and managerial talent • Lack of coordination among firms on local workforce development • Under utilization of non-commercial research facilities
Context for Firm Strategy and Rivalry	• Sale of Cronos to JDUniphase points to some success in development and marketing efforts by institutions for collaboration	• Sporadic cooperation among firms to jointly develop technology • Moderately intense local competition
Related and Supporting Industries	• Strong regional presence in most communications sub-clusters	• Insufficient frequency of contact with suppliers on innovation
Regional Demand	• North Carolina Information Highway project demands the latest technologies	• Insufficient frequency of contact with customers on innovation • Local demand conditions do not confer an advantage on the cluster
Government Policy	• High State support for R&D and training; e.g., North Carolina State University communications educational programs	• Federal government local R&D investments deemed inadequate • Dissatisfaction with state and local business regulations (and taxation)
Quality of Linkages	• Center for Advanced Computing and Communication, an NSF Industry / University Cooperative Research Center and MCNC unify parts of cluster	• NC Telecommunications Association — the local cluster association — is not yet well established as an effective regional organization

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

Select Survey Results

Communications Cluster, Research Triangle



Note: July 2001, *n=33*
Source: Cluster of Innovation Initiative Regional Web Survey

Agenda

- The Economic Performance of Regions
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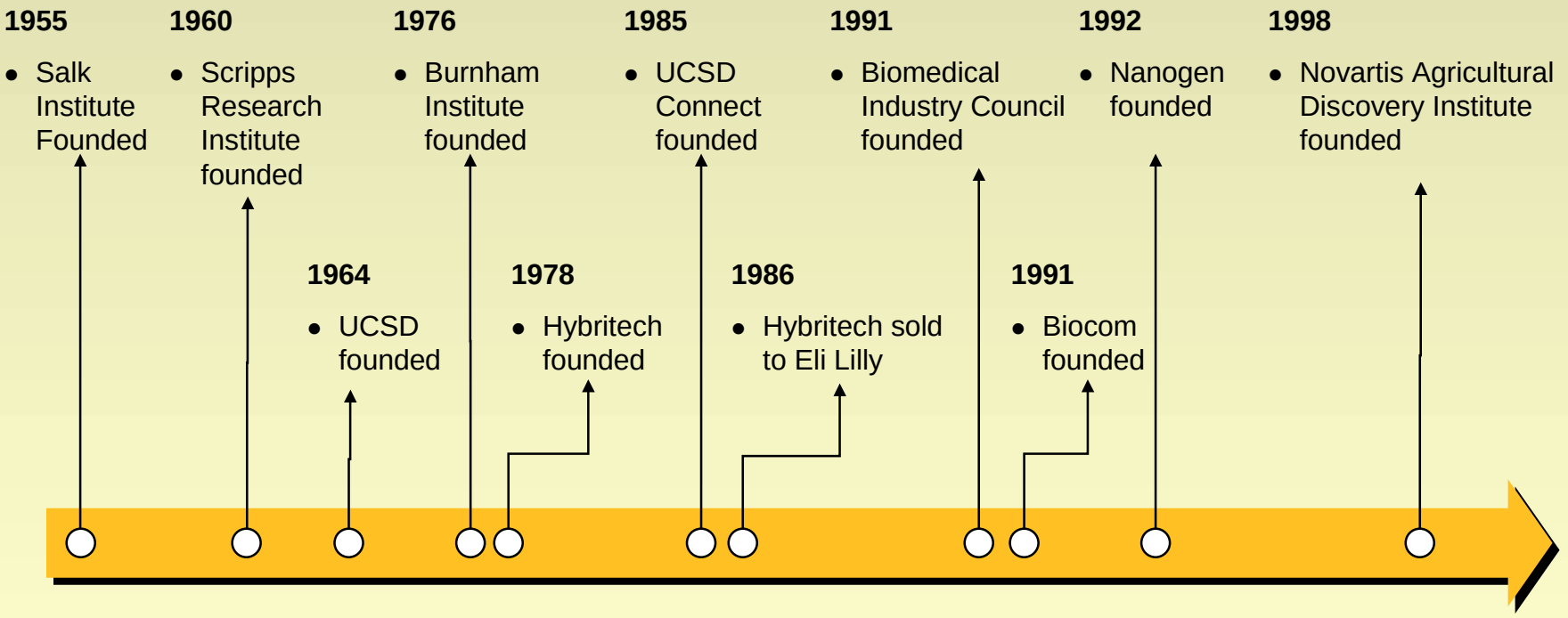
The Process of Cluster Development

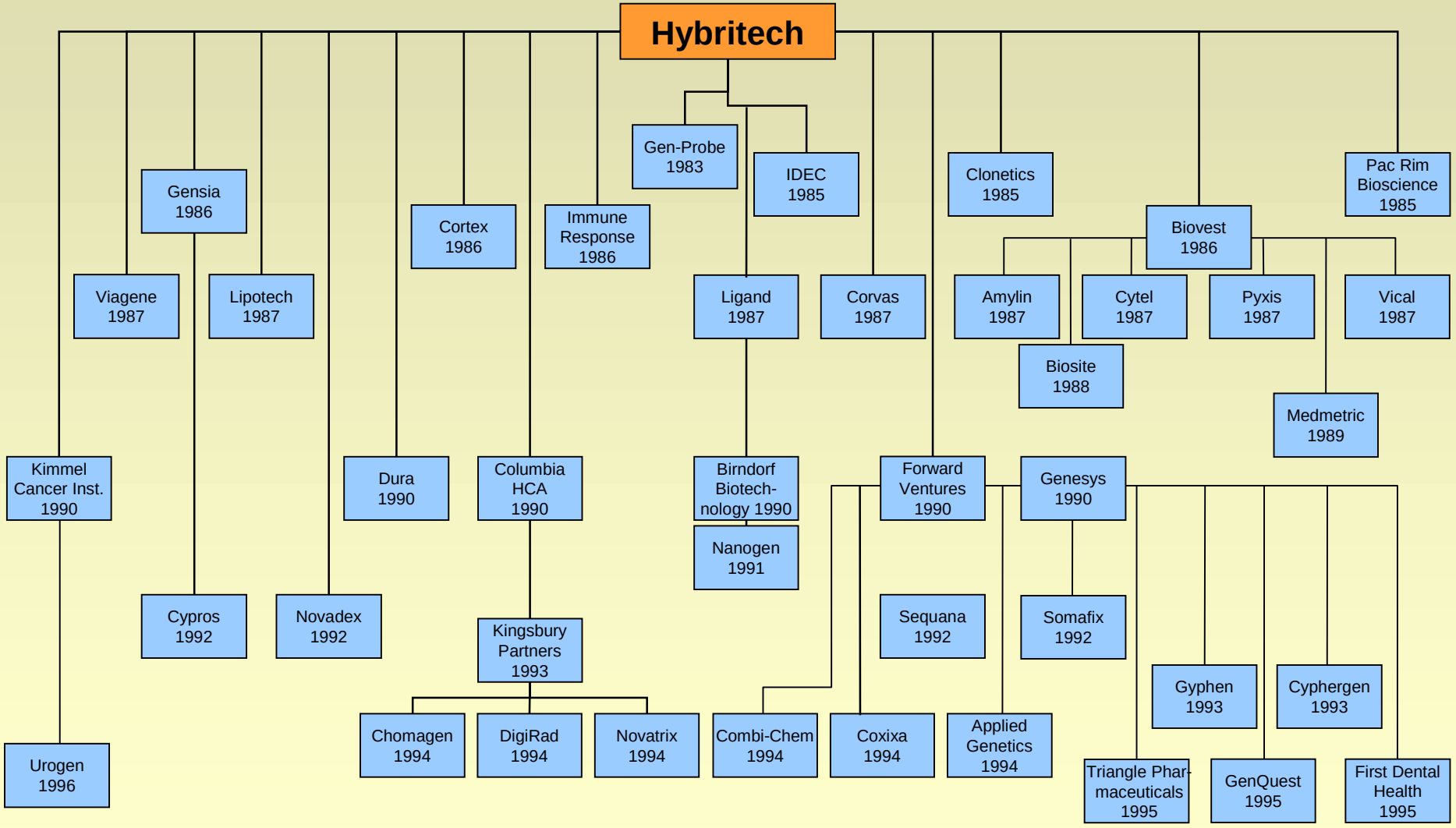
History of the San Diego Biotech / Pharma Cluster



Source: Clusters of Innovation Project

Anchor Companies

Spin-outs in the San Diego Biotech / Pharma Cluster



Source: CONNECT, University of California, San Diego

The Importance of Anchor Firms

Representative Interview Quotes

Pittsburgh

"FORE Systems and Free Markets have acted as anchor firms, spinning out such firms as Co-Manager, Laurel, AxelLife, and Yourfit. But it was the university professors that spun-out those firms and others, such as LYCOS and IGATE Technologies. The universities have been critical to the development of the IT sector and continue to create new firms."

– Professor

Research Triangle

"The partner in our firm thought the region was promising and established an office in the Research Triangle in the early 1980s. He left by the late 1980s and things drifted because there weren't enough Fortune 1000 companies in the region to make it work."

– Business Services Executive

San Diego

"Linkabit is this region's Fairchild. (Fairchild was the "mother firm" of semiconductor industry in Silicon Valley.) Many future start-up CEOs got their start at Linkabit and were trained under Irwin Jacob' s tutelage."

– Communications Executive

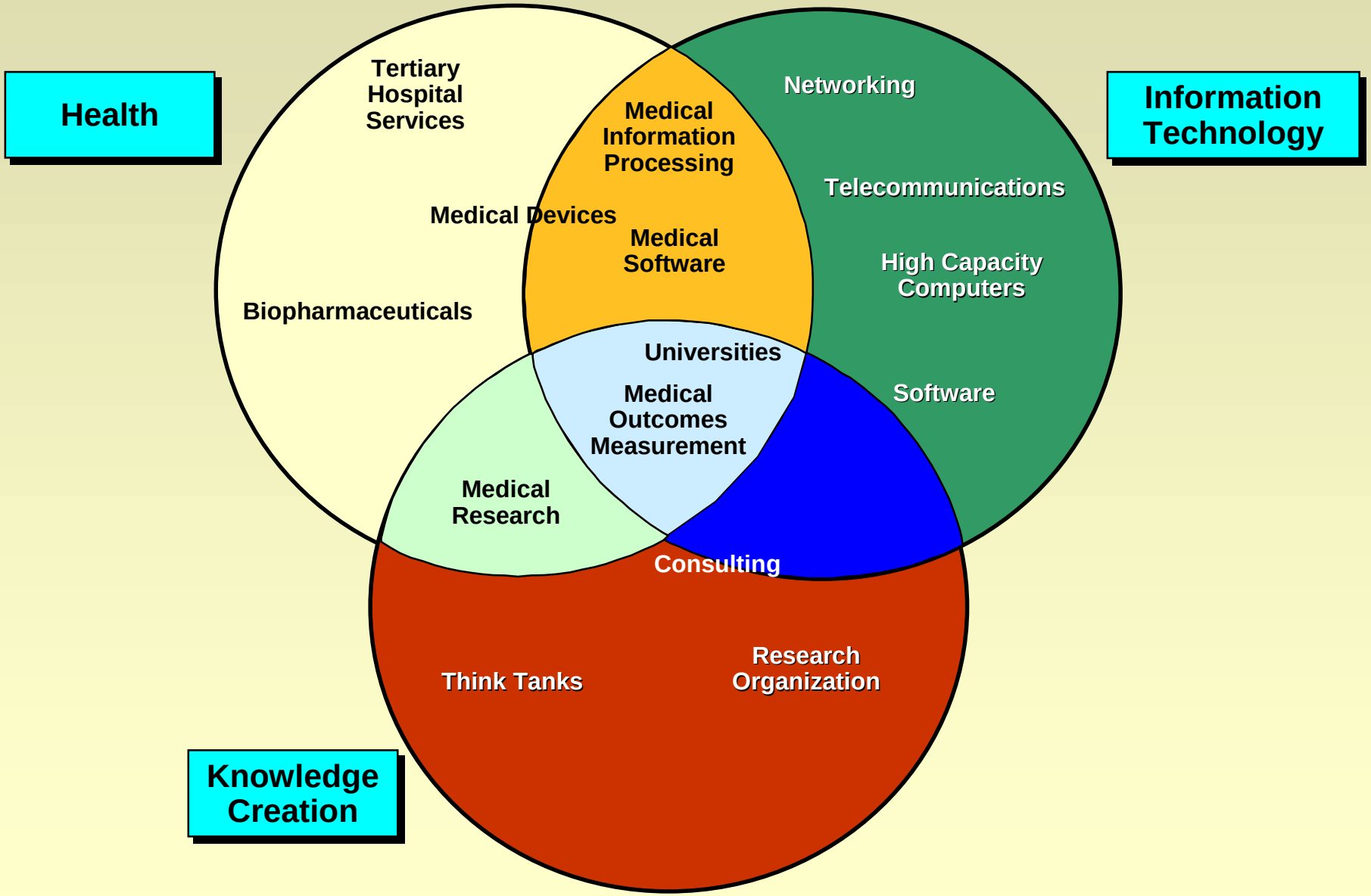
Wichita

"We came to Wichita because Bombardier but we also recognized the value of being near the other important OEMs such as Boeing, Cessna and Raytheon. Wichita is the air capital of the world — if you're a supplier, you need to be here."

– Aerospace Supplier Executive

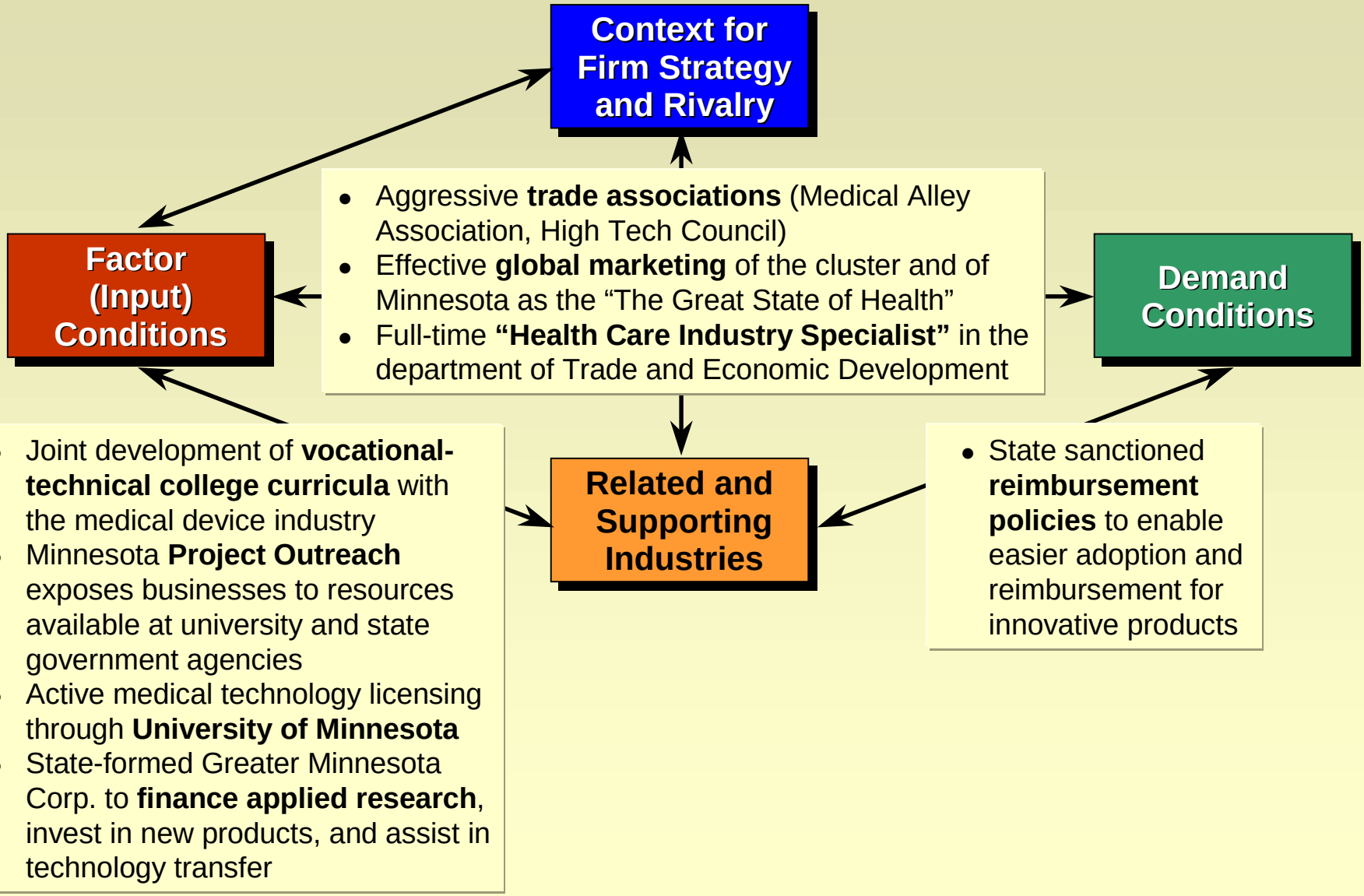
Source: Clusters of Innovation Initiative Regional Interviews

Opportunities at the Intersection of Select Clusters in Massachusetts



Public / Private Cooperation in Cluster Upgrading

Minnesota's Medical Device Cluster



The Development of Clusters

- **An explicit cluster development program**
  - Conscious efforts can meaningfully raise cluster competitiveness and innovative capacity
- **Recruiting for clusters**
  - Recruitment strategies should target strong clusters, or clusters which overlap with other clusters
  - Regions should identify gaps within clusters, and seek to attract companies to fill them

Agenda

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Creating and Implementing a Regional Economic Strategy

Connecticut's Cluster Development Initiative

Timeline

1996

- State Department of Economic and Community Development (DECD) reorganized to include **Industry Cluster and International Division**

1997

- Industry Cluster Initiative
- **Call to Action —** 120 Connecticut business leaders are engaged by the Governor
- **5 Industry Cluster Advisory boards** created:
  - Manufacturing
  - Financial Services
  - Telecommunications & Information
  - Health Care Services
  - High Technology
- Cluster advisory boards **finalize and prioritize recommendations** for the legislative session
- Recommendations and presentation to **Governor and legislative leadership**

1998

- **"Partnership for Growth" legislation** submitted to Governor and legislature
- Governor and legislature **unanimously approve first Cluster Bill**:
  - $7 million for cluster activation and projects
  - 6% R&D tax credit now available for smaller firms
  - Lengthen R&D tax credit carry forward from 5 to 15 years
- **Implementation** of cluster initiatives begin
- Establishment and first meeting of **Governor's Council on Economic Competitiveness and Technology**
- **Bioscience cluster** activated

Connecticut's Cluster Development Initiative

Creating and Implementing a Regional Economic Strategy

Timeline

1999

- The quasi-public **Connecticut Economic Resource Center (CERC)** becomes the implementation arm for the cluster initiatives outside of government
- **Second Cluster Bill submitted and unanimously approved** by Governor and legislature:
  - Net operating loss (NOL) carry forward -- from 5 to 20 years
  - Tax credit exchange established to help smaller firms capitalize tax credits
  - $4.5 million for cluster initiative over the next 2 years
- **Aerospace Component Manufacturers cluster** activated

2000

- **Software / IT cluster** activated
- **Metals Manufacturing cluster** activated

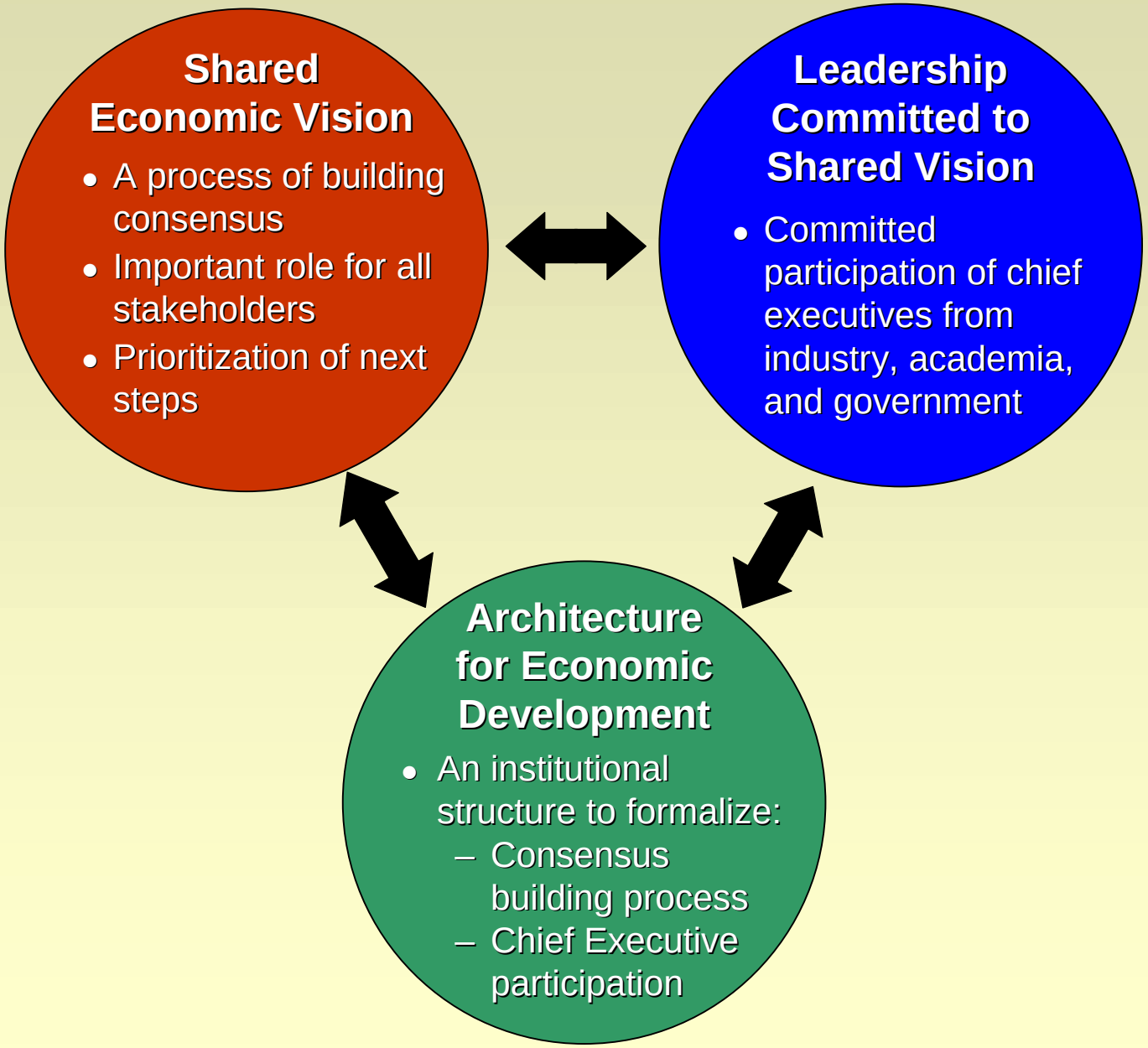
2001

- **Maritime cluster** activated
- **Plastics cluster** activated

Creating and Implementing a Regional Economic Strategy

- A shared economic vision helps elicit broad support and coordinate activities
- Strong leadership is a necessary part of any successful economic development strategy
- An overarching organization for economic development helps coordinate and routinize the process
- Broad-based collaboration is needed for development strategies to succeed
- Rigorous analysis is an important early step in implementing a regional strategy, but mechanisms for translating ideas into action are necessary
- Regions need to overcome transition points in the development of their economies
- Regions often encounter a common set of pitfalls

Creating the Capacity to Act



Leadership from the Public and Private Sectors

Government in Research Triangle

- *"The state wooed IBM with cheap labor, land and proximity to universities. Governor Sanford's involvement was crucial."*
  - University Leader
- *"Governor Hunt made it easy for us [a major communications firm] to move here."*
  - Communications Executive
- *"Technical institutes and community colleges were key in turning around the workforce. Governor Hodges started the community college system, and Governor Sanford really made it what it is."*
  - Research Triangle Park Leader
- *"Political leaders nurtured business. Governors Hodges, Sanford, Hunt being the most notable."*
  - Community Leader

Private Sector in Atlanta

- *"Regions can thrive only after they find a personality or driving force. Usually this is a business leader who has had success and then can motivate others. Regional groups should make this person the 'cause celebre' and publicize the success story in order to stimulate new business."*
  - Local CEO
- *"People and companies like Charles Brewer (Mindspring), Bert Ellis (IXL), John Yates all launched their way to success in [the mid-1990s]. These young guys represented the spawning of a new generation that inspired a lot of people."*
  - Venture Capitalist
- *"Ben Dyer (Peachtree Software), Jeff Levy (Relevant Knowledge), and Leland Strange were early entrepreneurs who started numerous companies, assisted many more and now, in fact, have started their own incubators."*
  - Local CEO

Source: Clusters of Innovation Initiative Regional Interviews

Organizing to Compete

Massachusetts Governor's Council on Economic Growth and Technology

Governor's Council on Economic Growth and Technology

Industry Cluster Committees

- Advanced Materials
- Biotechnology and Pharmaceuticals
- Defense
- Marine Science and Technology
- Medical Devices
- Software
- Telecommunications
- Textiles
- Information Technology

Functional Task Forces

- International Trade
- Marketing Massachusetts
- Tax Policy and Capital Formation
- Technology Policy and Defense Conversion

Issue Groups

- Cost of Doing Business
- Financing Emerging Companies
- Health Care
- Western Massachusetts
- Business Climate
- Competitive Benchmarking

An Economic Vision for Wichita

New Directions

Successes of Current Development Strategies	Targets of New Development Strategies
• **Defensive:** Preserve scarce labor supply; recruit new companies; withstand cyclical downturns; respond to crises	• **Offensive:** Proactively harness Wichita's many advantages and potential advantages; create new advantages
• **Enhance Efficiency:** Improve physical infrastructure; lower the costs of doing business	• **Foster Innovation:** Move to advance segments of the value system and new businesses
• **Celebrate Entrepreneurial Heritage:** Proud history of entrepreneurial activity	• **Enable New Entrepreneurs:** Develop linkages between industry, academia, and the venture capital community
• **Build Strong Companies:** Support for important local firms; attract others opportunistically	• **Build Strong Clusters:** Build upon existing strengths to develop core clusters, exploit cross-cutting opportunities; and create new clusters and businesses (e.g., aviation services, regional medical center)
• **Improve Incrementally:** **E**nhance efficiency and compete on price	• **Bold Strategy:** **C**reate new strategies to break constraints and energize the community

Economic Development Strategy
Common Pitfalls

Companies

Government

- Failure to communicate needs to other important actors (e.g., government, universities, and institutions for collaboration)
- Cluster-killing competitive strategies of firms
- Discouraging the entrance of local rivals
- Neglecting investment in the engines of innovation: universities and research centers
- Neglecting physical infrastructure
- Government regulations discouraging investment and innovation
- Focusing on narrow geographic areas
- Biases towards “high tech” clusters (e.g, IT and Biotech)
- Ignoring traditional strengths
- Recruiting big companies, not building competitive clusters
- Inattention to commercialization issues
- Insufficient cross-disciplinary collaboration

Economic Development Organizations

Research and Training Centers

Agenda

- The Economic Performance of Regions
- The Composition of Regional Economies
- The Evolution of Regional Economies
- The Determinants of Regional Competitiveness and Innovative Capacity
- Clusters
- The Development of Clusters
- Creating and Implementing a Regional Economic Strategy
- **Action Agendas for the Public and Private Sectors**

Federal Government

- Invest in the foundations of science and technology
- Improve the innovation policy context
- Allocate federal resources in ways that reinforce cluster development
- Provide better data for measuring regional economic composition and performance
- Encourage the development of regional economic development strategies that stress innovation

State Governments

- Invest in the foundations of science and technology
- Sponsor state programs that encourage cluster development
- Focus business recruitment around strong clusters
- Create a regional dimension to state economic development strategies
- Improve information systems to regularly collect data and measure progress

Regional and Local Governments

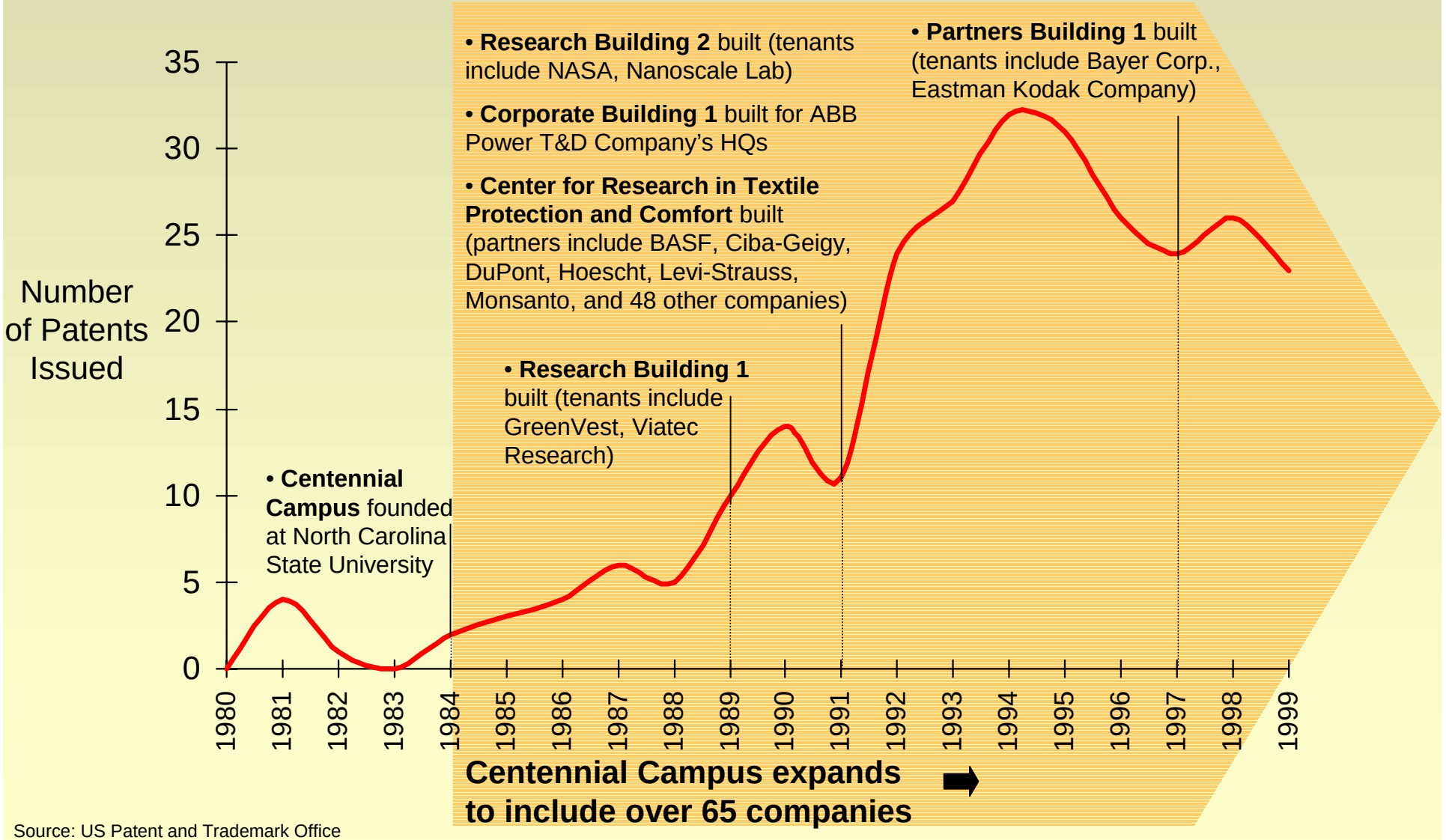
- Strongly support K–12 education
- Upgrade core business infrastructure
- Develop a regional strategy that involves all stakeholders
- Encourage cluster development

Universities and Research Institutes

- Recognize the important role of universities in regional economic development
- Create and support technology transfer offices
- Align university curricula to meet the needs of local clusters
- Actively participate in cluster development efforts
- Support company start-up efforts by professors and students

University-Industry Institutions for Collaboration

Patents Issued to North Carolina State University, 1980-1999

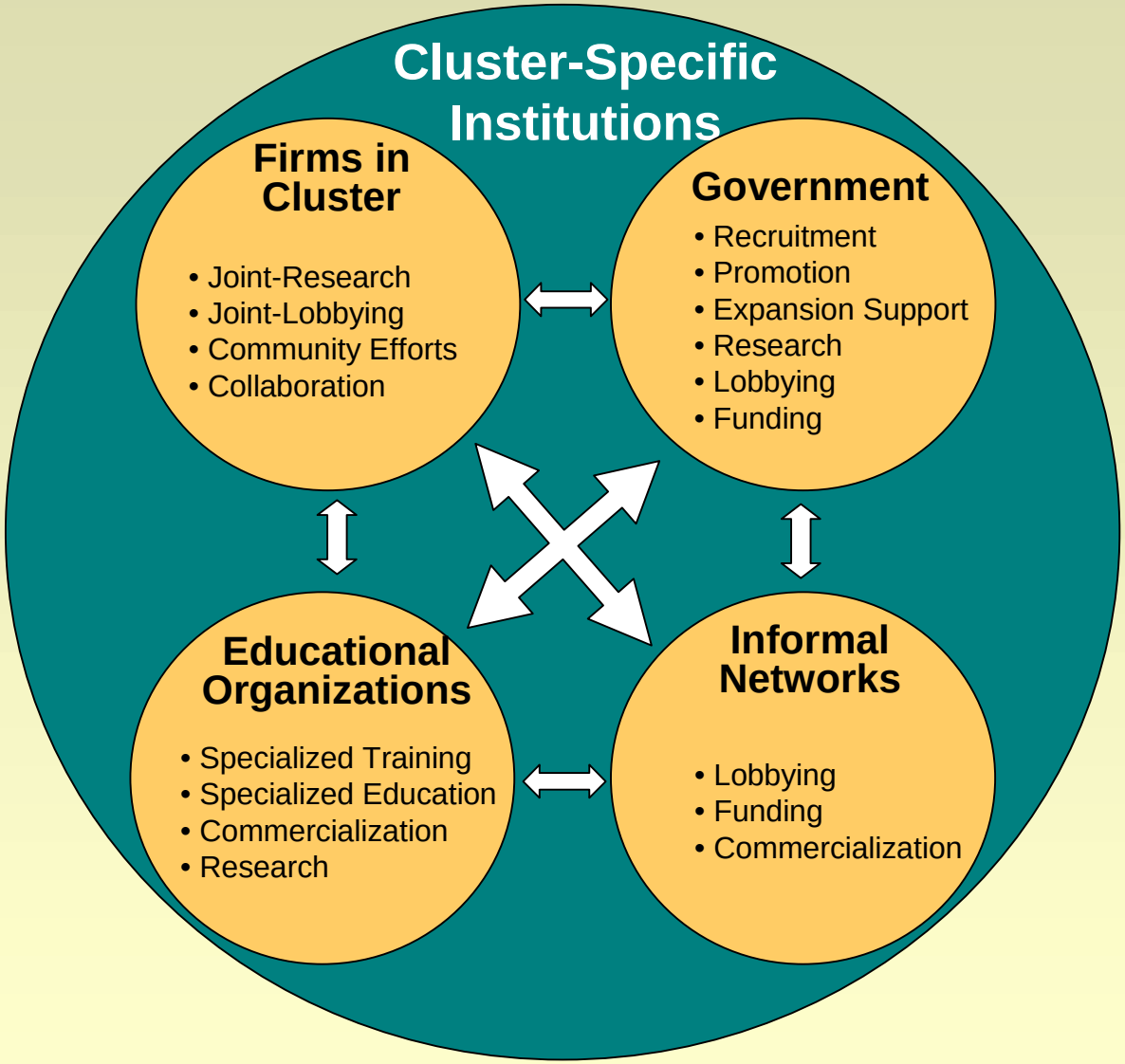


Source: US Patent and Trademark Office

Cluster-specific Institutions for Collaboration

- Promote cluster awareness
- Engage in ongoing diagnosis of cluster's competitive position
- Develop training and management programs
- Actively participate with government in recruitment efforts
- Widen institutional membership to include all cluster constituents

Cluster Specific Institutions for Collaboration



Firms

- Recognize the importance of location to competitive advantage
- Take an active role in improving the regional competitive environment
- See the cluster as a competitive asset
- Find your cluster
- Contribute actively to cluster development activities

Contacts

INSTITUTE FOR STRATEGY AND COMPETITIVENESS

- www.isc.hbs.edu

MONITOR GROUP

- www.monitor.com

Council on Competitiveness

- www.compete.org

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CLUSTERS of INNOVATION:
Regional Foundations of U.S. Competitiveness

CLUSTERS OF INNOVATION INITIATIVE

NATIONAL CLUSTERS OF INNOVATION MEETING
Washington, D.C. December 13, 2001