



MINNEAPOLIS-ST. PAUL REGIONAL CLUSTER COMPETITIVENESS STUDY

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ABSTRACT

This study uses both quantitative and qualitative data to profile the largest industry clusters in the Minneapolis-St. Paul (MSP) region. Quantitative data was gathered using the Cluster Mapping Tool, a tool developed for the U.S. Department of Commerce, Economic Development Authority (EDA), by Harvard Business School's Institute for Strategy and Competitiveness. The study focuses on the potential for knowledge flows across basic (exporting) industry sectors in the MSP region. This is analyzed by looking at similarities in occupations that different industries hire—particularly focusing on specialized workers. The study presents findings and recommendations for the MSP region.

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Introduction

Industry clusters are geographic concentrations that represent multiple levels of the business ecosystem. The framework includes competing, complementary, and independent companies, or companies that do business with each other and/or have similar talent, infrastructure, and technology demands. On a broader scale, industry clusters help paint the picture of the export-based industries within a regional economy. Approximately 26 percent of all jobs within a region can be attributed to traded clusters, those that sell goods or services outside of the region. Traded clusters are of particular interest to policymakers and economic developers since they generate wealth, pay higher salaries, support the locally based jobs within the region, and help to assure a competitive regional economy and quality of life.

In June 2012, the State and Local Policy Program at the Humphrey School of Public Affairs at the University of Minnesota, with support from the University Metropolitan Consortium (UMC), set out to conduct an in-depth study on the competitive industry clusters in the Minneapolis-St. Paul (MSP) region of Minnesota. Founded in 1991 to increase the Humphrey School's commitment to policy issues throughout the state, the State and Local Policy Program has conducted regional cluster studies within the Minneapolis-St. Paul (MSP) region and throughout the nation since 1995.

This particular study leverages quantitative data in addition to information gained through company interviews to produce a comprehensive cluster study of Greater MSP. It offers a useful compendium to understand the dynamic patterns and linkages within the regional economy today.

Methodology

The research project used both quantitative and qualitative data to profile the largest industry clusters in the Minneapolis-St. Paul region. Quantitative data was gathered using the Cluster Mapping Tool, developed for the U.S. Department of Commerce, Economic Development Authority (EDA), by Harvard Business School's Institute for Strategy and Competitiveness. This tool uses County Business Patterns (CBP) data, which allows the user to analyze and compare regions and clusters based on geographical and economic factors such as wages, employment, share of employment, and location quotient.

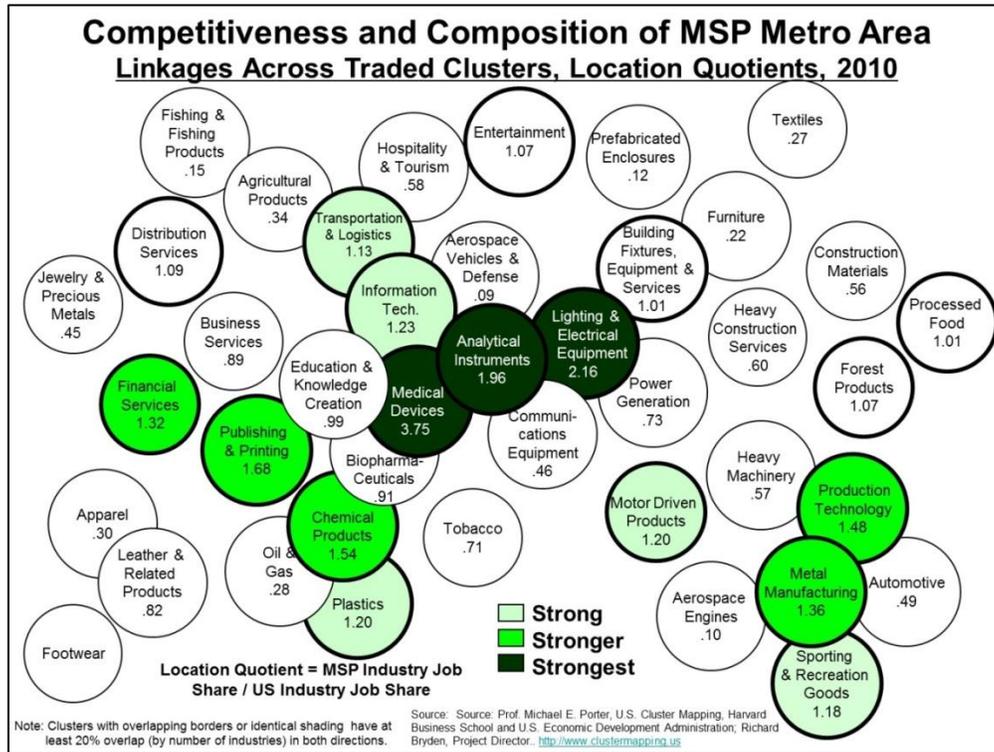
Quantitative data was used to assess the strength of the region, while qualitative data was used to help better explain the historical and anecdotal role of clusters in the region. Company interviews were used to gain insights into MSP's competitive advantage. Newspaper, magazine, and journal articles and company websites were also used to gather more information on industries within the region. Each of the companies interviewed for this project is highlighted in its corresponding cluster chapter.

Finally, in a separate analysis, the study focuses on the potential for knowledge flows across basic (exporting) industry sectors in MSP, or Twin Cities, region. This analysis looked at similarities in occupations that different industries hire—particularly focusing on specialized workers. The assumption is that the presence of a skilled workforce acts as an attractor to employers sharing similarities in labor needs even if they do not operate in the same industry. The more that multiple

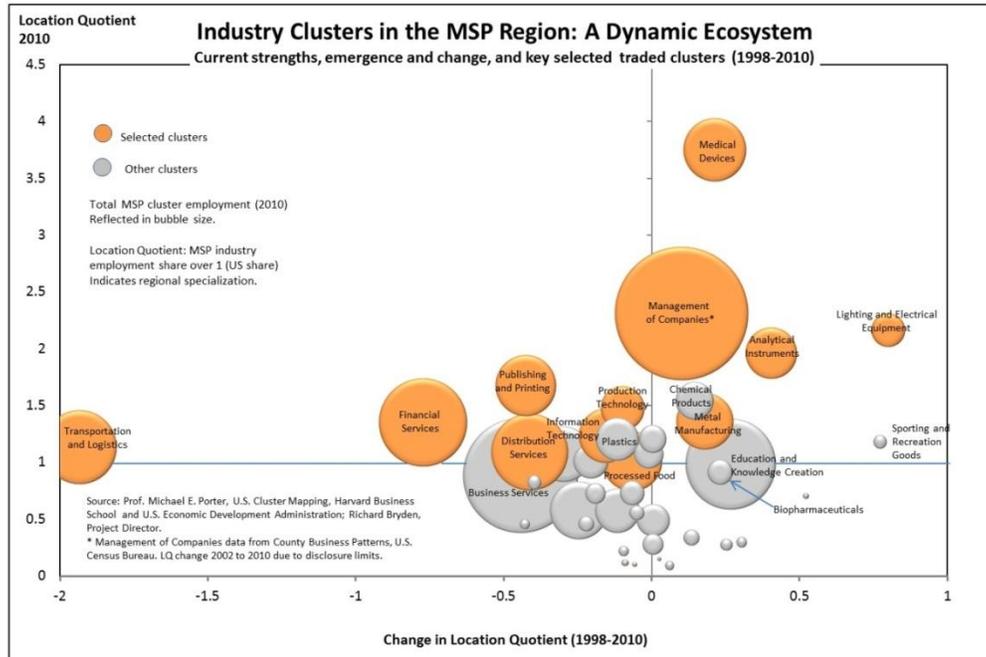
industries share a specialized workforce, the higher the likelihood for knowledge sharing through worker transfers.

Cluster Selection

Eleven clusters were selected from 41 traded clusters (industries that export products or services outside the region) in the Cluster Mapping Tool. In addition, corporate headquarters were added to the cluster analysis because of their importance to the MSP region. Corporate headquarters fall within the “management of companies” category in the NAICS industry classification scheme and are considered a local subcluster for most regions in the Cluster Mapping Tool. The following figure shows the concentration and linkages of traded clusters in the MSP region based on location quotients, the ratio of the share of regional employment to the share of national employment for each cluster.



The clusters selected for analysis are highlighted below. The following figure shows the level and change in location quotient for each industry cluster and the cluster employment level based on the size of each bubble.



The data available for the Cluster Mapping Tool during the course of this study covers the years 1998 to 2010. The data allows comparisons with other states for the cluster analysis and the major competing regions for each cluster are shown. The Minnesota Department of Employment and Economic Development (DEED) has compiled more recent employment data by industry through 2012. While the employment data collected by DEED is not completely consistent with the Cluster Mapping Tool data, based on County Business Patterns industry data, the following shows percent changes in employment for the clusters examined in this study, based on calculations by DEED staff.

MSP Regional Employment Growth by Cluster, 2010-2012

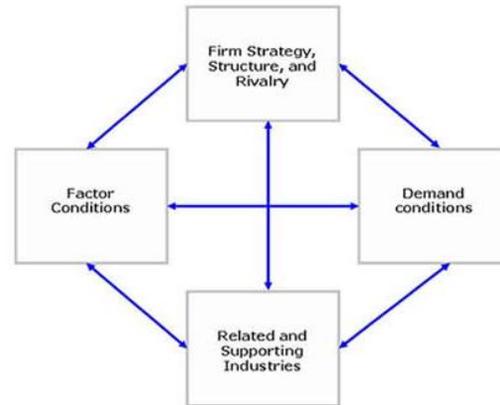
Cluster	Employment Growth, 2010-2012
Lighting and Electrical Equipment	13.69%
Metal Manufacturing	10.21%
Management of companies	6.44%
Production Technology	5.86%
Processed Food	3.92%
Analytical Instruments	1.88%
Financial Services	-0.26%
Information Technology	-0.52%
Transportation and Logistics	-0.68%
Distribution Services	-1.10%
Medical Devices	-1.60%
Publishing and Printing	-1.76%

Source: Minnesota Department of Employment and Economic Development

Cluster Competitiveness Analysis

For each industry this study includes a cluster competitive analysis based on Michael Porter's diamond of advantage.¹ The diamond of advantage identifies four components that affect cluster competitiveness by increasing the productivity of constituent firms and industries, by increasing the capacity for innovation and thus for productivity growth, and by stimulating new business innovation that supports innovation and expands the cluster.

- *Factor conditions*— specialized labor pool, specialized infrastructure, selected disadvantages that drive innovation and productivity improvement;
- *Demand conditions*— sophisticated and demanding home customers driving companies to innovate, especially if local demand anticipates global markets;
- *Related and supporting industries*— internationally competitive supplier industries, creating a high quality, supportive business infrastructure, and spurring innovation and spin-off industries;
- *Context for firm strategy and rivalry*— intense local rivalry among local industries that supports more sophisticated competition and higher levels of productivity; a local culture, institutions, and policies that influence individual industries' innovation and competition.



The following is a summary of this cluster competitiveness analysis for all clusters in the MSP region:

Factor Conditions:

- MSP clusters depend on a skilled work force, particularly in engineering, medical, IT, design, production, logistics, and distribution fields.
- University of Minnesota plays a critical role in research and education of high-skilled workers.
- MSP's large number of corporate headquarters compete for the best talent within the region and attract highly productive workers to the region.
- MSP's clusters historically developed and still benefit from Minnesota's natural resources—food, lumber, minerals, water.
- Ninth Federal Reserve District home and corporate headquarters stimulate robust financial service and insurance industry.

¹ Porter, Michael. *On Competition*, Harvard Business School Press, Boston, 2008.

Demand Conditions:

- Past local demand from computer and telecommunications industries and now medical devices have contributed to development of MSP's electrical equipment, analytical instruments, and metal manufacturing clusters.
- Increased global demand for food, feed, and fiber due to economic growth and demographic shifts in key developing countries, such as China and India, are creating opportunities for MSP's globally competitive processed food companies.
- Sophisticated local demand for healthy food and green products has helped to influence the direction of MSP's legacy food companies and entrepreneurs.
- Corporate headquarters contribute to favorable regional demand conditions for the financial industry as well as other clusters such as publishing and printing, advertising, and legal and business services in MSP.
- Local demand from the region's competitive industries has contributed to the development of companies in production technologies and other clusters involved in improving productivity through technology and process improvements.

Related and Supporting Industries:

- Due to the high concentration of corporate headquarters in Minnesota, there are many strong related and supported companies headquartered in MSP.
- MSP's analytic instruments cluster is tied closely to the region's past and current success in medical device and lighting and electrical equipment clusters.
- Transportation and logistics and distribution services clusters are related to many other clusters, as nearly all traded clusters require some form of transportation, distribution, and logistical services.
- MSP clusters benefit from the high-caliber professional services available, including accounting, advertising, legal, and marketing.
- Information technology products and services are utilized by a large and growing segment of the economy, and its employees are often recruited to fill in-house IT positions in competitive MSP clusters.

Context for Firm Strategy and Rivalry

- MSP's strengths in multiple clusters combined with its concentration of major corporate headquarters create an ecosystem that is ripe for innovation and entrepreneurship across clusters.
- MSP's corporate headquarters and major employers have competed historically for talented workers, occasionally recruiting from one another's ranks.
- MSP's corporate headquarters tend to focus their attention to global and national competitors, often sharing supportive rather than rivalry-based relationships with one another.

Key Findings

This study complements a case study by the Humphrey School's State and Local Policy Program on how the Minneapolis-St. Paul region has benefitted from applying a cluster approach as a conceptual framework for diagnosing the regional economy and as a platform for joint action to address the challenges identified.² The cluster framework provides public and private regional leaders with a common language for understanding regional competitiveness, significantly enhancing the effectiveness of their dialogue.

By organizing the policy discussion around clusters, regional organizations such as Greater MSP, the Regional Council of Mayors, and the Metropolitan Council have a common platform for focusing programs and investments through a broader regional economic development strategy.

This expansive cluster study yields many interesting results and insights. The following are six important findings.

Importance of Corporate Headquarters

Minneapolis-St. Paul is home to a large concentration of corporate headquarters, including 19 Fortune 500 companies and eight Fortune 1000 companies. Minneapolis-St. Paul is also home to the nation's largest private company, Cargill, and several other very large private corporations such as Carlson, M.A. Mortenson, and Holiday Companies. Although the region is also home to many smaller firms and other components of industrial supply chains, these corporate headquarters play a major role in fueling the regional economy. The reasons for the location of many of these headquarters vary; however, many corporations attribute Minnesota's competitive advantage to the state's strong work ethic, well-trained workforce, and high quality of life (CEOs for Cities Report, 2012).

Strong Technology Base Focused on Specialized Products and Advanced Manufacturing

Minneapolis-St. Paul's well-trained workforce, in conjunction with other locational factors, has allowed the region to specialize in production and advanced manufacturing. While shipping costs to major markets on the east and west coasts limit Minneapolis-St. Paul from being a key manufacturer of large-scale products, the region has adapted by manufacturing niche-market, highly specialized, and frequently smaller or lighter products. In many instances, these highly technical components stemmed from demand from some of the region's more established legacy clusters, such as medical devices or processed food. As the MSP region continues to grow within these industries, the ability to attract and retain qualified labor becomes extremely important not only to the larger corporations but to the smaller, more specialized firms as well.

² Munnich, Lee W., Jr., L. Burke Murphy, Megan L. Roberts, and Jennifer Schuler. *Minneapolis-St. Paul Regional Cluster Initiative: Providing a Framework for Minnesota's Economic Competitiveness*. State and Local Policy Program, Humphrey School of Public Affairs, University of Minnesota (2013)

Linkages among Clusters within the MSP Region and with Greater Minnesota

The Minneapolis-St. Paul region benefits from a diverse portfolio of traded clusters with linkages to other clusters within the region as well as with competitive clusters in Greater Minnesota. These linkages result from factor conditions, such as a skilled and specialized workforce serving multiple clusters, demand conditions where competitive clusters drive innovation in other regional clusters, and related and supporting industries that form a business ecosystem within the region. For example, in the MSP regional economy clusters, analytical instruments, and production technology play a largely complementary role to other clusters, such as medical devices and processed food. Other clusters, such as distribution services, transportation, and logistics, play a critical role in the distribution and dissemination of the region's manufactured products. The MSP region also benefits from linkages with competitive Greater Minnesota clusters, such as processed food, publishing and printing, and production technology.

Linkages through Knowledge Sharing

The most prominent sectors in the Minneapolis-St. Paul region also exhibit the potential for knowledge sharing by their occupational hiring practices. This study finds that diverse industries share multiple specialized occupational classes. These common hiring practices enable knowledge sharing as workers flow from industry to industry as job changes occur. For example, occupational data in the region show that corporate headquarters (management of companies sector) seek expertise that is also sought by electromedical manufacturing and insurance carriers. These and other occupational sharing patterns highlight certain occupations as important to multiple regionally important industry clusters. Occupations run the range from those requiring academic degrees (e.g., statisticians, programmers, and engineers) to those in trade sectors (e.g., machine operators and mechanical drafters). The presence of these hiring similarities also suggests that the policymakers ought to take a closer look at the extent to which tomorrow's workforce is being prepared to ensure the region's competitive edge in key industries.

Entrepreneurship and Innovation as Drivers of Economic Growth

Many of the most prominent companies are headquartered in Minneapolis-St. Paul because they were formed within the region. Minnesota has long been known for its entrepreneurial and innovative nature, beginning with advanced manufacturing from the mining industry, its legacy as a global milling hub, and as a global epicenter for medical devices. For MSP to continue to grow and prosper it must not only continue to support these legacy industries, but, more importantly, renew and enhance the entrepreneurial and innovative spirit that led to their establishment. Within its established industries, the region continues to innovate, in addition to innovating around complementary and emerging industries as well.

Emerging Opportunities

Stemming from its legacy industries, Minneapolis-St. Paul is at the forefront of many emerging technological fields, such as advanced water tech, biorenewables, 3D printing, and robotics. Although it is difficult to classify each of these industries in their own cluster (or, in many

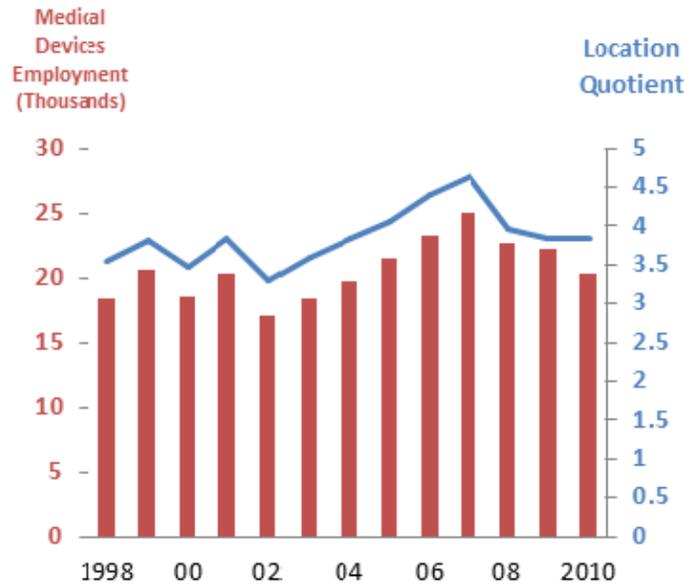
instances, into a predetermined cluster), they all have the capability to advance the region's economy. All of these fields are high-tech and high-knowledge industries with far-reaching regional, national, and global implications. The region needs to continue to attract and retain the workforce necessary for industrial and technological growth.

MEDICAL DEVICES

Key Performance Indicators



Medical Devices employment and location quotient increased consistently until 2007, where it has since tapered off.



2010

Number of Employees

20,097

Location Quotient

3.75

Medical Devices jobs are nearly four-times as concentrated in Minneapolis-St. Paul as in the nation.

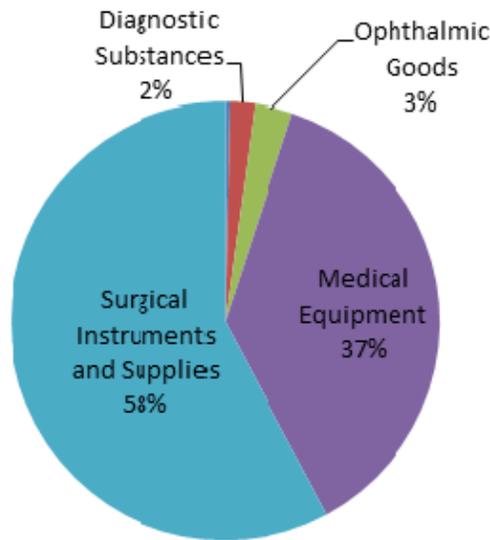
Average Annual Wage

\$82,399

Average Medical Devices wages in Minneapolis-St. Paul were the third highest in the nation.

Largest Companies

- Medtronic
- St. Jude Medical
- Boston Scientific
- Starkey Laboratories
- 3M
- Smith's Medical
- GN Rescund



The largest sub cluster within the Medical Devices cluster is Surgical Instruments and Supplies, followed by Medical Equipment.

Los Angeles has the largest employment within the Medical Devices cluster, followed by Minneapolis-St. Paul and New York.



Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns, Company Data, Dun & Bradstreet, Million Dollar Database

Minneapolis–St. Paul Medical Devices Cluster

As defined by the BioBusiness Alliance of Minnesota (BBAM) and the Minnesota Department of Employment and Economic Development, “the medical device market consists of all instruments, apparatuses, implements, implants, in vitro reagents, or component parts or accessories that are used to prevent, diagnose, treat, or cure diseases.”³

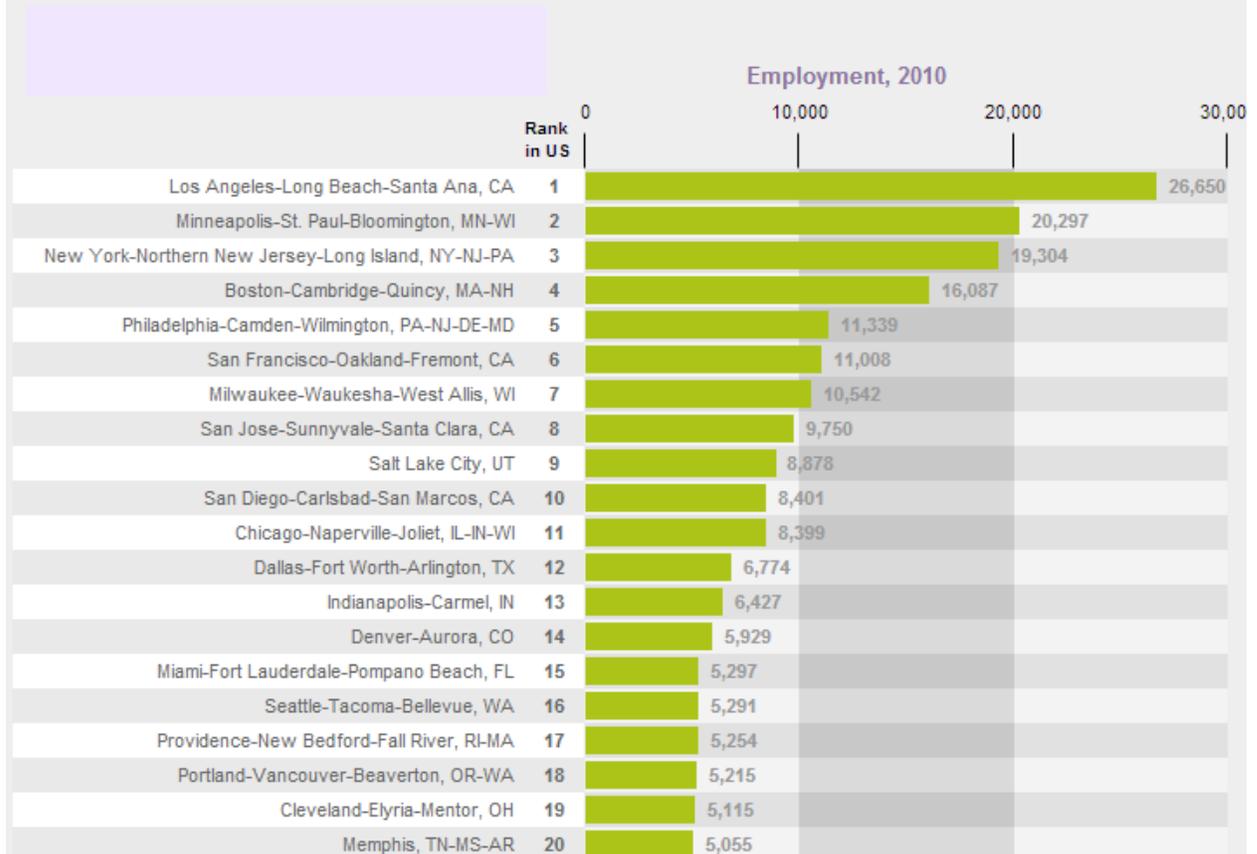
Beginning in 1949 with the invention of the pacemaker and the formation of Medtronic, Inc., the Minneapolis-St. Paul medical devices cluster is one of the metropolitan area’s most well known and influential industry clusters. Industry leaders such as Boston Scientific, 3M, Medtronic, and St. Jude Medical anchor the cluster and have benefited historically from being surrounded by numerous small- and medium-sized medical device companies, leading to acquisitions and competition. Likewise, the cluster has been home to groundbreaking medical research stemming from large institutions, such as the University of Minnesota or the Mayo Clinic, and other regional hospitals and life science firms. Although the cluster is relatively new to the area, Minneapolis-St. Paul’s strength in medical devices stems from its ability to innovate, collaborate, and compete nationally, leading to decades of growth. The leading private sector firms, specialized suppliers, and strong institutes for collaboration within the region have made the medical device cluster a cornerstone of Minnesota’s economy.

Despite Minneapolis-St. Paul being home to many major cardiac device firms, the cluster is diverse and ranks high nationally in a variety of other medical device fields. As a whole, the MSP region has the second most medical device employees in the United States, and the third largest location quotient, which is used to measure how concentrated the industry is in the region compared to the nation. In 2010, the region had 20,297 employees and a location quotient of 3.75, meaning that industry employment is 3.75 times more concentrated within the region than in the nation. Other highly competitive regions with significant employment in the medical device industry cluster are Los Angeles, New York, Boston, Philadelphia, San Francisco, Milwaukee, San Jose, Salt Lake City, San Diego, and Chicago.

³ BioBusiness Alliance of MN & Deloitte Consulting, "Destination 2025—Minnesota's Medical Device Industry: A Vision for the Future," January 2009.

Medical Devices Cluster

Employment by Metropolitan Statistical Area, 2010



The MSP region is most competitive within the medical equipment and surgical instruments and supplies subclusters, where it ranks second nationally in terms of employment. Of metropolitan areas with greater than 5000 surgical instrument employees, MSP has the second highest location quotient. Warsaw, IN, which has the highest location quotient within the subcluster, is home to DePuy Manufacturing, the world's first orthopedic device manufacturer and competitors, such as Zimmer, Inc. and Biomet. Despite having the second most medical equipment employees, MSP has the seventh largest location quotient of metropolitan areas with more than 1000 employees within the subcluster. Still, the region has a location quotient of 6.71 within the subcluster, meaning that medical equipment employment is nearly seven times more concentrated within the region than in the nation.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Medical Devices Cluster				
Cluster/Subcluster Name	Employment	National Employment Rank	MSP Location Quotient	Other Competitive Regions
Medical Devices	20,297	2	3.75	Los Angeles, New York, Boston
Biological Products	31	96	0.07	East Stroudsburg (PA), Philadelphia, San Francisco, New York
Dental Instruments and Suppliers	37	61	0.17	Salt Lake City, Portland, Los Angeles
Diagnostic Substances	375	26	1.05	Indianapolis, San Diego, San Francisco, Boston, Rochester (NY)
Ophthalmic Goods	580	12	1.87	Los Angeles, Dallas, Jacksonville, Rochester (NY)
Surgical Instruments and Supplies	11,730	2	4.10	Los Angeles, New York, Warsaw (IN), Boston
Medical Equipment	7544	2	6.71	Milwaukee, Los Angeles, San Jose, New York

Several major breakthroughs in the Medical Devices realm have occurred in the MSP region. Medtronic developed the first wearable, external, battery-operated pacemaker in 1957. Other notable inventions and innovations include the first bileaflet mechanical heart valve (University of Minnesota, 1972), the first inflatable penile prosthesis implant (American Medical Systems, 1973), the first implanted mechanical heart valve (American Medical Systems, 1977), and the single-channel cochlear implant (3M, 1984). Advancements with the pacemaker also occurred in 1978, with the first single-chip pacemaker, which reduced size and increased reliability (Siemens-Elcoma), and in 2004, when Medtronic unveiled the first digital pacemaker. Innovations have also occurred at the university level, especially with the work of Dr. Doris Taylor, who specializes in groundbreaking stem cell research. In 2008 Dr. Taylor created a working rat heart from baby rat stem cells.

- Starkey Laboratories, which specializes in hearing aids ranging from digital, invisible, wireless, and children’s hearing aids of several varieties;
- Smiths Medical, a manufacturer of drug delivery systems that help treat cancer patients and provide pain relief, and vital care products for the reduction of infections and managing patient airways throughout the surgical process;
- GN Resound, a developer of hearing aids and diagnostic audiological instruments; and
- EV3, a developer of devices such as stents, guidewires, and catheters.

Minnesota’s general business environment also allows for the region to maintain its competitive advantage. The factor conditions within the cluster are strong, as the Twin Cities are home to numerous skilled workers with a relationship to medical devices, such as engineers, technicians, regulatory professionals, manufacturing assemblers, and clinical staff. Many companies seek out this skilled and specialized workforce. The University of Minnesota and the Mayo Clinic also interact heavily with the cluster and have historically aided in groundbreaking research and fostering entrepreneurship. These institutions, in addition to a variety of technical colleges, are also critical in training the workforce.

Although the prestige of the Mayo Clinic and the University of Minnesota Medical School draws patients from across the nation, the demand for medical devices is far greater outside of the region than inside of it. Still, historical demand conditions proved pivotal in the development of the cluster as the region innovated in areas such as cardiovascular devices.

Firm rivalry is critical to the continued success of the region’s medical device cluster. The hundreds of firms in the cluster work closely together in supply chain linkages, while also directly competing against one another for business. This competition fosters innovation. Between 2006 and 2010, 3M, which manufactures medical device components, among other technological products, had 1016 patents while Medtronic, a strictly medical device company, had 771. Other industry leaders with a strong innovative presence include Cardiac Pacemakers, Inc., which had 575 patents between those years, Boston Scientific, which had 272 patents, and Sci-Med Life Systems and St. Jude Medical, which both had 46 patents within that timeframe. It is critical to the long-term viability of the cluster that firms compete with one another and race for market share, prompting even more innovation. Furthermore, many companies seek to buy out or merge with smaller companies in order to expedite this innovative process or diversify their medical



Company Profile: St. Jude Medical

Founded in St. Paul in 1976, St. Jude Medical got its start as a manufacturer of bi-leaflet implantable mechanical heart valves. Beginning in 1994, the company went through a period of acquisitions and diversification, purchasing companies that make pacemakers and defibrillators. The company now develops and manufactures cardiac resynchronization devices, pacemakers and defibrillators, catheters, heart valves, and groundbreaking neuromodulation systems. A global company with operations and manufacturing facilities worldwide, the company stands to benefit from global demographic changes, lower health care costs, and the need for medical devices in underdeveloped countries. St. Jude Medical employs 2800 workers throughout the Twin Cities with operations in Plymouth, Minnetonka, Maple Grove, and St. Paul, employing many Twin Cities engineers and other talented workers. The company incorporates many local businesses in its supply chain and continues to innovate, using advanced information technology systems to update surgical procedures while revolutionizing and modernizing the cardiovascular devices that allowed the company to grow and prosper.

device holdings. It is important that these companies continue to grow and compete globally in order to reach newer markets. The innovative environment for new medical device companies and the venture capital dollars needed for entrepreneurship continue to create new startups to increase competition. Currently, the region is lacking in venture capital, especially when compared with other competitive areas such as California and Massachusetts.

Many other clusters within the region are critical to the success of the medical device cluster. For example, the analytical instruments, biopharmaceuticals, financial services, and information technology clusters all play a role in the medical device cluster supply chain. Many companies have a distinct advantage by being geographically close to many of their more important suppliers. Suppliers within the medical device cluster include component suppliers, equipment manufacturers and integrators, and software vendors, while institutions for collaboration, educational institutions, and hospitals and doctors' offices also play a major role in shaping the cluster.

One notable policy concerning the medical device cluster is the medical device tax. With the June 2012 Supreme Court decision to uphold the Affordable Care Act, a tax on medical devices also was upheld. This excise tax, which took effect in January 2013, collects 2.3 percent of the sale price on medical devices and is expected to raise an estimated \$29 billion over the next decade. The tax is hotly contested among critics, including many in the medical technology industry, who suggest that it will increase health costs and lead to job losses. Minnesota's Research and Development Tax Credit is designed to encourage innovation within the cluster, helping Minnesota to be more competitive in research-intensive, high-tech areas, such as medical devices.

Cluster Competitiveness Analysis

Factor Conditions: Minneapolis-St. Paul has a skilled workforce with labor stemming from the region's premier research universities, in addition to workers from the region's larger companies. Furthermore, the region is able to utilize research that comes from the area's hospitals and universities to commercialize medical device products.

Demand Conditions: Demand for medical device products has become increasingly international. Because of locational factors, area hospitals and doctors' offices are able to leverage relationships with medical device companies to not only express areas of need or concern, but for testing. In recent years, the demand for medical devices has become global as many new foreign firms are entering the field, while a new global middle class (whose health has been increasing) now demands advanced medical care.

Related and Supporting Industries: Among traded clusters, the analytical instruments cluster and biopharmaceutical cluster are related to medical device care. Ultimately, the development of medical devices requires relatively high-tech and high-skilled manufacturing. In addition to manufacturing, local health services (such as doctors' offices and hospitals) play a critical role in the research and development side of the industry. Professional services firms, such as patent lawyers, consultants, and regulatory aids are also crucial to the process.

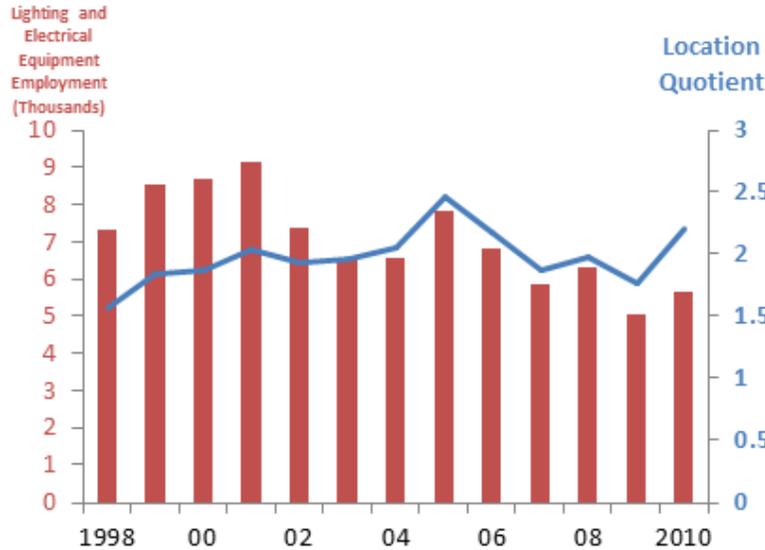
Context for Firm Strategy and Rivalry: Historically, Minneapolis-St. Paul has relied on competition among its smaller and larger firms to create a critical mass in this cluster. In recent years, with funding and regulatory inconsistencies, it has been crucial for firms to continue to innovate. These inconsistencies, however, have had an impact on the entrepreneurial market. Because of this, larger firms, research institutions, and universities have attempted to spin-off companies and new devices where they can still have the support not found in traditional start-up culture.

LIGHTING AND ELECTRICAL EQUIPMENT



Key Performance Indicators

Lighting and Electrical Equipment employment peaked in 2001, while the region's location quotient peaked in 2005.

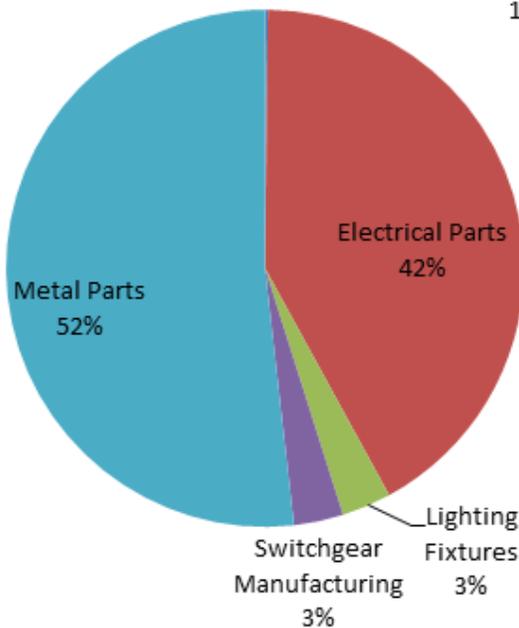


2010

Number of Employees
5,677

Location Quotient
2.16
Employment in the Lighting and Electrical Equipment Cluster is more than twice as concentrated in MSP as in the region.

Average Annual Wage
\$55,585
Average Lighting and Electrical Equipment wages in Minneapolis-St. Paul were the third highest in the nation.

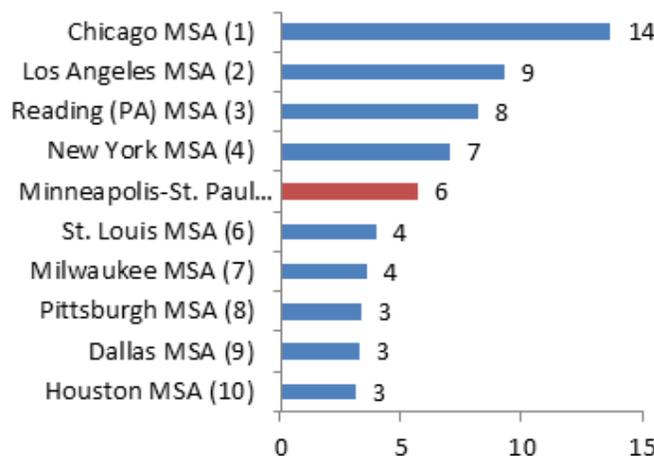


The largest sub cluster within the Lighting and Electrical Equipment cluster is Metal Parts, followed by Electrical Parts.

- Largest Companies**
- Hirel Systems
 - MN Wire
 - Precision Inc
 - R&D Batteries
 - Electric Wire Products Corp

Chicago has the largest employment within the Lighting and Electrical Equipment cluster, followed by Los Angeles and Reading (PA). Minneapolis-St. Paul has the 5th highest total employment of all metropolitan areas.

2010 Lighting and Electrical Equipment Employment (Thousands)



Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database.

Minneapolis-St. Paul Lighting and Electrical Equipment Cluster

The MSP region ranks fifth in the U.S. in employment in the lighting and electrical equipment cluster. Other competitive regions for this cluster are Chicago, Los Angeles, Reading, and New York. The region ranked second in employment among metropolitan regions in two subclusters, electrical parts and metal parts, with cluster employment shares three-and-one-half times the national shares.

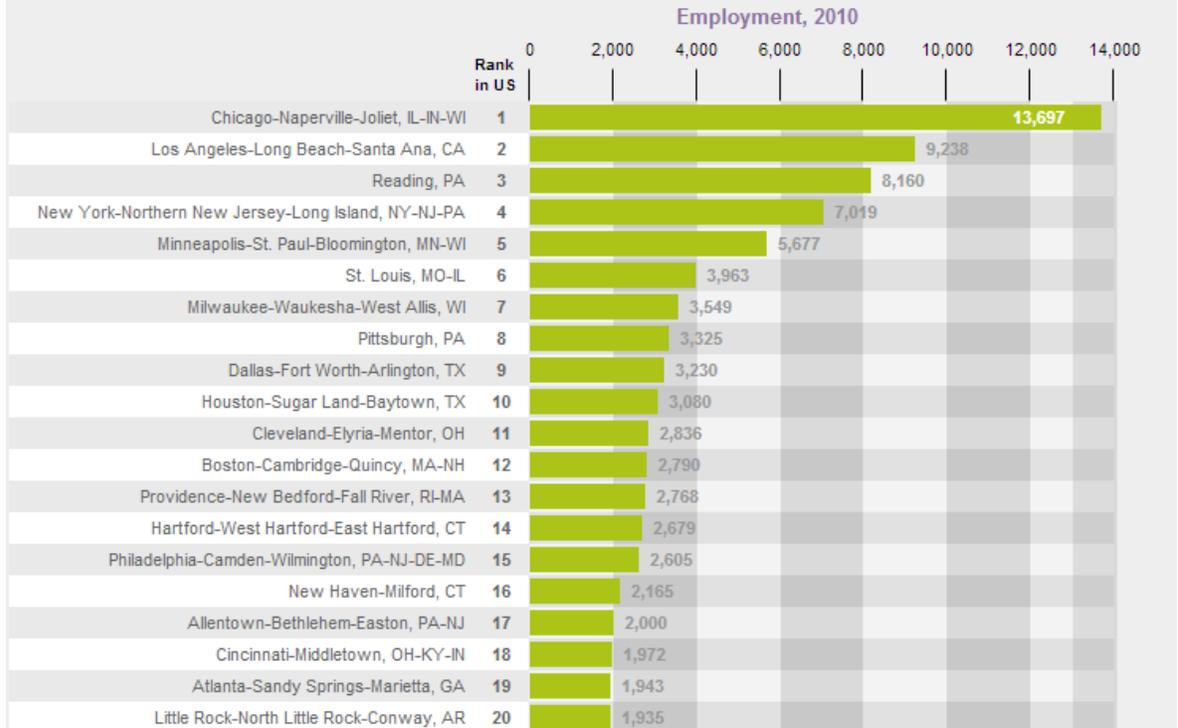
The development of this cluster has been influenced by the evolution of strong technology-based regional clusters since World War II. The MSP region was a major player in the development of the computer industry from the late 1940s through the mid-1980s, drawing upon local electrical equipment companies for specially designed components. Similarly, the telecommunications industry had a strong presence in the region from the late 1980s through 2000, generating further business for these companies. Finally, the medical device industry cluster has emerged as a premier cluster within the region since the 1980s, creating opportunities for the region's cluster of electrical equipment suppliers. Companies in this cluster may also be critical as the MSP seeks opportunities in emerging energy and green industries.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Lighting and Electrical Equipment Cluster

Cluster/Subcluster Name	2010 MSP Employment	National Employment Rank	MSP Location Quotient	Other Competitive Regions
Lighting and Electrical Equipment	5,677	5	2.16	Chicago, Los Angeles, Reading (PA), New York
Electric Lamps	10	56	0.09	Lexington (KY), Manchester (NH), New Haven (CT), Cleveland, Columbus (OH)
Lighting Fixtures	175	43	0.5	Chicago, Los Angeles, New York, Philadelphia
Switchgear	175	61	0.43	Chicago, Houston, Los Angeles, Pittsburgh, Milwaukee
Electrical Parts	2,377	2	3.5	Chicago, Los Angeles, Allentown (PA), Little Rock
Metal Parts	2,940	2	3.57	Chicago, St. Louis, Los Angeles, New York, Pittsburgh, Milwaukee
Batteries	N/A	N/A	N/A	Reading (PA), St. Joseph (MO), Los Angeles

In 2010 the MSP region employed 5,677 in the lighting and electrical equipment cluster with an average annual wage of \$55,585. The MSP average annual wages for this cluster were the third highest in the nation. Over 90 percent of the jobs in the region were in two subclusters—electrical parts, 2377, and metal parts, 2940. The MSP region has very little employment in lighting equipment.

Lighting and Electrical Equipment Cluster
 Employment by Metropolitan Statistical Area, 2010



Precision Incorporated was started as a machine shop in 1919. The company’s major customer was the vending machine industry until electronic machines replaced mechanical machines in the 1960s. Precision was sold to Cummins in 1964. The company specialized in coil winding for transformers and provided power resistors for Onan Power, Honeywell, Summit Gear, and NSP in the 1960s and 1970s. The Minnesota computer industry was a major customer for Precision until the computer industry’s decline in Minnesota in the mid-1980s. Since then Precision has shifted to the medical device industry, with Medtronic as one of its primary customers. Precision’s other long-term customers have included Graco, Data Card, Cummins Engine, Honeywell, General Electric, and Rockwell International.

Precision has experienced the rise and fall of the computer and telecommunications industries in the Greater MSP region and benefited from the growth of the region’s medical device industry. The company has implemented quality systems and is ISO 9000-1345 (medical device) certified. Precision Inc applications for medical device customers include:

- High frequency inductors for surgical navigation instruments
- Primary and secondary coils for wireless charging applications
- Antenna coils for telemetry use in reading and programming pacemakers and other like devices
- PFC inductors used in defibrillation devices
- Send and receive coils for base to device communication

- Antenna coils for communication
- Isolation transformers for medical equipment requirements
- Switch mode transformers and inductors for ablation equipment

Solar energy is one of its growing markets, and the company has expanded in this market by purchasing a company for in Loveland, Colorado. Precision Inc. is a major supplier of key components to inverter manufacturers who are providing products to the alternative energy market including solar energy, wind energy and geothermal power. These products consist of buck/boost inductors, DC to AC conversion, drive inductors, line reactors, EMI filters, isolation transformers, and gate drive transformers.

The company has also expanded in China to take advantage of market opportunities there. The company needs highly skilled electrical engineers to design its specialized products for corporate clients. The company's competitors are in the Chicago area associated with the TV industry.

Cluster Competitiveness Analysis

Factor Conditions: The companies in this cluster rely on skilled electrical engineers and technicians with strong design and quality skills. Education at all levels and workforce training focused on STEM skills, design, and quality tools are likely to be important for the future competitiveness of this cluster.

Demand Conditions: Local demand from the computer and telecommunications industry have contributed to the development of the electrical equipment cluster in the MSP region. Demand for high-quality electrical components from the region's medical device cluster have driven the companies in this cluster to focus on design and quality in recent years. Demand for new energy technologies are offering new opportunities for the electrical equipment cluster in the MSP region.

Related and Supporting Industries: The electrical equipment cluster plays an important role as a supplier of other clusters in the region and has expanded its business to major companies outside of the region, making the MSP region one of the top competitors in this cluster.

Context for Firm Strategy and Rivalry: The electrical equipment cluster is an important part of the ecosystem that contributes to the success of other regional clusters, such as medical devices.



Company Profile: Precision Incorporated

Precision Incorporated was founded as a machine shop in 1919 serving the vending machine industry. The Brooklyn Center company now designs and manufactures magnetic coils for medical devices and the energy market.

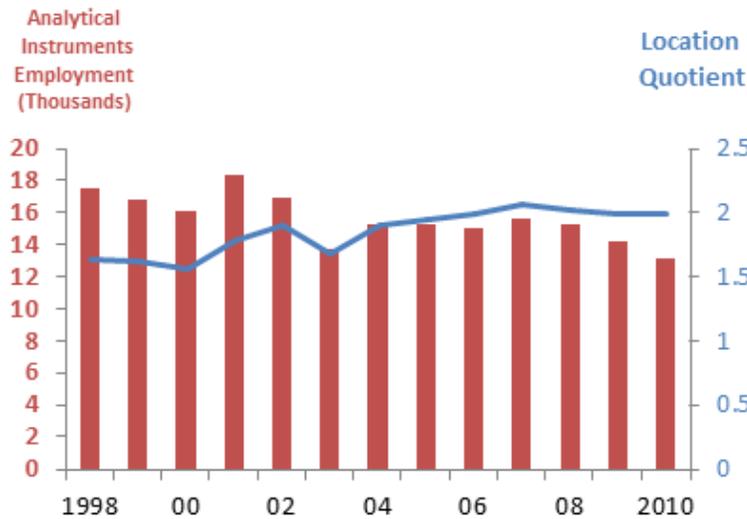
The company does ultrafine wire windings for implantable devices, hearing aids, surgical navigation, neurological implants, and dialysis equipment. In addition to medical devices, Precision's customers are aerospace, controls, and alternative energy industries.

ANALYTICAL INSTRUMENTS



Key Performance Indicators

Analytical Instrument employment and location quotient has remained relatively constant since 1998



2010

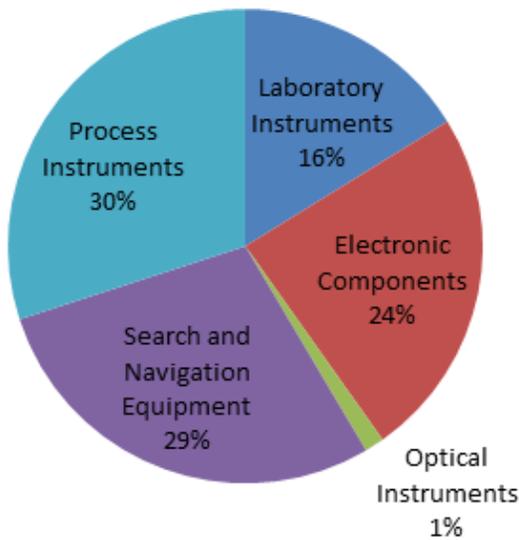
Number of Employees

13,157

Location Quotient

1.96

Employment in the Analytical Instruments Cluster is nearly twice as concentrated in MSP as in the nation.



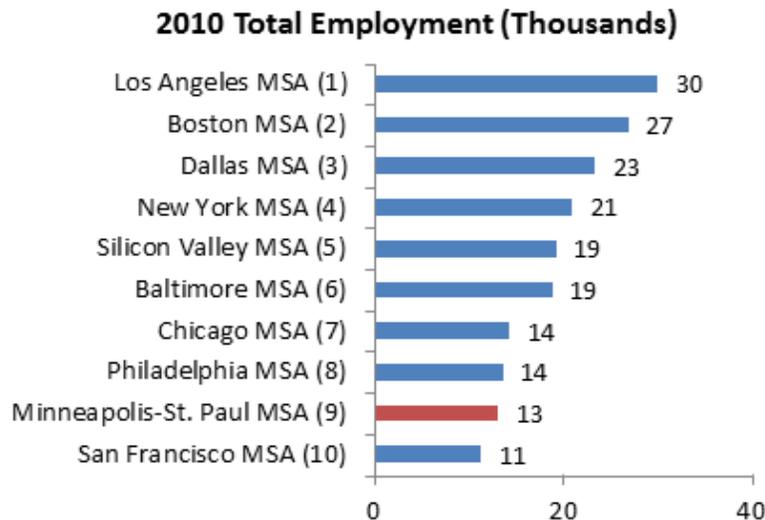
The largest sub cluster within the Analytical Instruments cluster is Process Instruments, followed by Search and Navigation Equipment and Electronic Components

Average Annual Wage

\$62,816

Average Analytical Instruments wages in Minneapolis-St. Paul were the fourteenth highest in the nation.

Los Angeles has the largest employment within the Analytical Instruments cluster, followed by Boston and Dallas . Minneapolis-St. Paul has the 9th highest total employment of all metropolitan areas.



Largest Companies

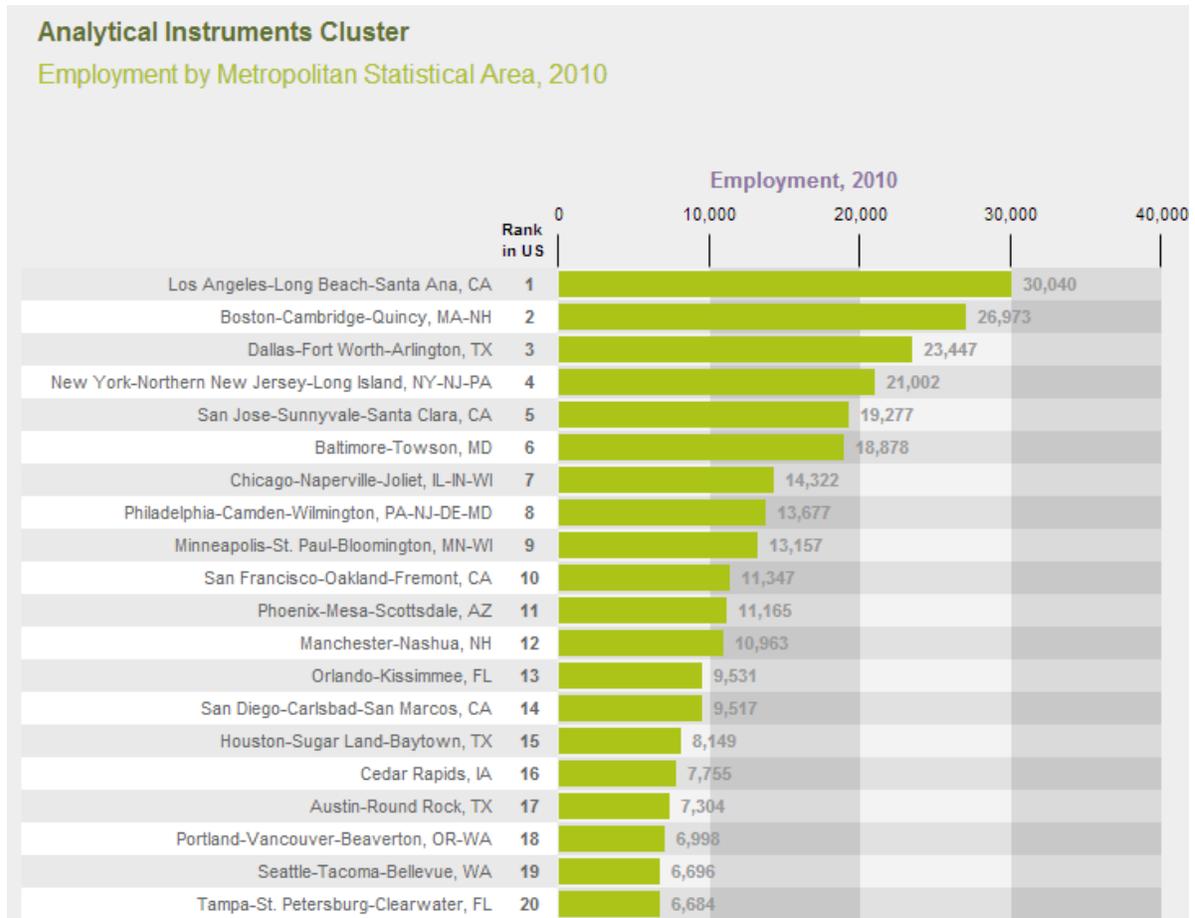
- MTS Systems
- Rosemount Inc.
- Bergquist
- TSI Incorporated
- 3M Precision Optics
- Cyber Power Systems

Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database



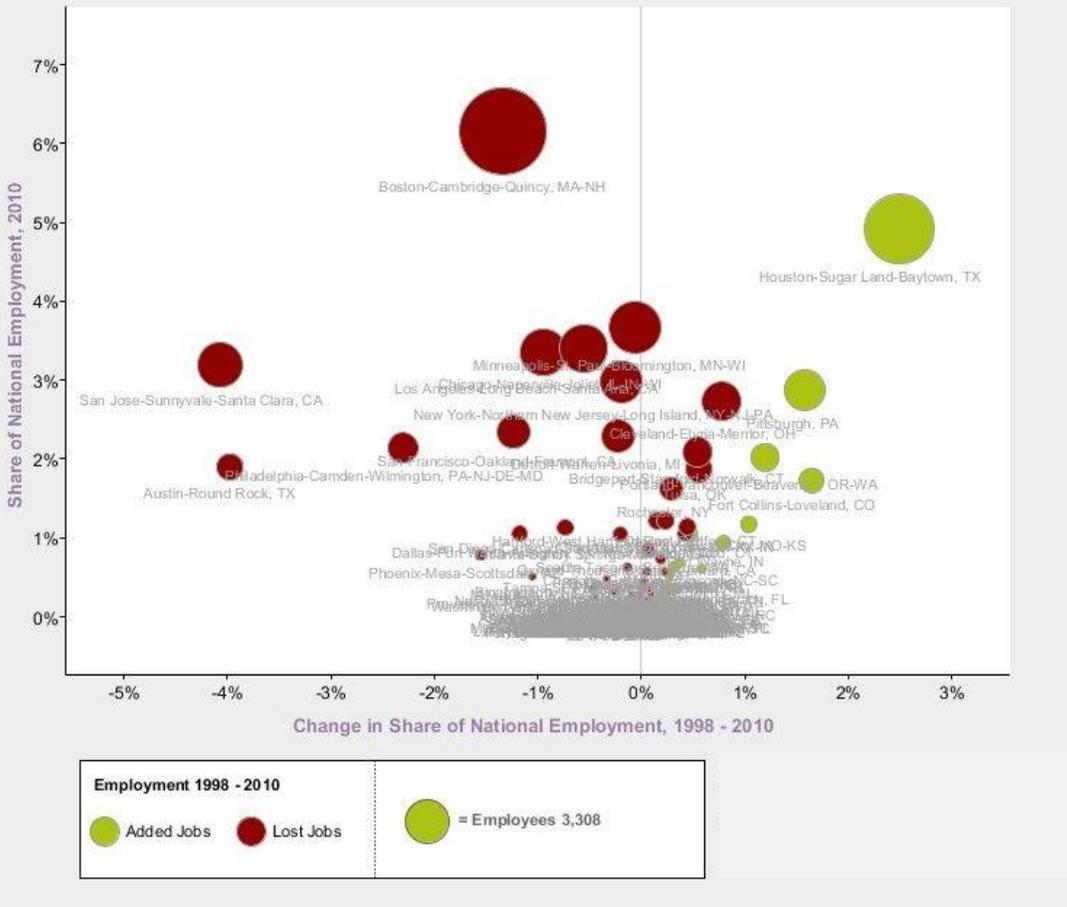
Minneapolis-St. Paul Analytical Instruments Cluster

The analytical instruments cluster accounted for over 13,000 jobs in the region in 2010, placing MSP ninth among U.S. metropolitan areas. Los Angeles, Boston, and Dallas are the top three regions in analytical instruments employment. With a location quotient of 1.96, MSP's analytical instruments cluster boasts an employment concentration roughly twice the national rate. The average annual wage for analytical instrument employees in the MSP region was \$62, 816 in 2010.



Between 1998 and 2010, the MSP region's analytical instruments cluster held steady by capturing a nearly 4 percent share of the cluster's national employment during the span; only Boston and Houston performed better in this regard.

Analytical Instruments Cluster: Process Instruments Subcluster
 Share of National Cluster Employment by Metropolitan Statistical Area, 1998 - 2010



The MSP region’s analytical instruments cluster is comprised of process instruments (30% share), search and navigation equipment (29%), electronic components (24%), laboratory instruments (16%), and optical instruments (15%). The MSP region is particularly competitive within the process instruments subcluster, ranking third nationally with a location quotient of 2.62 and regional employment of nearly 4000. The region also is relatively strong in laboratory components, employing over 2100 with a location quotient of 2.19 and standing in the nation’s top eight.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Analytical Instruments Cluster

Cluster/Subcluster Name	Employment	National Rank	Location Quotient	Other Competitive Regions
Analytical Instruments	13,157	9	1.96	Los Angeles, Boston, Dallas, New York, Silicon Valley, Baltimore
Optical Instruments	175	32	0.77	Boston, Springfield (MA), Los Angeles, Portland, Santa Rosa (CA), Detroit
Laboratory Instruments	2,130	8	2.19	Silicon Valley, Boston, San Francisco, New York, Los Angeles, Philadelphia
Electronic Components	3,157	11	1.62	Los Angeles, New York, Boston, Chicago, Silicon Valley, Austin
Search and Navigation Equipment	3,750	14	1.83	Dallas, Baltimore, Los Angeles, Cedar Rapids (IA), Manchester (NH), Boston
Process Instruments	3,945	3	2.62	Boston, Houston, Chicago, Los Angeles, Silicon Valley

Among the region’s top firms within this cluster, MTS Systems engineers and deploys high performance testing and sensing solutions globally. Rosemount Inc., now an Emerson Electric Company subsidiary, began as a significant supplier for NASA during expansion of the aerospace industry in the 1950s. The company has since diversified, and currently focuses on producing sensors that measure changes in temperature, pressure, level, and flow. The company employs roughly 1000 workers at its Chanhassen headquarters.

Cluster Competitiveness Analysis

Factor Conditions: Like many of MSP's other major clusters, the region's analytic instruments cluster relies upon highly skilled workers. Historically, the University of Minnesota has provided a pipeline of workers in this and related fields. More and more, though, MSP firms are recruiting talent from beyond Minnesota's borders to supplement the region's existing workforce.

Demand Conditions: The firms in this cluster provide businesses with the



Eden Prairie-based MTS Systems has been working, since 1966, to engineer and deploy “high performance testing and sensing solutions ... around the world, enabling precise control of forces and motions as well as real-time feedback that optimizes performance.”

The firm is a global supplier of test systems and industrial position; specifically, it provides mechanical test systems, material testing, fatigue testing and tensile testing services, as well as motion simulation systems and calibration services. Examples of MTS products include: rolling road simulators; hydraulic actuators; shaker tables; and medical testing equipment.

The firm operates in two segments: the test segment and the sensors segment. In 2012, the test and sensors segments represented approximately 80 percent and 20 percent of the company's revenue, respectively. The test segment provides testing solutions, including hardware, software, and after-market support. Products in the sensors segment are used by industrial machinery and mobile equipment manufacturers to automate the operation of their products.

technology and precision measurement capability necessary for their products to succeed. Local demand comes from medical device, defense, and aeronautics firms, among others.

Related and Supporting Industries: The analytic instruments cluster is tied closely to the region's past and current success in medical device and lighting and electrical equipment clusters. Technological, application, and educational overlap account for some of this interrelation and synergy.

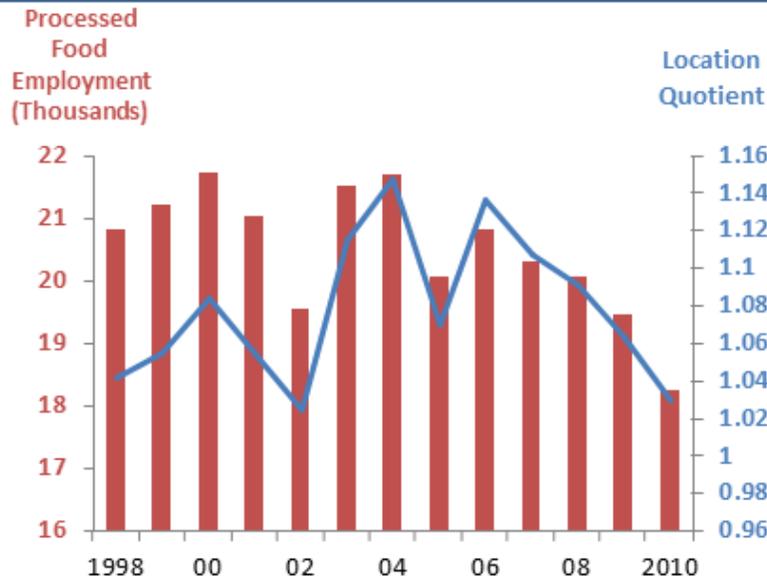
Context for Firm Strategy and Rivalry: Firms in the analytic instruments cluster provide a wide range of products for customers seeking cutting-edge technology for precision measurement. The firms in this cluster offer a strong foundation for business solutions in this area.

PROCESSED FOOD

Key Performance Indicators



Processed Food employment and location quotient has fluctuated since 1998



2010

Number of Employees

18,256

Location Quotient

1.01

Employment in the Processed Food Cluster is as concentrated in MSP as in the nation.

Average Annual Wage

\$47,065

Average Processed Food wages in Minneapolis-St. Paul were the third highest in the nation.

Largest Companies

CHS Inc

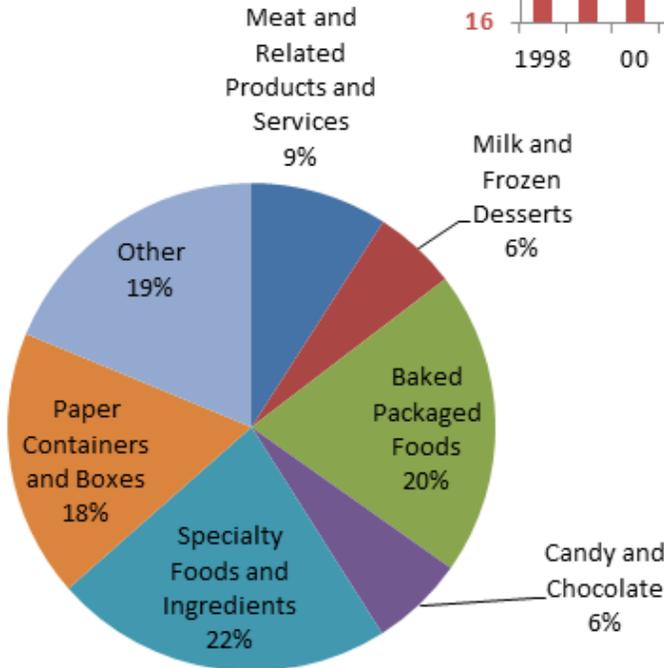
General Mills

Land O'Lakes

MOM Brand Company

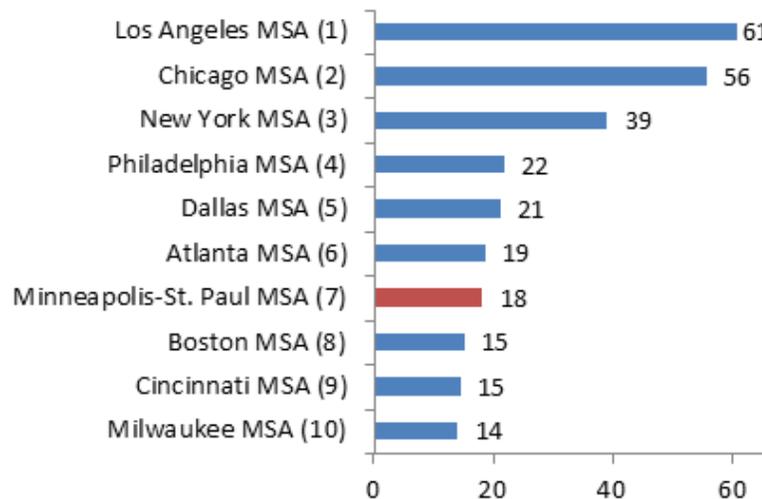
MG Waldbaum

Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database



The largest sub cluster within the Processed Food Cluster is Specialty Foods and Ingredients, followed by Baked Packaged Foods and Paper Containers and Boxes.

2010 Processed Food Employment (Thousands)



Los Angeles has the largest employment within the Processed Food Cluster followed by Chicago and New York. Minneapolis -St. Paul has the 7th highest total employment of all metropolitan areas.

Minneapolis-St. Paul Processed Food Cluster

Agriculture and food processing have played an important role historically in the development of the Minnesota economy and continue to be a significant competitive cluster for the state. The MSP region has some of the largest national and multinational food and agriculture businesses in the world. Major agribusiness companies based in the region include Cargill, General Mills, Land O'Lakes, and CHS. General Mills and Pillsbury (now part of General Mills) played a significant role in the development of Minneapolis in the late nineteenth century. Entrepreneurs from the East took advantage of St. Anthony Falls on the Mississippi River, the rich agricultural land of Minnesota, new technologies such as roller mills, combined with human and knowledge capital to give the region an early competitive advantage in milling and food processing. As these companies matured, diversified, and globalized, the MSP region has benefited from a strong base of research and development in food and agribusiness and corporate leadership. These legacy companies continue to give the region a competitive advantage in the processed food cluster.

In 2010, the processed food cluster in Minnesota employed 45,558, with 18,256 of those jobs in the MSP region. The region ranked seventh in processed food employment among metropolitan regions, with Los Angeles and Chicago topping the list. While the MSP region had a location quotient of 1.01 in 2010, indicating an employment share matching the national average, processed food jobs tended to be located in rural rather than urban areas, so that most metropolitan areas would have location quotients for processed food significantly less than 1. Processed food jobs in metropolitan areas tended to be more related to specialized functions, such as research, marketing, distribution, logistics, management, and administrative, as opposed to actual food production. The average wage for the processed food cluster in the MSP region was \$47,065, above the national average of \$42,058.



Company Profile: Cargill Inc.

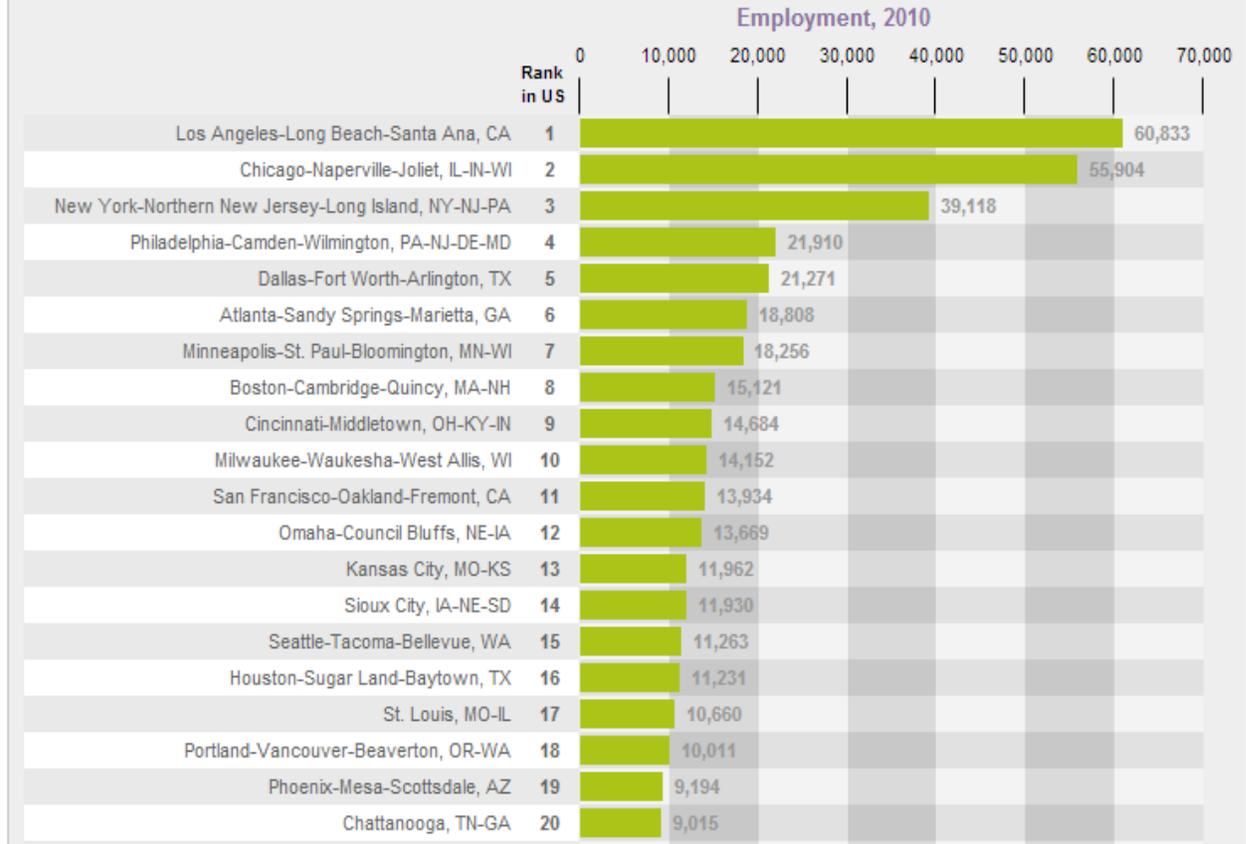
Cargill is an international producer and marketer of food, agricultural, financial and industrial products and services. Founded in 1865, the privately held company employs 142,000 people in 65 countries.

The company evolved from trading soybeans, to processing them into meal and oil, to producing high-value natural vitamin E from a soybean byproduct. And it moved from trading corn, to processing corn into ethanol and fructose, to creating a whole new family of renewable products—from plastics to fabric—made from corn.

Source: Cargill website

Processed Food Cluster

Employment by Metropolitan Statistical Area, 2010



Cargill, a global leader in agribusiness, based in the MSP region has contributed to emerging bio-based companies with the region. These include NatureWorks LLC, founded in 1997 as a joint venture with Cargill by Cargill employees. NatureWorks has developed bio-based “green” products based on sustainable polymer research, including apparel, bottles, gift cards, films, durable goods, folded cartons, food packaging, textiles, non-woven fabrics, and service-ware and compostable plastic bags. Other recent sustainable polymer start-ups that have emerged from Cargill and other MSP companies are Segetis in 2006, Gevo in 2009, and BioAmber in 2009.

**2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area,
Processed Food Cluster**

Cluster/Subcluster Name	Employment	National Rank	Location Quotient	Other Competitive Clusters
Processed Food	18,256	7	1.01	Los Angeles, New York, Chicago, Philadelphia, Dallas
Meat and Related Products and Services	1,658	55	0.40	Los Angeles, Sioux City (IA), Chicago, Omaha, St. Joseph (MO/KS)
Malt Beverages	73	50	0.21	Denver, Los Angeles, Milwaukee, St. Louis, Fort Collins (CO)
Coffee & Tea	123	32	0.61	Los Angeles, Birmingham (AL), Virginia Beach, Charlotte, New York
Metal and Glass Containers	610	17	0.95	Chicago, Modesto (CA), Los Angeles, Denver, Cincinnati
Processed Dairy and Related Products	771	16	0.89	Sheboygan (WI), Springfield (MO), Wausau (WI), Logan (UT), Hanford (CA)
Milk and Frozen Desserts	1,009	11	0.94	Los Angeles, Boston, Dallas, Chicago, New York
Flour	550	10	1.43	Los Angeles, Chicago, Dallas, New York, Atlanta
Milling	851	9	0.69	New York, Indianapolis, Chicago, Kansas City, Cedar Rapids (IA)
Baked Packaged Foods	3,685	9	1.13	Chicago, Harrisburg (PA), San Francisco, Los Angeles, New York
Candy and Chocolate	1,135	8	1.54	New York, Chicago, Los Angeles, Chattanooga, Atlanta
Specialty Foods and Ingredients	4,107	6	1.40	Los Angeles, Chicago, New York, Dallas, Cincinnati
Paper Containers and Boxes	3,238	5	1.59	Chicago, Los Angeles, New York, Dallas, Cincinnati

Cluster Competitiveness Analysis

Factor Conditions: St. Anthony Falls on the Mississippi River was a natural factor in the development of the milling and food processing industry in Minneapolis. Today, the presence of a skilled workforce in all aspects of food production, research, distribution, branding, as well as strong academic base for agricultural and food research at the University of Minnesota, contribute to the competitiveness of the processed food cluster in the MSP region.

Demand Conditions: While the MSP processed food industry competes in a global marketplace, sophisticated local demand for healthy food and green products has helped to influence the direction of the legacy companies and entrepreneurs. From a global perspective, there is an increased demand for food, feed, and fiber due to economic growth and demographic shifts in key developing countries, such as China and India, creating opportunities for MSP's globally competitive processed food companies.

Related and Supporting Industries: Due to the high concentration of corporate headquarters in Minnesota, many strong related and supported companies are headquartered in MSP. Their location in MSP helps agribusinesses facilitate efficient transport and arbitrage of agricultural products and create logistical innovation and knowledge. C.H. Robinson is a global leader in supply chain management and logistics, with roots in the grocery produce transport business. Supervalu is the fourth largest food and drugstore company in the country. Ecolab is a worldwide leader in water and hygiene products and its divisions are devoted to food service, food retail, and food and beverage processing. Furthermore, MSP's nationally recognized health services cluster could become a more important related cluster in the future as consumers increasingly look to food as an aspect of overall wellness. Another related cluster is the plastics industry

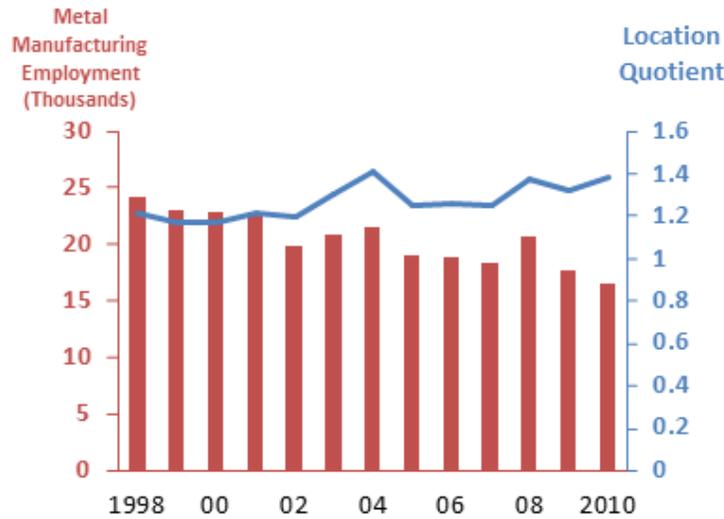
Context for Firm Strategy and Rivalry: Cargill, the nation's largest privately owned company in any industry, not just agribusiness, and General Mills, Land O'Lakes, and CHS are ranked within the top ten companies for their industry in the country. In addition to these national leaders, many other agricultural companies have non-headquarter locations in the state. Twenty-nine of the top fifty U.S. agricultural companies have locations within Minnesota.

METAL MANUFACTURING

Key Performance Indicators



Metal Manufacturing employment has decreased since 1998, while location quotient has increased steadily within the region.



2010

Number of Employees

16,458

Location Quotient

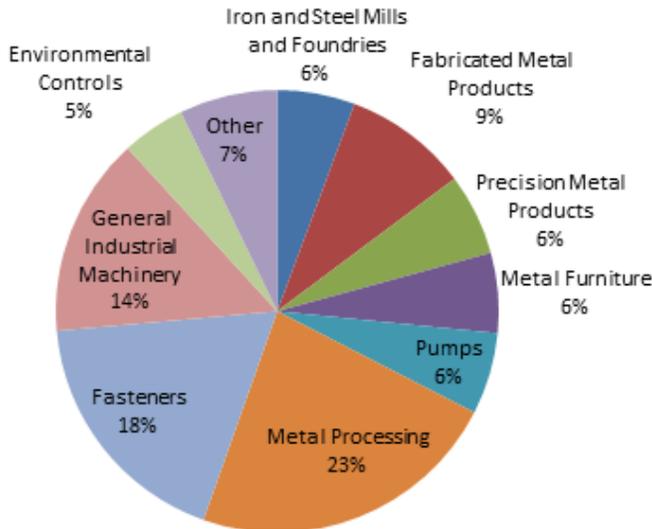
1.36

Employment in the Metal Manufacturing Cluster is more concentrated in MSP than in the region.

Average Annual Wage

\$54,261

Average Metal Manufacturing wages in Minneapolis-St. Paul were the fourteenth highest in the nation.



The Metal Manufacturing cluster is diversified. The largest sub cluster within the cluster is Metal Processing, followed by Fasteners and General Industrial Machinery.

Largest Companies

Pentair

Metal-Matic

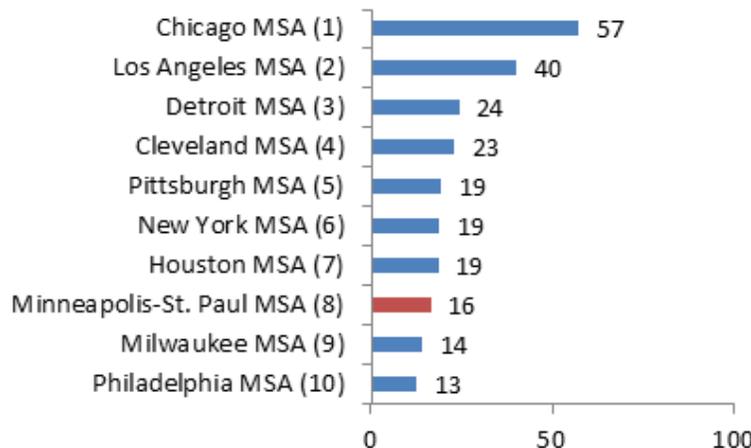
Kurt Manufacturing

Hearth & Home Technologies

Graco Inc.

Chicago has the largest employment within the Metal Manufacturing cluster, followed by Los Angeles and Detroit. Minneapolis-St. Paul has the 8th highest total employment of all metropolitan areas.

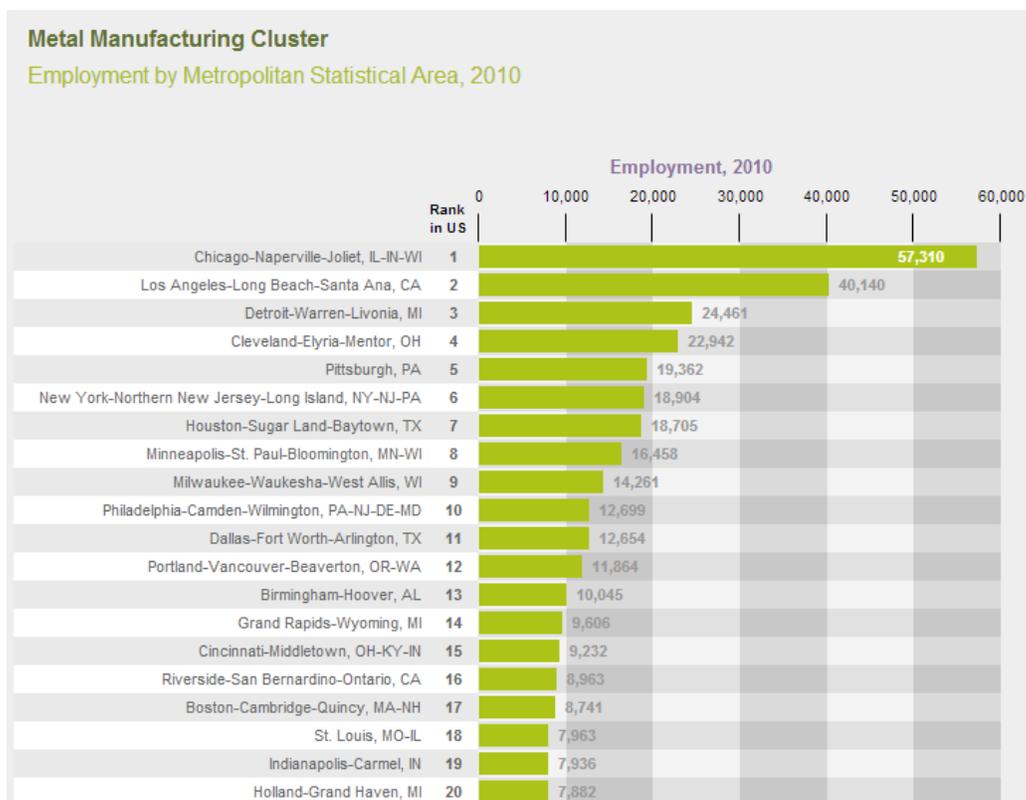
Total 2010 Employment In Thousands



Minneapolis-St. Paul Metal Manufacturing Cluster

The metal manufacturing cluster includes establishments that manufacture both upstream and downstream metal products. Upstream metal products include things such as pipes, tubes, metal closures, wires, springs, and related products. Also included are iron and steel mills, metal forgeries, and foundries, as well as related metal processing techniques. Downstream metal goods included in the cluster are metal containers, prefabricated metal structures, and end user metal products such as tool manufacturing, watch and clock parts, and household products.

Because of its strategic location on the Mississippi River and close proximity to the Iron Range of Northern Minnesota, the MSP region has been an economically competitive region for metal manufacturing for over a century. Much of the region's strength can be attributed to its specialization within the cluster. Although MSP's distance made shipping very large metal products difficult, the region has been able to maintain its competitiveness through diversification and specialization. Today, there are over 630 metal manufacturing firms within the region, and despite a decline in industry employment throughout the past decade and the Great Recession, the region still remains particularly competitive as a result of its niche role within the industry.



Overall, the metal manufacturing cluster is diversely defined with 13 subclusters. In 2010 Minneapolis-St. Paul had 16,458 metal manufacturing employees, the seventh highest total in the nation. The region's location quotient in 2010 was 1.36, meaning that the industry is 1.36 times more concentrated within the region than in the nation. The most highly competitive regions in the cluster are Chicago, Detroit, Cleveland, and Pittsburgh. Although Los Angeles also employs the second most people within the cluster (40,140), it has a relatively low location quotient (1.08).

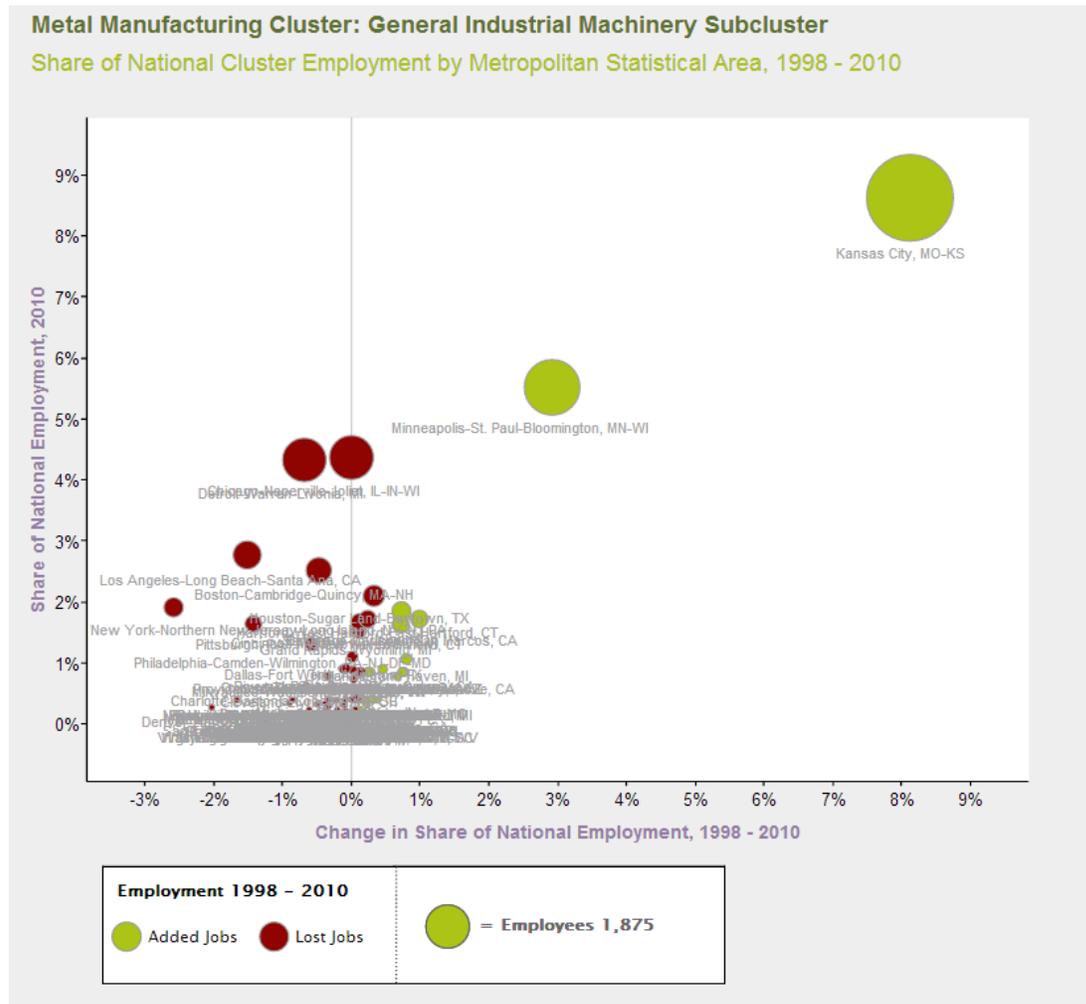
The average wage for the cluster in 2010 in Minneapolis-St. Paul was \$54,261, the seventh highest in the nation. The region is most competitive in the environmental controls and general industrial machinery subclusters, ranking highly in both total employment and location quotient. The environmental controls subcluster comprises establishments that engage in manufacturing automatic controls and regulators for applications, such as heating, air-conditioning, refrigeration and appliances. Within this subcluster, MSP employed 762 employees in 2010, the second most in the nation, and had a location quotient of 5.23, meaning that within this subcluster the region is 5.23 times more concentrated than the nation. General industrial machinery comprises firms primarily engaged in manufacturing general purpose machinery not included in the other subclusters. MSP's strength in this subcluster is a testament to the region's diversification and specialization within the metal manufacturing industry.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Metal Manufacturing Cluster

Cluster/Subcluster Name	Employment	National Employment Rank	MSP Location Quotient	Competitive Regions
Metal Manufacturing Cluster	16,458	8	1.36	Chicago, Los Angeles, Detroit, Cleveland, Pittsburgh
Saw Blades and Handsaws	10	65	0.15	Portland, Springfield (MA), Canton (OH), Cleveland
Laundry and Cleaning Equipment	10	57	0.05	Marion (OH), Fremont (OH), Fond du Lac (WI), Louisville
Iron and Steel Mills and Foundries	933	30	0.42	Chicago, Pittsburgh, Birmingham (AL), Detroit, Cleveland, Canton (OH)
Nonferrous Mills and Foundries	523	20	0.76	Chicago, Cleveland, Milwaukee, Portland
Wire and Springs	638	17	0.88	Chicago, New York, Los Angeles, Houston, Scranton (PA)
Fabricated Metal Products	1,498	13	1.17	Chicago, Houston, Cleveland, Louisville
Precision Metal Products	982	11	1.28	Los Angeles, Chicago, Indianapolis, Milwaukee, New York, Cleveland, Hartford
Metal Furniture	962	7	1.44	Holland (MI), Grand Rapids (MI), Los Angeles, Philadelphia
Pumps	983	7	2.24	Dallas, Tulsa (OK), Chicago, Houston, Oklahoma City
Metal Processing	3,763	7	1.39	Los Angeles, Chicago, Detroit, Houston, Cleveland
Fasteners	2,992	6	1.92	Los Angeles, Chicago, Detroit, Cleveland, Philadelphia
General Industrial Machinery	2,402	2	3.94	Kansas City, Chicago, Detroit, Boston
Environmental Controls	762	2	5.23	Chicago, Mansfield (OH), Rockford (IL), Atlanta

Within this subcluster, MSP employed 2,402 in 2010, the second most in the United States, and had a location quotient of 3.94, fifth among all metropolitan areas.

Historically, metal manufacturing played a critical role in the development of many of the region's other industries such as processed food or railroad freight. For example, early companies, such as St. Paul Brassworks, founded in 1889, began producing brass goods, castings, and railroad brass using steam power. Another company, St. Paul Stamps, founded in 1870 was the first manufacturer of rubber stamps in the region and among the first companies to advertise and use catalogs for sales outside of the region. One of the first industries served by St. Paul Stamps was processed food, where the company manufactured labels for flour. The region was well suited for metal manufacturing to become a complementary cluster. In addition to a skilled workforce known for a strong work ethic, the region was also close to transportation networks and large-scale metal deposits. Furthermore, the region is home to a nationally ranked Materials Science and Engineering program at the University of Minnesota, while technical schools provide training in areas such as machine tool technology, welding, or metal fabrication.



Today, some of the largest companies in the region are Pentair, Hearth & Home Technologies, and Metal-Matic. Based in Minneapolis, Pentair is a global leader in water, fluid, thermal management, providing critical inputs to a wide range of industries.

Originally founded as a manufacturer of high-altitude research balloons, the company is now quite diverse and employs more than 30,000 people worldwide. Hearth & Home Technologies is the world's leader in the production and installation of hearth products such as indoor and outdoor fireplaces, barbecues, and heating systems. Metal-Matic is a global leader among manufactures of specialized carbon steel tubing for a variety of industries. Other specialized manufactures in the region include Kurt Manufacturing, a leading manufacturer of close tolerance parts and assemblies, and Sico Inc., the global leader in folding, rolling, and space efficient products such as carts, platforms, and furniture. Of companies within the general industrial machinery subcluster, the largest is Osmonics, now a subsidiary of General Electric Water and a manufacturer of membrane elements for reverse osmosis systems.

Overall, demand for metal manufacturing products is hardly distinctive to the Twin Cities. Instead, firms from throughout the United States rely on Minneapolis-St. Paul businesses for their technical expertise, specialization, and skilled labor. Like many traded clusters, exports are an important component of the metal manufacturing cluster. Instead of producing large-scale machinery, the metal manufacturing cluster in MSP is largely specialized component-based.

An emerging subcluster of interest is pumping technologies as the region has been home to numerous technological advancements. Although Pentair is by far the largest company within this industry subsector, Minnesota's large amounts of aquatic and agricultural land position the state as a potential leader in this area as demand for more innovative pumping technologies continues



Family owned and private since its opening, Metal-Matic is a niche player in the metal manufacturing cluster, making metal tubes from ¼ to ½ inch OD (outside diameter) thick, primarily for the automotive industry. Originally, the company began as a research and development tool shop doing one-off job orders. In the 1950s, they began making primers for artillery shells for the government. Instead of purchasing steel tubes to prime, Metal-Matic realized they were better off buying steel and making the tubes themselves. In the 1950s, they began contracting with Whirlpool Vacuums and began making handle tubes, leading to a client-base shift from 100% government to 100% civilian.

Metal-Matic makes very long steel tubes and then cuts them to a specific lengths, per the request of the customer. Transportation and logistics are very important to Metal-Matic, especially because all steel comes from the East. Currently, the Minneapolis location is home to much of the firm's technical expertise.

The company is relatively unique in that it tends to groom people from the ground up, rewarding employee and company loyalty. The Metal-Matic workforce has particularly specialized skills. In addition to rewarding people/customer skills, there is an expert metallurgist and another metallurgist in the pipeline. This helps with quality control and obtaining second-hand knowledge. Overall, Metal-Matic requires skilled labor and, in some instances, has struggled to find a consistent supply of labor.

to rise. Pumps can be used in areas such as natural gas extraction, reverse osmosis filtration, or advanced irrigation, all sectors in which the regional economy stands to gain.

Cluster Competitiveness Analysis

Factor Conditions: The cluster relies on skilled labor for manufacturing, in addition to heavy machinery and raw materials such as steel. Overall, the cluster hires a wide range of workers including mechanical engineers and metallurgists, in addition to skilled laborers for production and machine work.

Demand Conditions: Because many of the companies within the region are specialized, the demand for Minneapolis-St. Paul metalwork is hardly local, with firms nationwide requiring the goods produced in MSP factories. Although local demand has occurred from the processed food and medical devices industries, many industries require manufactured metal goods. Metal manufacturing is unique in that it includes both components and final products that are available in both business-to-business and straight to consumer type sales.

Related and Supporting Industries: Metal manufacturing requires raw metal materials for manufacturing. Although this component of the supply chain is included in the cluster's definition, Minneapolis-St. Paul is relatively weak in this area and must import these components. Metal manufacturing companies manufacture related products for a wide range of industries including automotive, heavy machinery, production technology, and many other manufacturing or high-tech industries.

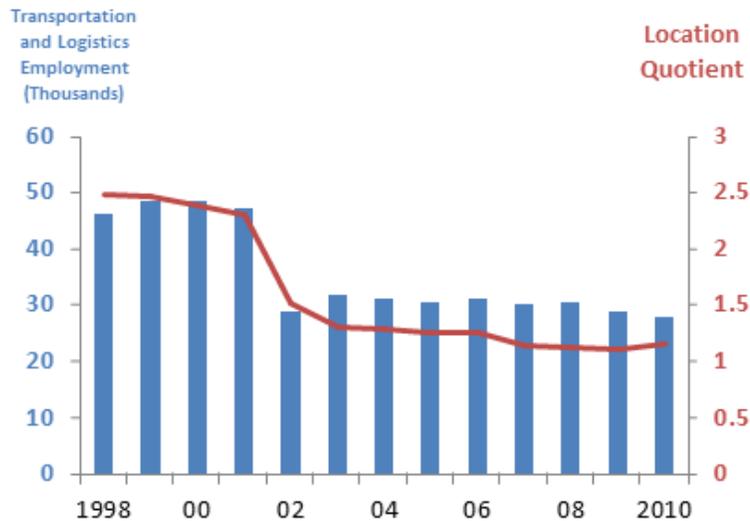
Context for Firm Strategy and Rivalry: Because of Minneapolis-St. Paul's skilled workforce, the region has been able to specialize and diversify in the metal manufacturing cluster. This diversification, in addition to being in a close vicinity to other manufacturing hubs and a historical association with the cluster, has allowed the industry to continue to progress and innovate. As a result, MSP remains highly competitive in the cluster.

TRANSPORTATION AND LOGISTICS



Key Performance Indicators

Transportation and Logistics employment and location quotient decreased sharply in 2002 and has since remained relatively constant



2010

Number of Employees

27,821

Location Quotient

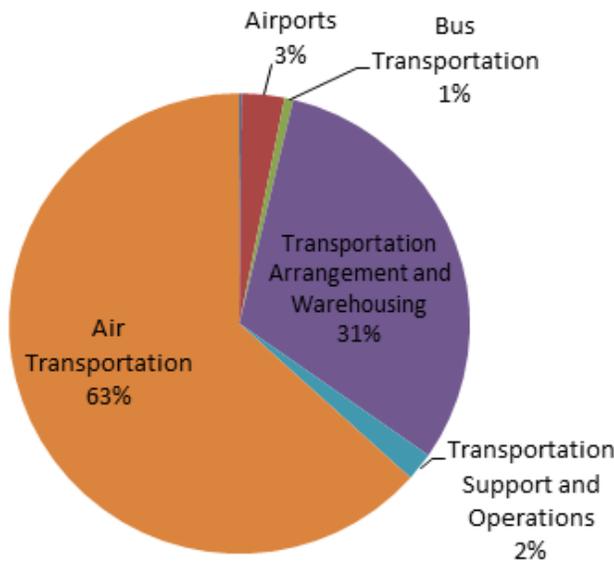
1.13

Employment in the Transportation and Logistics Cluster is somewhat more concentrated in MSP than in the nation.

Average Annual Wage

\$50,738

Average Transportation and Logistics wages in Minneapolis-St. Paul were the sixth highest in the nation.



The largest sub cluster within the Transportation and Logistics cluster is Air Transportation, followed by Transportation Arrangement and Warehousing.

Largest Companies

C.H. Robinson

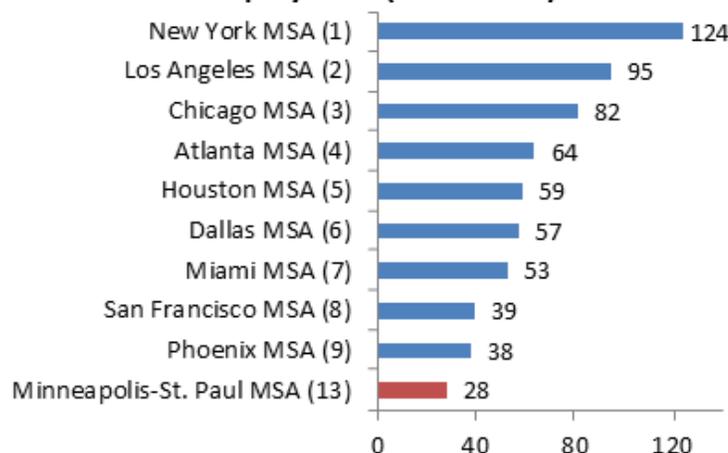
Carlson Wagonlit

Delta Airlines

Minneapolis-St. Paul International Airport

New York has the largest employment within the Transportation and Logistics cluster, followed by Los Angeles and Chicago. Minneapolis-St. Paul has the 13th highest total employment of all metropolitan areas.

2010 Transportation and Logistics Employment (Thousands)



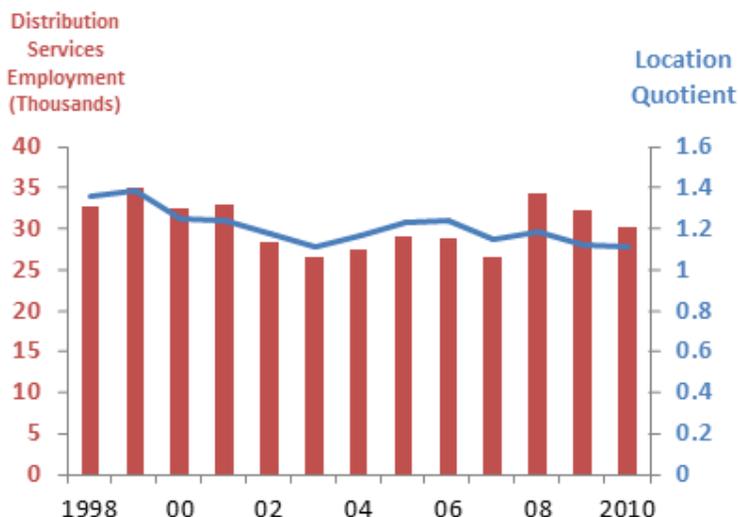
Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

DISTRIBUTION SERVICES

Key Performance Indicators



Distribution Services employment and location quotient has remained relatively constant since 1998



2010

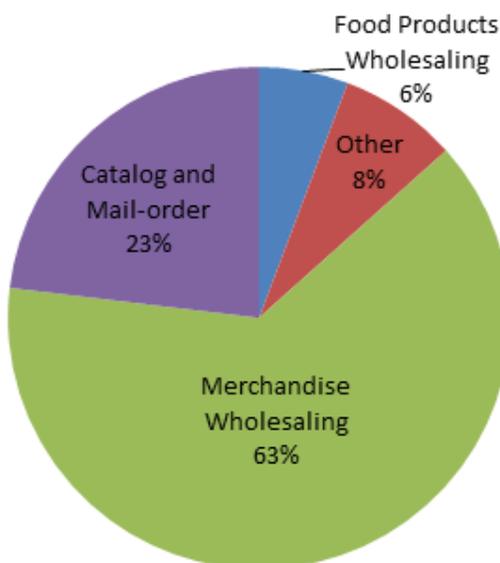
Number of Employees
30,108

Location Quotient
1.09

Employment in the Distribution Services Cluster is only somewhat more concentrated in MSP than in the nation.

Average Annual Wage
\$73,209

Average Distribution Services wages in Minneapolis-St. Paul were the fourteenth highest in the nation.



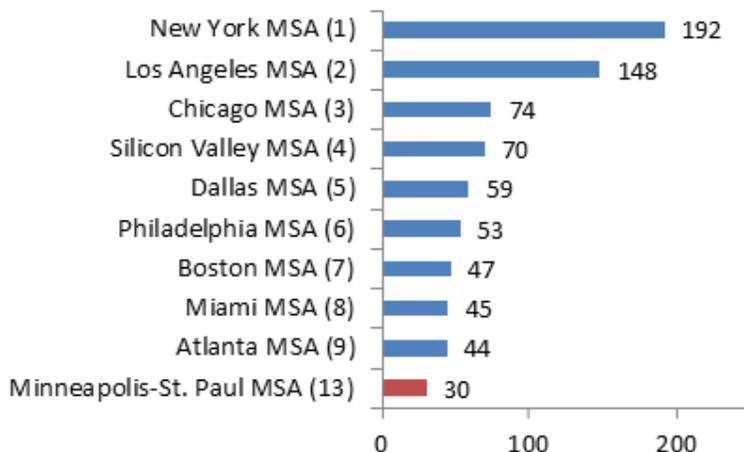
The largest sub cluster within the Distribution Services cluster is Merchandise Wholesaling, followed by Catalog and Mail-Order Business.

Largest Companies

- Cargill
- CHS Inc.
- Mosaic
- Shop NBC
- Northern Tool & Equipment Catalog

New York has the largest employment within the Distribution Services cluster, followed by Los Angeles and Chicago. Minneapolis-St. Paul has the 13th highest total employment of all metropolitan areas.

2010 Distribution Services Employment (Thousands)



Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

Minneapolis-St. Paul Distribution Services, Transportation, and Logistics Clusters

Because of the close overlap between the two clusters, the distribution services and transportation and logistics clusters are combined here to represent the infrastructural and logistical components associated with the region's trade. Historically, Minneapolis-St. Paul has long been considered a hub for distribution given its close ties to the food, mining, and lumber industries. As sawmills and flour mills began to appear alongside the Mississippi River and St. Anthony Falls, the region required the transportation infrastructure necessary to keep up with the inputs needed for its mills and to disperse its products across the nation.

For many years, St. Paul was considered a railroad and frontier town, connected to numerous railroads to both the east and west. Although Minneapolis was originally served by a spur from St. Paul through the Chicago, Milwaukee, St. Paul, and Pacific Railroad, the region was able to gain a competitive advantage by becoming a hub of multiple railroads, namely the Minneapolis and St. Louis Railway, which connected the Lake Superior and Mississippi Railroad. With the establishment of the Great Northern Railway in 1893, the Twin Cities region became connected to the northern portion of the United States, stretching from St. Paul to Seattle.⁴

With the expansion of the transportation networks, the region was able to enhance its key role as a distributor of lumber and grain. Between 1848 and 1887, Minneapolis led the nation in sawmilling.⁵ Founded as the Minneapolis Chamber of Commerce in 1881, the Minneapolis Grain Exchange (MGEX) was formed to promote the fair trade of wheat, oats, and corn.⁶ Two years later, the Chamber of Commerce introduced its first futures contract: hard red spring wheat. Before the development of this centralized marketplace, many of the region's farmers were unable to adequately gauge the market for their grain, and because most farmers harvested and sold crops at the same time, there was a glut of a grain in the market that skewed the supply and demand curve for grain. Although the organization no longer operates an open outcry trading floors, trading is continued from an electronic platform.

As a whole, Minneapolis-St. Paul lost jobs in the distribution services cluster from 1998 to 2010, although employment fluctuated a bit during this time period and the cluster has done better than others. Much of this uncertainty can likely be attributed to the economic recession. Average wages within the cluster were \$73,209 in 2010, the fourteenth highest in the nation. Minneapolis-St. Paul had the third most jobs in the nation in the farm material and supplies wholesaling subcluster, behind only Chicago and New York. By employment, the largest subcluster is merchandise wholesaling, which makes up 62 percent of all cluster employment.

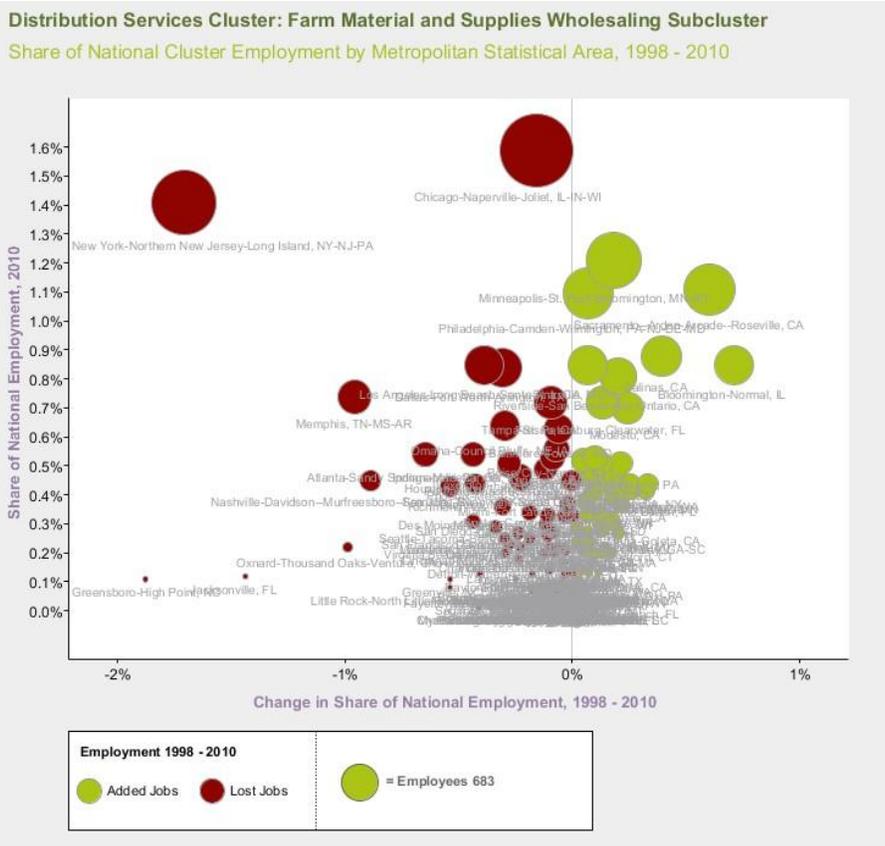
⁴ Hofsommer, Don L. *Minneapolis and the Age of Railways*. Minneapolis, MN: University of Minnesota Press, 2005.

⁵ Kane, Lucile M. *The Falls of St. Anthony: The Waterfall That Built Minneapolis*. St. Paul, MN: Minnesota Historical Society, 1966 (revised 1987).

⁶ <http://www.mgex.com/history.html>

**2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area,
Distribution Services Cluster**

Cluster/Subcluster Name	Employment	National Employment Rank	Location Quotient	Other Competitive Regions
Distribution Services	30,108	13	1.09	New York, Los Angeles, Chicago, Silicon Valley, Dallas, Philadelphia
Apparel and Accessories Wholesaling	858	25	0.34	New York, Los Angeles, Miami, Philadelphia
Transportation Vehicle and Equipment Distribution	407	23	0.58	Los Angeles, Miami, Dallas, New York, Chicago, Houston
Food Products Wholesaling	1,727	18	0.94	Los Angeles, New York, Chicago, Miami, Philadelphia, Atlanta
Merchandise Wholesaling	19,129	16	1.13	New York, Los Angeles, Silicon Valley, Chicago, Dallas, Boston, Atlanta
Catalog and Mail-order	6,951	8	1.59	New York, Chicago, Los Angeles, Philadelphia, Madison, Dallas, Phoenix
Farm Material and Supplies Wholesaling	1,036	3	0.86	Chicago, New York, Sacramento, Philadelphia, Salinas (CA), St. Louis

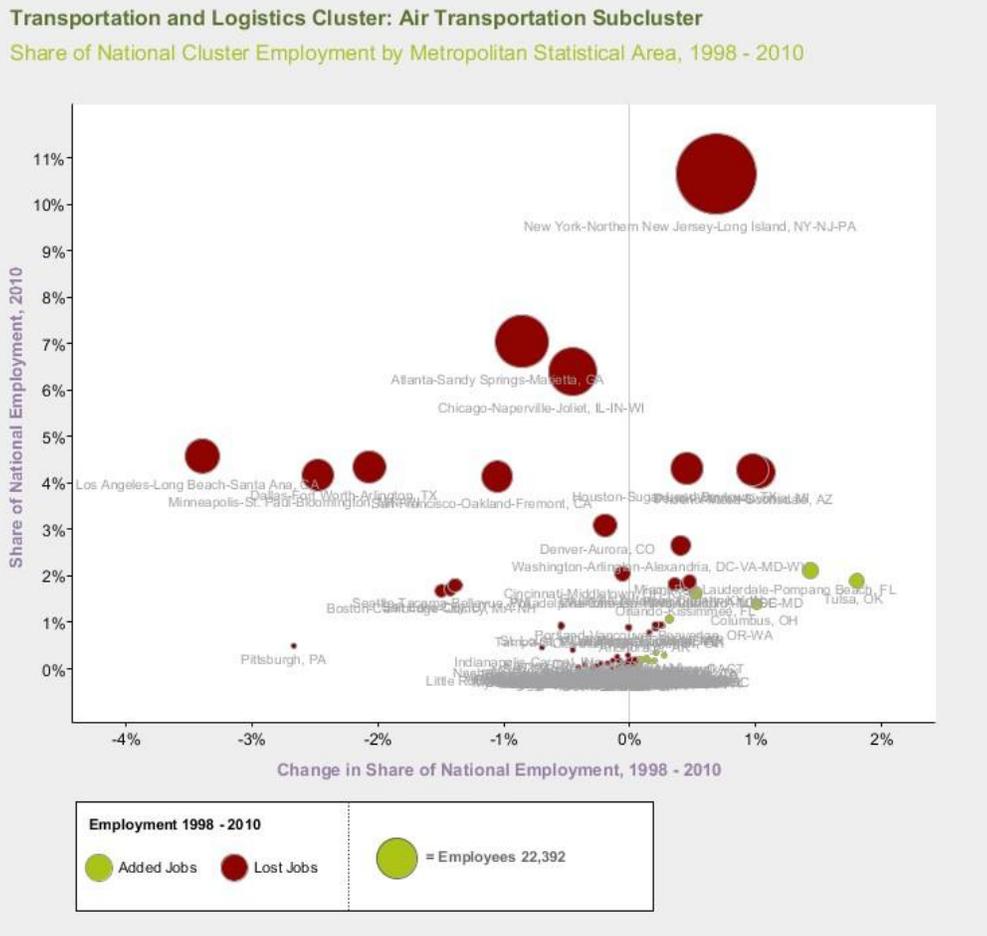


With 27,821 total employees, the transportation and logistics cluster is slightly more concentrated in Minneapolis-St. Paul than in the nation. The annual wages in 2010 were \$50,738, the sixth highest in the nation. Although the region saw a significant reduction in employment within the cluster in 2002, employment and location quotient has since leveled. Overall, the largest subcluster in terms of both employment and location quotient was air transportation. This is a testament to the size and clout of the Minneapolis-St. Paul International Airport, the largest airport in the Upper Midwest. Although MSP has a high share of employment nationally within the Air Transportation subcluster, it lost share between 1998 and 2010.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Transportation and Logistics Cluster

Cluster/Subcluster Name	Employment	National Employment Rank	Location Quotient	Other Competitive Regions
Transportation and Logistics	27,821	13	1.13	New York, Los Angeles, Chicago, Atlanta, Houston, Dallas, Miami
Marine Transportation	40	132	0.02	Los Angeles, Houston, New York, New Orleans, Seattle, Miami, San Francisco
Airports	834	39	0.37	Miami, New York, Los Angeles, Dallas, Atlanta
Bus Transportation	175	31	1.02	New York, St. Louis, Phoenix, Los Angeles, Dallas
Transportation Arrangement and Warehousing	8,603	23	0.63	New York, Los Angeles, Chicago, Dallas, Atlanta
Transportation Support and Operations	554	20	0.76	Chicago, Los Angeles, Philadelphia, Virginia Beach
Air Transportation	17,615	9	2.99	New York, Atlanta, Chicago, Los Angeles, Dallas, Houston, Detroit, Phoenix

As a result of its locational competitive advantage and historical roots in transportation and distribution, Minneapolis-St. Paul is now home to many of the nation’s largest firms within the two clusters. Cargill, the largest private company in the nation, is a major purchaser and distributor of grain and other agricultural commodities. In a similar light, CHS Inc. is a Fortune 100 company owned by agricultural cooperatives, farmers, ranchers and thousands of preferred stock holders. CHS Inc. owns and operates numerous businesses dealing with food processing, wholesaling, farm supplies, fuel, and financial services. The Mosaic Company, a Fortune 500 company, is a combined producer, marketer, and distributor of concentrated phosphate and potash, which are mostly used for fertilizer.



Headquartered in Eden Prairie, C.H. Robinson is one of the world’s largest third-party logistics providers, offering logistics services such as supply chain analysis, freight consolidation, carrier management and information reporting. In 2005 C.H. Robinson acquired FoodSource Procurement, a leader in procurement, packaging, and transportation services for the food industry. Carlson Wagonlit Travel, a subsidiary of Minnetonka-headquartered Carlson, is a global leader in business travel management and coordination.

Until its merger with Delta in 2008, Northwest Airlines was one of the largest airlines in the world and was headquartered in Eagan. The low-cost airline Sun Country Airlines is headquartered in Mendota Heights and serves 31 destinations across the nation. Minneapolis-St. Paul International airport is the largest and busiest airport in the six-state region of Minnesota, Iowa, Nebraska, North Dakota, South Dakota, and Wisconsin, and in terms of passengers were the 17th busiest airport in the United States and the 51st busiest airport in the world.⁷

⁷ [2012 Airport Traffic Statistics](#). The Port Authority of New York and New Jersey.

Cluster Competitiveness Analysis

Factor Conditions: Like many of the region's clusters, the transportation and logistics and distribution services clusters are dependent on the region's ability to provide a skilled workforce. Further inputs include actual materials for trade. This is most relevant to the distribution services cluster, especially those companies dealing in agricultural commodities. Minneapolis-St. Paul's vicinity to the "grain belt" of the Midwestern United States aids this competitive advantage.

Demand Conditions: Although Minneapolis-St. Paul is far from main markets on the West and East coasts, the region has been able to use its location to coordinate between supply and demand. This has largely given the region the important role as the hub of the Upper Midwest, coordinating the trade of commodities and finished products.

Related and Supporting Industries: The transportation and logistics and distribution services clusters are related to many other clusters, as nearly all traded clusters require some form of transportation, distribution, and logistical services. Within Minneapolis-St. Paul, there is an especially close relationship between the processed food cluster and the distribution services cluster. This is because the processed food industry is entirely reliant on the distribution of agricultural commodities and processed food products.

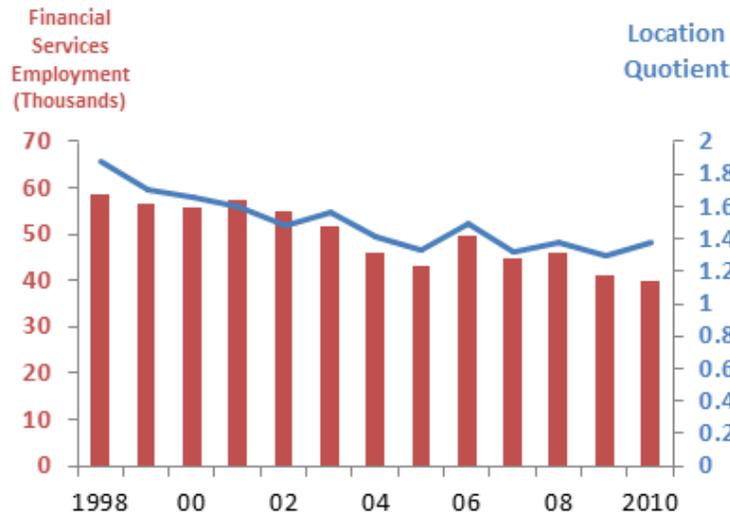
Context for Firm Strategy and Rivalry: Minneapolis-St. Paul has been able to exploit its historical legacy as a transportation and distribution hub. The region is home to many of the cluster's largest companies, especially in the realm of food and commodity related distribution services.

FINANCIAL SERVICES

Key Performance Indicators



Financial Services employment and location quotient has decreased since 1998



2010

Number of Employees

39,806

Location Quotient

1.35

Employment in the Financial Services Cluster is more concentrated in MSP than in the region.

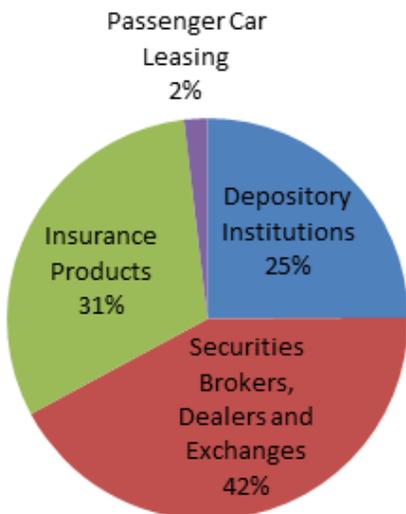
Average Annual Wage

\$96,691

Average Financial Services wages in Minneapolis-St. Paul were the twelfth highest in the nation.

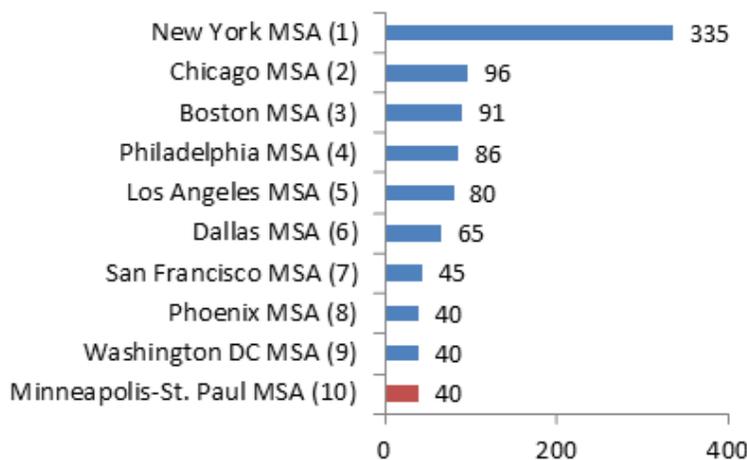
Largest Companies

- United Health
- US Bancorp
- Ameriprise Financial
- Thrivent Financial for Lutherans
- Securian Financial Group



The Financial Services cluster is diversified. The largest sub cluster within the cluster is Securities Brokers, Dealers, and Exchanges followed by Insurance Products and Depository Institutions.

2010 Financial Services Employment (Thousands)

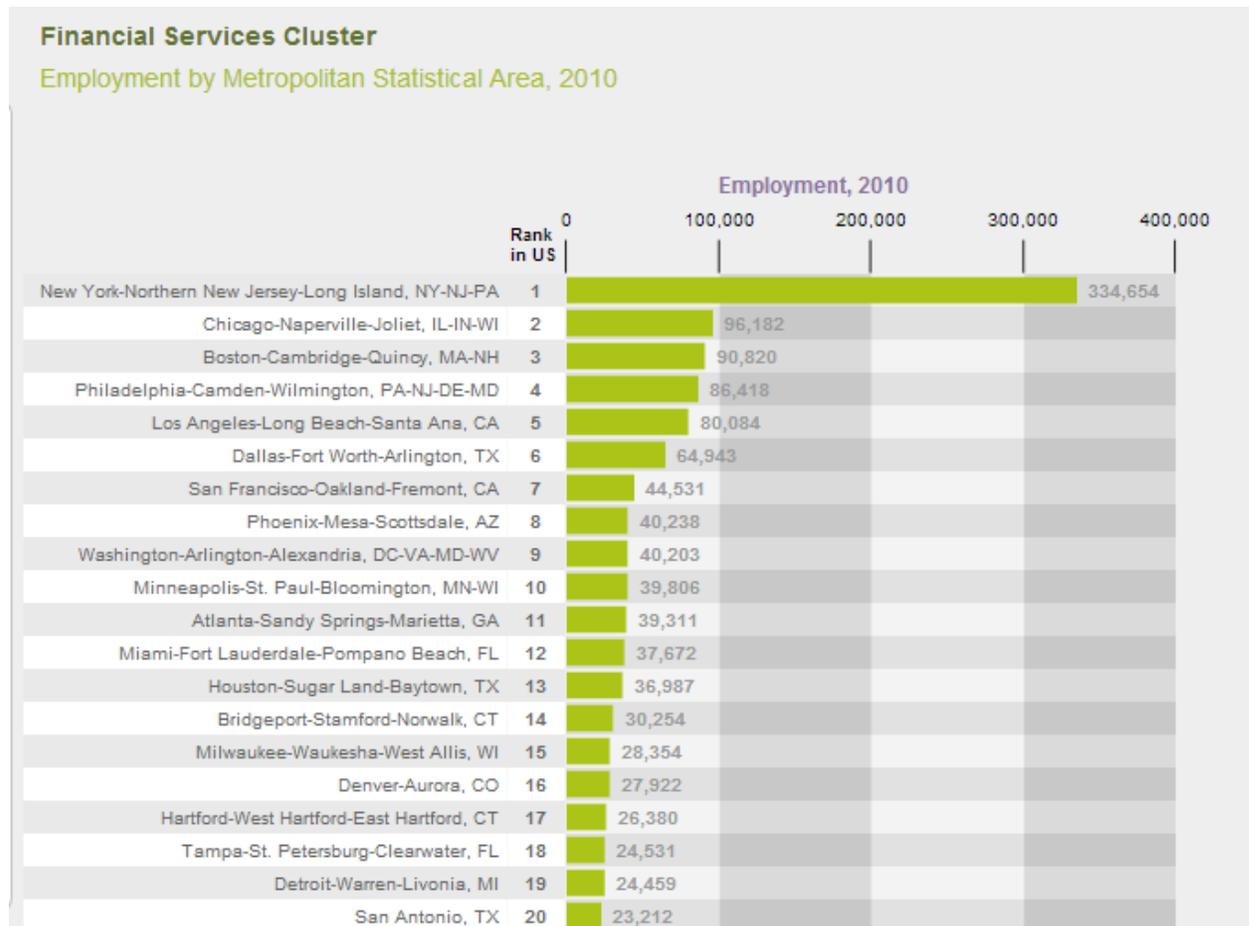


New York has the largest employment within the Financial Services cluster, followed by Chicago and Boston. Minneapolis-St. Paul has the 10th highest total employment of all metropolitan areas.

Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

Minneapolis-St. Paul Financial Services Cluster

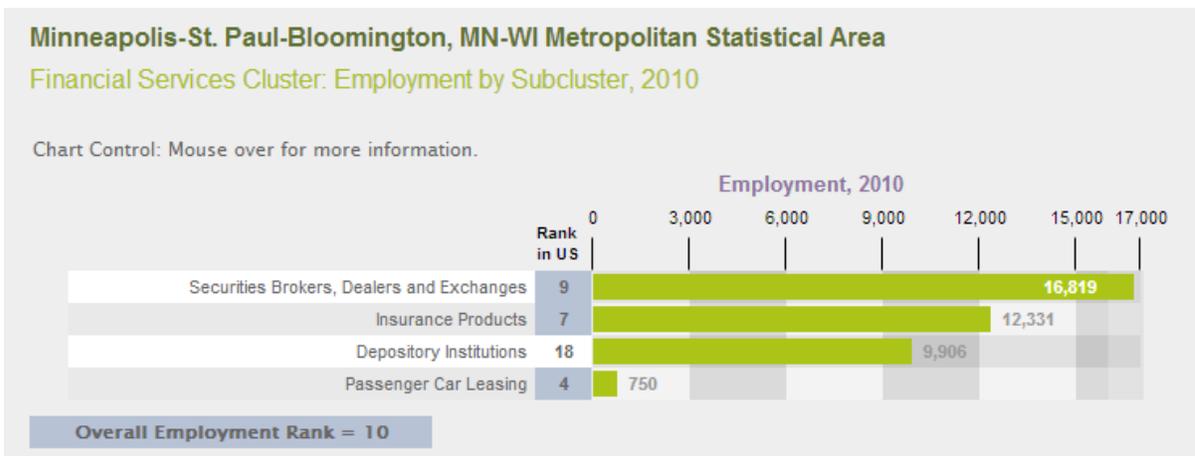
The MSP region ranks tenth in U.S. employment in the financial services cluster. New York City is by far the largest employer in the financial services cluster, with Chicago, Boston, Philadelphia, and Los Angeles as the next largest employers. The MSP region lost jobs in the financial service cluster since 1998, dropping from 58,437 jobs in 1998 to 39,806 in 2010. While this was a national trend, the MSP region lost proportionally more jobs in financial services than the nation as a whole. The MSP location quotient for the financial services cluster dropped from 1.88 to 1.38. The average wage for the financial services cluster is \$96,691, reflecting very high salaries for many of the jobs in the financial services industry.



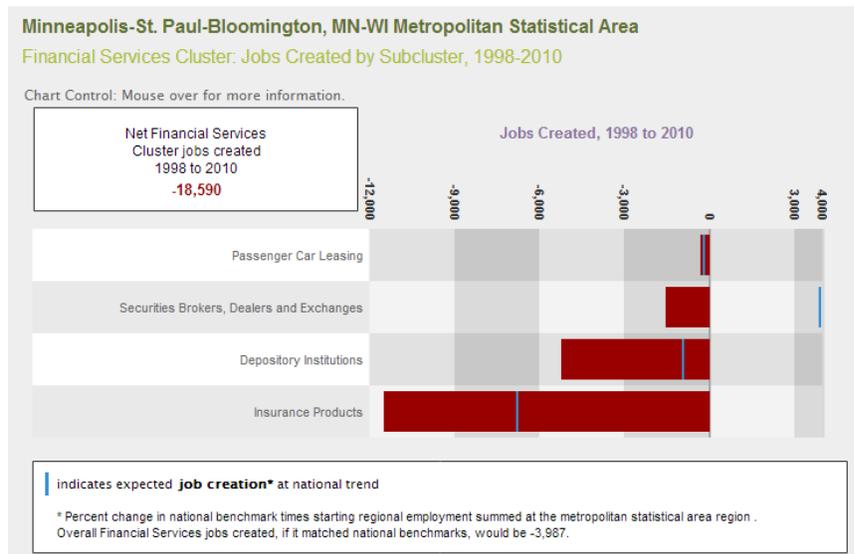
The financial services cluster includes four subclusters: The largest of these subclusters is securities, brokers, dealers, and exchanges, which represented 16,819 jobs in the MSP region in 2010 and ranked ninth in employment among U.S. metropolitan regions. The next largest subcluster is insurance products providing 12,311 jobs to the MSP region in 2010 and ranking seventh in employment among metropolitan regions. The depository institutions subcluster accounted for 9,906 jobs in 2010 and ranked 18th in the nation. The smallest financial services subcluster is passenger car leasing with 750 jobs in the MSP region in 2010 but ranking fourth in employment among metropolitan regions.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area Financial Services Cluster

Cluster	Year	Employment	National Rank	Location Quotient	Other Competitive Regions
Financial Services	2010	39,806	10	1.35	New York, Chicago, Boston, Philadelphia, Los Angeles
Depository Institutions	2010	9,906	18	0.91	New York, Dallas, Philadelphia, Los Angeles, Chicago
Securities Brokers, Dealers and Exchanges	2010	16,819	9	1.36	New York, Boston, Chicago, Philadelphia, Los Angeles
Insurance Products	2010	12,331	7	2.03	New York, Hartford, Milwaukee, Des Moines, Los Angeles
Passenger Car Leasing	2010	750	4	8.11	Chicago, New York, Baltimore, Atlanta



While all four of the financial services subclusters lost jobs from 1998 to 2010, over 60 percent of the jobs lost, 11,514, were in the insurance products subcluster.



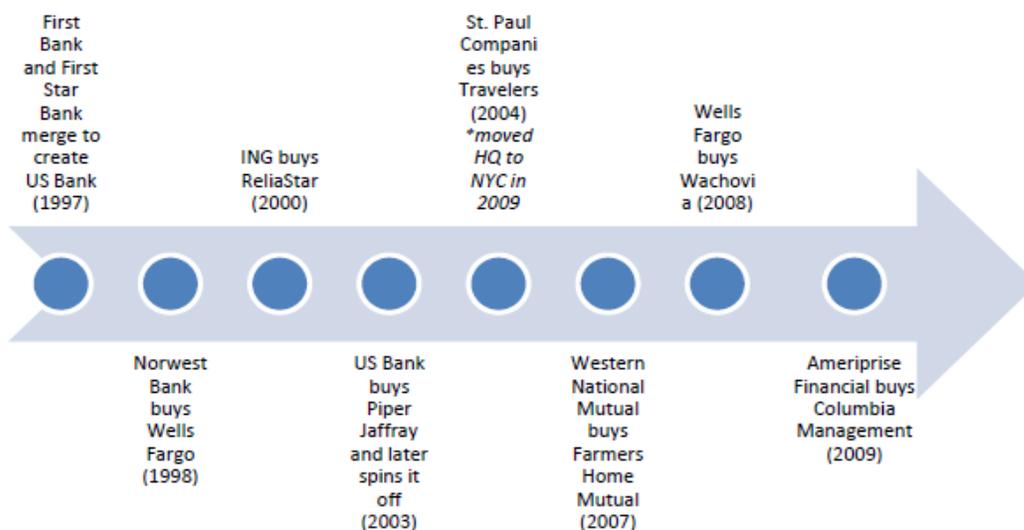
Cluster Competitiveness Analysis

Factor Conditions: MSP's location of the Ninth Federal Reserve Bank as well as the home to a concentration of corporate headquarters make it natural center for a robust financial services industry, a major financial influence in the Upper Midwest between Chicago and Seattle. Banking leaders, such as Wells Fargo (formerly Norwest Bank) and U.S. Bancorp, play an important role in the regional economy. Insurance leaders, such as Thrivent, Securian, and United Health, have helped make the region competitive in the cluster.

Demand Conditions: Corporate headquarters contribute to favorable regional demand conditions for the financial industry in MSP. Historically, insurance companies such as Thrivent (formerly Lutheran Brotherhood) started by serving special populations (Lutherans) in response to local demand but have since expanded to broader national markets.

Related and Supporting Industries: MSP financial services firms benefit from the high-caliber professional services available in the metro area, including accounting, advertising, legal, and marketing. Accounting and legal services are strongly supported by Minnesota's educational system with numerous post-secondary educational institutions offering accounting certificates, two-year accounting degrees, four-year accounting degrees, and law.

Context for Firm Strategy and Rivalry: Several consolidations have taken place within the last decade as shown in following figure:



Source: Laura Bolstad, Dan Maloney, Cynthia Yuen. *The Financial Services Cluster of the Twin Cities*, Humphrey School, 2010.

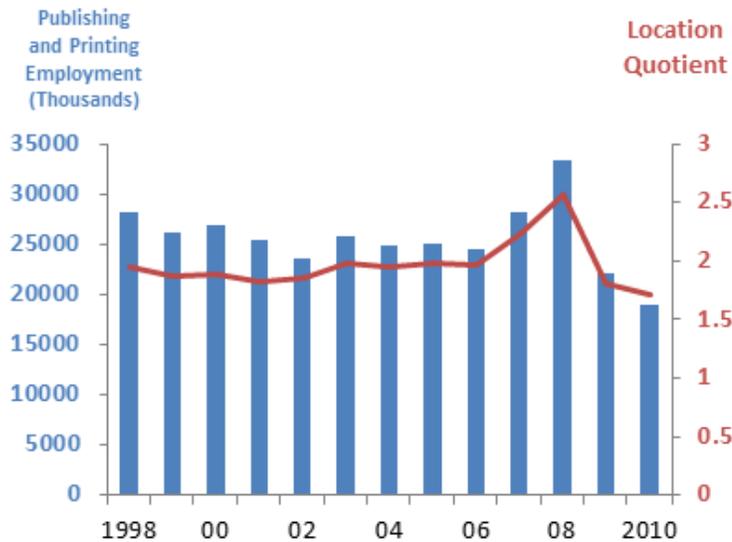
There have also been efforts within smaller regional banks, such as Frandsen Financial Corp., which consolidated the eight charters it held for community banks into one. Finally, other mergers and acquisitions in the Twin Cities have created business for ancillary financial services firms, such as the Delta-Northwest Airlines merger.

PUBLISHING AND PRINTING



Key Performance Indicators

Publishing and Printing employment peaked in 2008, while location quotient has shifted accordingly.



2010

Number of Employees

18,826

Location Quotient

1.68

Employment in the Publishing and Printing cluster is more concentrated in Minneapolis-St. Paul than in the nation

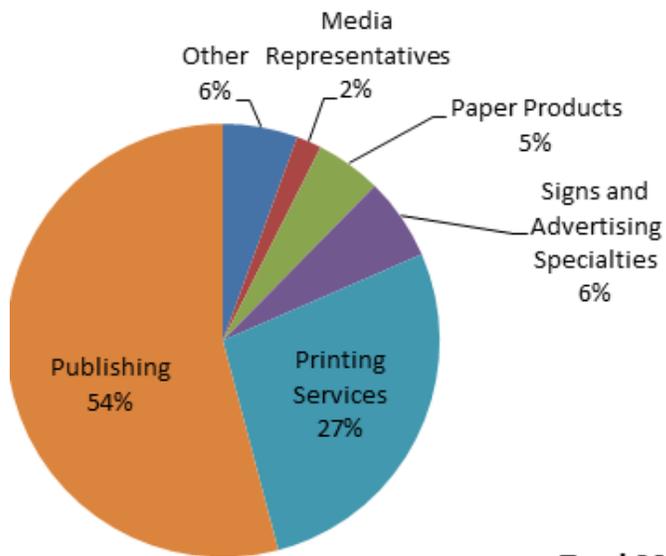
Average Annual Wage

\$53,618

Average Publishing and Printing wages in Minneapolis-St. Paul were the fifth highest in the nation.

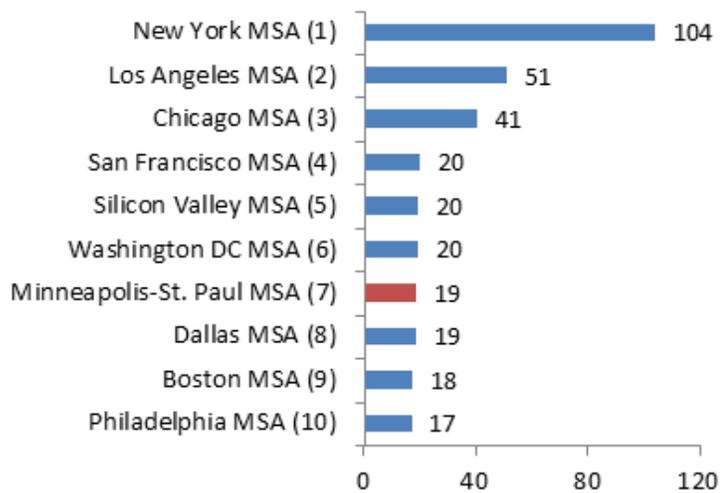
Largest Companies

- Thomson Reuters
- Smead Manufacturing
- Smyth Companies
- Wicks Educational Publishing
- Skyline Displays
- Lerner Publishing
- Varitronic Systems



The largest sub cluster within the Publishing and Printing cluster is Publishing, followed by Printing Services.

Total 2010 Employment (Thousands)

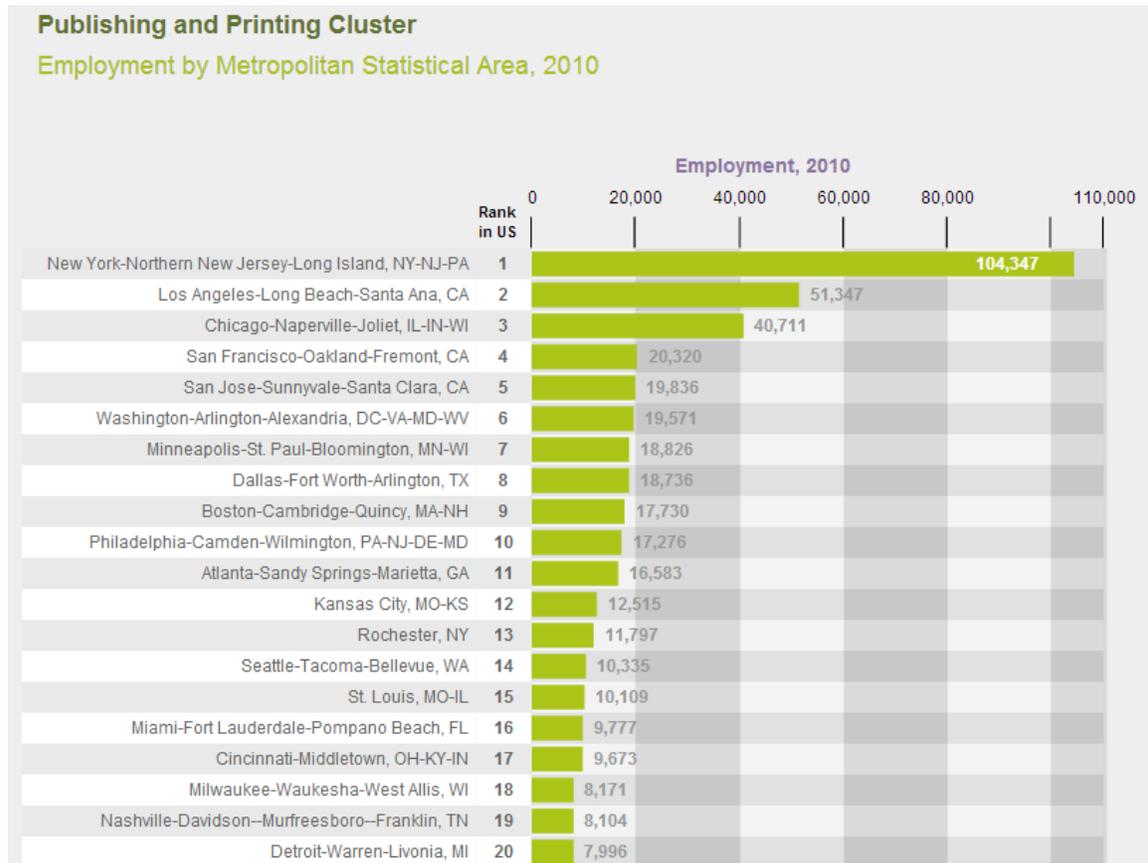


New York has the largest employment within the Printing and Publishing cluster, followed by Los Angeles and Chicago. Minneapolis-St. Paul has the 7th highest total employment of all metropolitan areas.

Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

Minneapolis-St. Paul Publishing and Printing Cluster

MSP’s publishing and printing cluster accounts for nearly 19,000 jobs, with core printing and publishing employment placing fourth and eighth, respectively, in U.S. rankings. In cluster employment, the MSP region ranks seventh behind the New York, Los Angeles, Chicago, San Francisco, San Jose, and the Washington, DC, metropolitan areas. The MSP region has lost employment and employment share since the 2008 recession, but still has a relatively high location quotient of 1.68.



Historically, the printing and publishing industries have been closely linked. Minnesota’s first printing and publishing companies date back to the late 1800s and these early companies were often vertically integrated with paper companies. For example, Charles Blandin purchased the Itasca Paper Company in 1916 to secure a reliable source of newsprint paper for the St. Paul Pioneer Press/Dispatch Printing Company. Blandin later sold the printing company but kept the paper mill, which became world famous under the Blandin name. Similar arrangements existed for book and periodical publishers as well. For example, the University of Minnesota Press developed as a joint printing and publishing operation to produce and disseminate the work of University professors. Newspaper and periodical publishers played the role of local advertisers as well.

**2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area
Publishing and Printing Cluster**

Cluster/Subcluster Name	Employment	National Employment Rank	Location Quotient	Competitive Regions
Office Equipment and Supplies	10	42	0.18	New York, Tampa Bay, San Antonio, Boston
News Syndicates	55	29	0.48	New York, Washington DC, Los Angeles, San Francisco, Glen Falls (NY)
Photographic Equipment and Supplies	136	29	0.45	Rochester (NY), Los Angeles, Greeley (CO), New York
Specialty Paper Products	235	32	0.57	Kansas City, Louisville, New York, Chicago
Photographic Services	280	4	2.07	New York, Los Angeles, Chicago, Greensboro (NC)
Printing Inputs	332	15	1.31	Virginia Beach, Los Angeles, Chicago, San Francisco, Portland
Media Representatives	355	15	0.89	New York, Chicago, Los Angeles, Detroit, Miami
Paper Products	923	11	1.45	Chicago, New York, Los Angeles, Dallas, Atlanta, St. Louis
Signs and Advertising Specialties	1,154	10	1.17	New York, Brookings (SD), Los Angeles, Chicago, Dallas
Printing Services	5,159	4	1.84	Los Angeles, Chicago, New York, Dallas, Philadelphia
Publishing	10,187	8	1.99	New York, Los Angeles, San Jose, Chicago, San Francisco, Washington DC

By the 1950s, advertising developed as a mature, related industry in Minnesota. Specialized firms emerged and operated independently of existing publishers. Yet, advertisers remained an integral partner in the success of local printers and publishers. Because these new advertising agencies were not vertically integrated with printers and publishers, the advertising industry has been considered a separate entity.

However, the story of MSP's printing and publishing cluster is better understood when advertising is taken into account. Although strict cluster definitions distinguish these areas, there is a great deal of overlap as the clusters share similar challenges tied to an increasing reliance upon digital and electronic media. Publishers and advertising agencies also draw upon many of the same freelance writers, graphic designers, and illustrators. These phenomena may be due to strong occupational spillover.

Furthermore, innovations in printing are driven by customer demands from publishing and advertising alike. Research shows that these three industries are bound together in an interdependent customer-supplier network.

While printing and publishing firms can be found in nearly every county of the state, advertising is generally concentrated in the MSP region. Altogether, approximately 68,000 people were employed in these clusters in 2010, representing more than 3 percent of all jobs in Minnesota.

Cluster Competiveness Analysis

Factor Conditions: Lumber, clays, and related inputs for the printing and publishing cluster remain readily available in this region. The introduction of new technology, demand for more sophisticated products, and trends in manufacturing require increasingly skilled workers to fill positions in this cluster.

Demand Conditions: An increased reliance upon electronic documentation, online communications, and cloud-based networking has significantly decreased the demand for traditional printing and publishing products. However, niche markets remain and the region's remaining printing and publishing firms have established a foothold in one or more of these specialty areas.

Related and Supporting Industries: The printing and publishing cluster has close ties to the region's corporate headquarters concentration and professional services strengths, particularly in the legal and advertising areas.

Context for Firm Strategy and Rivalry: In general, pure economic survival has driven strategy for firms in the printing and publishing cluster. As market forces have significantly influenced this sector, regional firms appear to have found their respective niches and anticipate modest, but steady growth in coming years.



Based in Hastings, Smead Manufacturing is a classic success story in Minnesota's Printing and Publishing cluster. Begun in 1906 with introduction of its "bandless file," Smead has brought thousands of paper-based products to market, ranging from simple file folders to more complex hanging file systems and accordion folders. In the process, Smead has established its position as a leader in what it calls the "business of organization."

With advances in computer technology and a relative decline in the reliance on paper-based communications and data retention, Smead has evolved to meet the needs of an ever-changing business world. A growing portion of its product line has been tailored to supplement the Internet age, and the company reports stable market share with a small number of established global peers and competitors.

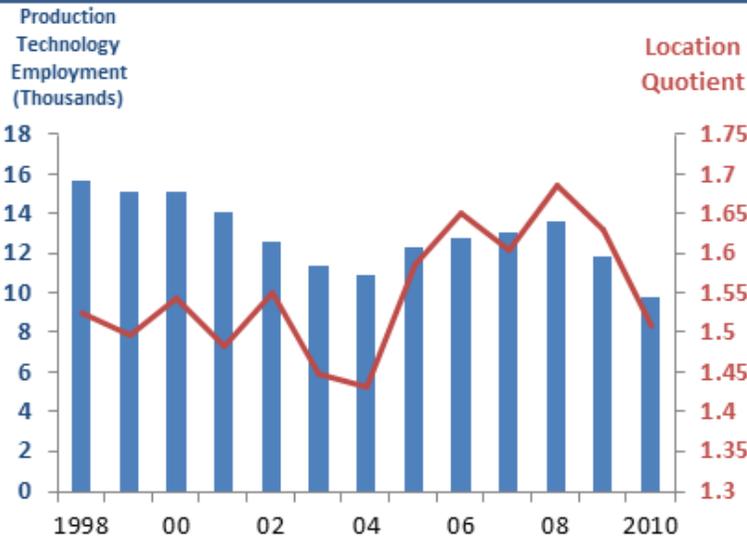
As more of its production line becomes automated, and more of its sales Internet-based, Smead is focused on attracting and retaining qualified workers in skilled manufacturing and IT positions. Although employment growth is not anticipated, the company fills a valuable niche in the business products space and is intent on continued product-line innovation.

PRODUCTION TECHNOLOGY



Key Performance Indicators

Production Technology employment and location quotient has fluctuated since 1998



2010

Number of Employees

9,789

Location Quotient

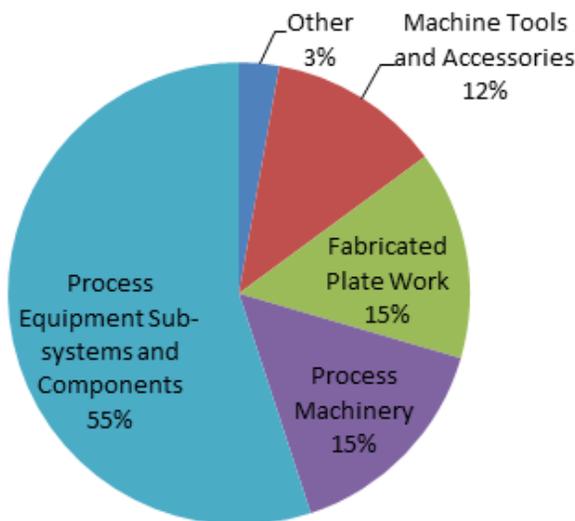
1.48

Employment in the Production Technology Cluster is more concentrated in MSP than in the region.

Average Annual Wage

\$61,226

Average Production Technology wages in Minneapolis-St. Paul were the fifth highest in the nation.



The largest sub cluster within the Production Technology is Process Equipment Subsystems and Components, followed by Process Machinery and Fabricated Plate Work.

Largest Companies

Chart Inc.

Thiele Technologies

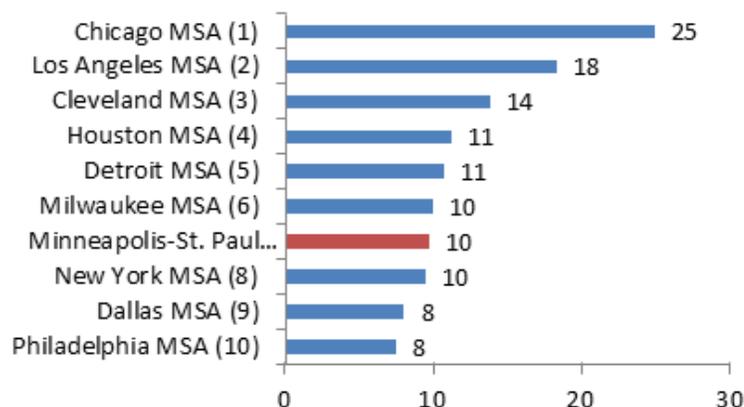
Bosch Packaging Tech.

DynamicAir

Banner Engineering

Chicago has the largest employment within the Production Technology cluster, followed by Los Angeles and Cleveland. Minneapolis-St. Paul has the 7th highest total employment of all metropolitan areas.

Total 2010 Employment (Thousands)



Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

Minneapolis-St. Paul Production Technology Cluster

Production technology is closely related to the metal manufacturing cluster, producing products used in the manufacturing production process. The production technology cluster supports other industry clusters within the region. The MSP region ranks seventh among U.S. metropolitan areas in employment in the production technology cluster, with 9789 jobs in 2010. Other competitive regions in production technology are Chicago, Los Angeles, Houston, Cleveland, and Detroit. Among the production technology subclusters, the MSP region is most competitive in machine tools and accessories, industrial patterns, process machinery, process equipment sub-systems and components, and fabricated plate work.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Production Technology Cluster

Cluster/Subcluster Name	2010 MSP Employment	National Employment Rank	MSP Location Quotient	Other Competitive Regions
Production Technology	9,789	7	1.48	Chicago, Los Angeles, Cleveland, Houston, Detroit
Ball and Roller Bearings	10	98	0.03	Chicago, Sandusky (OH), Manchester (NH), Indianapolis
Industrial Patterns	89	8	1.66	Cleveland, Fort Wayne (IN), New York, Appleton (WI), Detroit, Portland
Industrial Trucks and Tractors	175	42	0.62	Dallas, Columbus (IN), Houston, Chicago, Indianapolis, Kansas City
Machine Tools and Accessories	1,185	7	1.77	Detroit, Chicago, Los Angeles, Rockford (IL), Cleveland, Cincinnati
Fabricated Plate Work	1,430	8	1.35	Tulsa, Houston, Beaumont (TX), Chicago, Pittsburgh
Process Machinery	1,513	11	1.64	Cleveland, Chicago, Detroit, New York, Appleton (WI)
Process Equipment Sub-systems and Components	5,387	8	1.62	Chicago, Los Angeles, Cleveland, Houston, New York, Milwaukee, Buffalo

With productivity improvements as well as the economic recession, the production technology cluster nationwide has lost jobs nationwide from 1998 to 2010. However, the MSP region was one of the few U.S. regions to increase jobs in the machine tools and accessories subcluster over that period. The average wages in the industry are relatively high, over \$60,000 for the MSP region in 2010. Occupations that are important to the production technology cluster are mechanical engineers and high-skilled welders.

Ohio, later acquired the New Prague operation and has invested in the company's expansion in Minnesota. Chart was a spinoff of Trane industries, specializing in heat exchangers and converting gas to liquid. The name Chart was taken from the first names of the founders, Charlie and Art Holmes.

Chart has expanded into other markets for cryogenic containers, and now its markets are divided among biomedical, energy, and general industrial applications. Chart Industries is a leading provider of highly engineered cryogenic equipment for the hydrocarbon, industrial gas, and biomedical markets. In the biomedical area, Chart provides containers for oxygen therapy and gas generation products. End markets include home healthcare and nursing homes, hospitals and long-term care, biomedical and pharmaceutical research, and animal breeding.

Chart has been expanding its operations in Minnesota with a new facilities in New Prague and Owatonna, and has set up an engineering office in Burnsville to recruit mechanical engineers, who are critical to its business. The Owatonna plant is designed to increase capacity and competitiveness in producing mobile LNG containers.

The Minnesota Department of Employment and Economic Development (DEED) has provided incentive funding for Chart's expansions in Minnesota, which are tied to the booming demand for LNG containers, both stationary LNG fuel tanks as well as mobile equipment for buses, trucks, and trains. The price of natural gas fuel has declined from about the same as diesel fuel in 2000 to about one-tenth the price of diesel fuel currently.

Chart employs mechanical engineers who specialize in fluid force and thermodynamics. Chart recruits mechanical engineers from the University of Minnesota and has a rotation of engineering students who work at Chart. The Burnsville engineering office was set up to recruit engineers who would choose to live in the Metro area but are close enough to their operations in New Prague and Owatonna to be involved in production and operations. Chart also employs high-skilled welders and offers an in-house training program for prospective welders.

Suppliers include, stainless steel plates from Kentucky, special plates from Belgium, and stamping and metal stamping and spinning for tank heads by Rao Manufacturing and Acme Metal Spinning. Most shipping is by truck and little by rail. Some of the containers are too wide for rail cars, and the company is exploring shipment by sea.



Company profile: Chart Industries

Started in 1963 in New Prague, as Minnesota Valley Engineering, the company was later acquired by Chart Industries of Cleveland, OH. Chart has expanded its operations in Minnesota, producing cryogenic containers for the biomedical and energy industries as well as for general industrial applications

Chart Industries is a technology leader in providing heat exchangers and cold boxes critical to liquid natural gas (LNG), olefin petrochemicals, natural gas processing and industrial gas markets, and in separation, liquefaction and purification of hydrocarbon and industrial gases. The company is a manufacturing leader, one of three global suppliers of mission-critical LNG and LNG liquefaction equipment. Chart Industries has expanded its operations in Minnesota to take advantage of the competitiveness of LNG with other fuels.

Chart's major competitors are Taylor-Wharton in Mobile, Alabama, and INOXCVA, an Indian company with U.S. operations in Houston, producing mobile cryogenic containers.

Quality Tool specializes in fabricated sheet metal, press breaking, welding, metal stamping, tool and die manufacturing, and machining. The company is a contract manufacturer, doing vertically integrated metal manufacturing work, making metal casings and platings for products such as computers. Quality Tool makes power delivery bus bars using copper for insulation, ranging from as large as 400 pounds to as small as 4 ounces. Quality Tool's customers include computing, medical device, defense, industrial, and telecommunications companies.

Within Quality Tool's industrial base, much is associated with Rockwell Collins, which makes just about anything going into a factory, and Hoffman, which makes electrical boxes. Major medical clients are GE Healthcare in Waukesha, Wisconsin, and St. Jude Medical and Medtronic. The company also has a relationship with FoxCon in China, which does computer switch covers. Quality Tool thrived on high-mix and low-volume orders, typically producing between 1,000 to 2,000 pieces at a time.

Quality Tool has a full spectrum of employees, including very skilled program engineers, operations staff, customer service workers, and other workers. Its major competitors are located in Chicago.

Quality Tool excels in keeping up to date on the latest trends and technologies. The company uses a 3D printer to do quick prototypes, and all of its records are electronic, making it easy to communicate within its own firm and with clients.

Cluster Competitiveness Analysis

Factor Conditions: Production technology relies on highly skilled mechanical engineers and welders. The University of Minnesota is an important source of mechanical engineers for this industry. While welders require less formal education, they need specialized on-the-job training and applied learning skills for jobs in the production technology cluster.

Demand Conditions: The businesses in the production technology cluster supply other major industries and are driven to innovate and provide quality products by demanding local customers. Local demand from the region's competitive industries, such as agriculture, has contributed to the development of companies such as Chart Industries, and as these companies have matured, they have branched out supplying other industries such as medical and transportation.



Company profile: Quality Tool

Quality Tool began in 1959 as a tool and die shop. The company has 111 employees in St. Paul, and 90 employees in Brookings, South Dakota. As computers began to advance with sophisticated Enterprise Resource Planning (ERP) system links, Quality Tool was able to develop a niche market in casings.

The company had 28 million in sales in 2012, and has experienced a 14 percent growth in the last 8 years. 60 percent of their client base is industrial, while 21 percent is medical, 6 percent is defense, and 13 percent is associated with computers and electronics.

Related and Supporting Industries: The production technology cluster is an important supplier for other industries in the MSP region and exports its products to other regions as well. A strong local supply network in the production technology and metal manufacturing industries allows the region to support and grow other industries as well.

Context for Firm Strategy and Rivalry: Businesses in the production technology cluster provide a range technology solutions for improving manufacturing processes and productivity. The companies in this cluster provide a strong base for development of robotics in the MSP region.

INFORMATION TECHNOLOGY

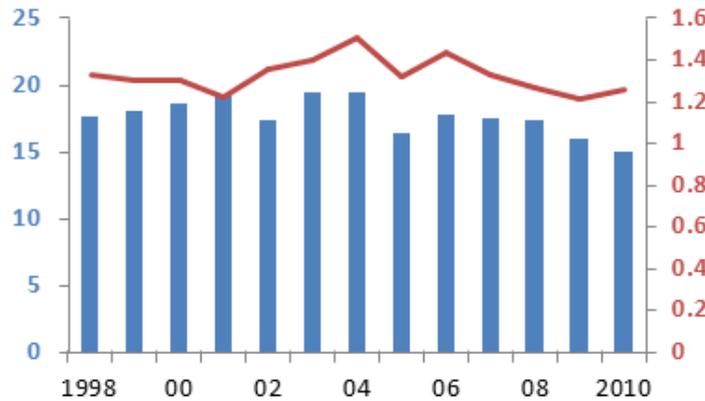
Key Performance Indicators



Information Technology employment and location quotient has remained relatively constant since 1998

Information Technology Employment (Thousands)

Location Quotient



2010

Number of Employees

14,919

Location Quotient

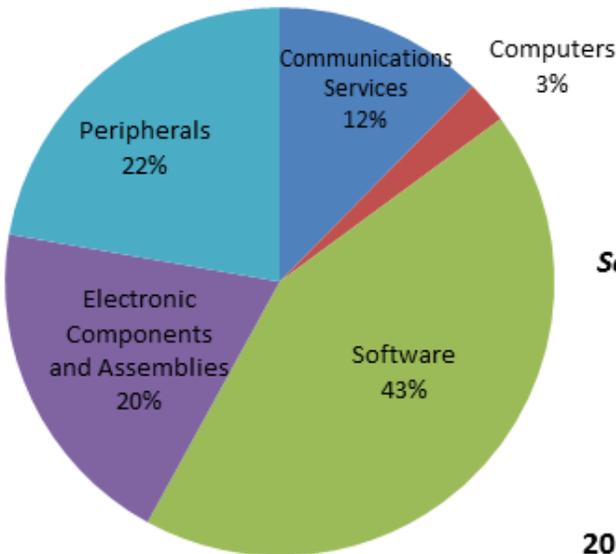
1.23

Employment in the Information Technology Cluster slightly more concentrated in MSP than in the nation..

Average Annual Wage

\$94,305

Average Information Technology wages in Minneapolis-St. Paul were the twelfth highest in the nation.



The largest sub cluster within the Information Technology cluster is Software, followed by Peripherals, and Electronic Components and Assemblies.

Largest Companies

Thomson Reuters

Dolan Company

Resistance Technology

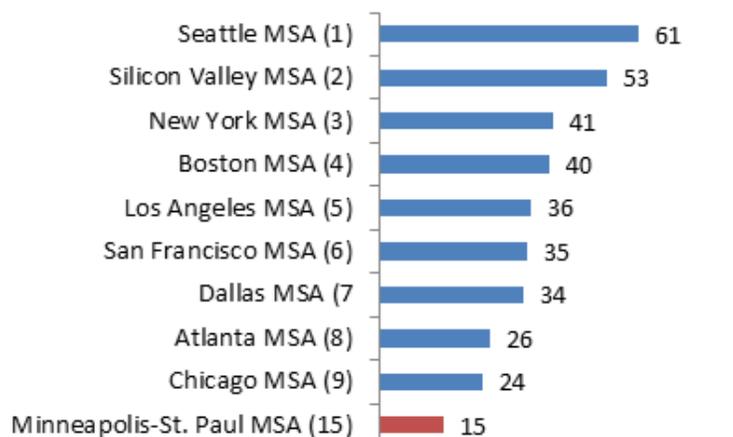
Polar Semiconductor

XRSCorporation

Kroll Ontrack

Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Dun & Bradstreet, Million Dollar Database

2010 Total Employment (Thousands)



Seattle has the largest employment within the Information Technology cluster, followed by Silicon Valley and New York. Minneapolis-St. Paul has the 15th highest total employment of all metropolitan areas.



Minneapolis-St. Paul Information Technology Cluster

While MSP's printing and publishing cluster must react to the drive toward digitalization, the region's information technology (IT) cluster is benefitting from the increasingly networked and cloud-based economy of the 21st century. Trailing leaders such as Seattle and Silicon Valley, MSP currently ranks 15th nationally in IT employment, with nearly 15,000 metro-area residents working in the cluster. A location quotient of 1.23 indicates that MSP's IT employment concentration is above the national average, but not as competitive as other MSP clusters. The region's average IT salary of \$94,305 ranks 12th nationally.

2010 Cluster Breakdown, Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area, Information Technology Cluster

Cluster/Subcluster Name	Employment	National Rank	Location Quotient	Other Competitive Regions
Information Technology	14,919	15	1.23	Seattle, Silicon Valley, New York, Boston, Los Angeles, San Francisco
Communications Services	1,847	38	0.45	New York, Atlanta, Dallas, Kansas City, Seattle
Computers	374	16	1.11	Houston, Johnstown (PA), Portland, Los Angeles, Seattle
Software	6,430	14	1.26	Seattle, Silicon Valley, Boston, San Francisco, New York, Los Angeles
Electronic Components and Assemblies	2,951	11	1.63	Silicon Valley, Portland, Dallas, Los Angeles, Boston, Phoenix
Peripherals	3,317	3	5.02	San Diego, Boise, Boston, Chicago, Silicon Valley

The sheer diversity and rapidly changing aspect of the IT cluster have presented the MSP region with an opportunity to stand out in certain areas, though. For its part, the IT cluster is comprised of five predominant subclusters: software, by far the largest subcluster; peripherals, a distant second; electronic components and assemblies, third; communications services, fourth; and computers, a far-off fifth. While Seattle and Silicon Valley stand out in software, for instance, MSP has found its own niche: IT peripherals.

The peripherals subcluster includes devices that are connected to a host computer, but not part of it. Peripherals expand the host computer's capabilities but do not form part of the core computer architecture. It is often, but not always, partially or completely dependent on the host computer. There are three different types of peripherals: *input*, used to interact with, or send data to the computer, such as a mouse or keyboard; *output*, which provides output to the user from the computer, such as monitors or printers; and *storage*, which stores data processed by the computer, such as hard drives or flash drives.

Indeed, consideration of the IT peripherals subcluster portrays MSP's IT cluster in favorable terms. With an approximate 7 percent share of subcluster national employment in 2010 and nearly 3 percent increase in its share of national employment since 1998, MSP joins the San Diego, Boston, and Boise regions as the nation's most competitive in this area.

Cluster Competiveness Analysis

Factor Conditions: The demand for skilled workers in any number of IT subfields is on a steady, if not dramatic, rise. Despite the seeming impersonal nature of the online economy, human capital is behind every webpage and accounts for nearly every advance in system interoperability and customer experience. In particular, talent is highly sought in the areas of software design, data storage, and security. The competition for skilled workers is amplified by the fact that in-house IT service provision is a growing component of businesses across a wide array of clusters.

Demand Conditions: Nothing is more cutting edge in the modern economy than information technology. The pressure for continued innovation and advancement is omnipresent—and ever mounting. Consumers, particularly early adopters, are reliably interested in the next gadget or gizmo, and businesses are sensitive to providing their products and services on platforms that best serve their needs—and satisfy customer expectations. This is true at the global, national, and regional levels.

Related and Supporting Industries: Perhaps more than any other, the information technology cluster has an influence that reaches far and wide. Its products and services are utilized by a large and growing segment of the economy, and its employees are often recruited to fill in-house IT positions.

Context for Firm Strategy and Rivalry: Providing the right mix of innovation and new technology with attention to individual business needs represents the sweet spot for IT success. Driving demand through product awareness and interoperability are imperative.



With its Minnesota roots extending to the late 19th century, first as West Publishing and later Thomson West, Thomson Reuters has evolved from a predominantly print-based provider of legal information to an Internet-dependent source of information in four principal markets: financial and risk; legal; tax and accounting; and intellectual property and science.

Based in Eagan, the Minnesota branch of Thomson Reuters remains focused on legal information, with the Westlaw product line leading the way. Second only to the company's financial and risk information market, Thomson's legal market accounted for \$3.3 billion of revenue in 2012.

With more and more of its product available online, largely through searchable databases, Thomson Reuters is intrinsically tied to advances and challenges in information technology. While the company remains dependent upon access to a pipeline of traditional talent in legal and business analytics, the need for IT professionals -- particularly in the areas of software, data storage, and security -- is ever-mounting and increasingly competitive.

MANAGEMENT OF COMPANIES

Key Performance Indicators



Minnesota's Fortune 500 Companies (2013)

Fortune 500 Rank	Company Name	Revenue (\$ millions)	Total Employees	Fortune Industry Definition
17	United Health Group	110.6	133,000	Health Insurance and Management
36	Target	73.3	361,000	General Merchandisers
61	Best Buy	45.1	165,000	Specialty Retail
69	CHS	40.6	9,495	Food and Grocery Wholesaling
86	Supervalu	36.1	130,000	Food and Drug Stores
101	3M	29.9	87,677	Miscellaneous
132	U.S. Bancorp	22.2	64,486	Commercial Banks
169	General Mills	16.7	35,000	Food Consumer Products
172	Medtronic	16.5	44,944	Medical Products and Equipment
194	Land O'Lakes	14.1	9,600	Food Consumer Products
229	Ecolab	11.8	40,860	Chemicals
237	C.H. Robinson Worldwide	11.4	10,929	Transportation and Logistics
246	Mosaic	11.1	8,000	Chemicals
263	Ameriprise Financial	10.3	12,235	Diversified Financials
266	Xcel Energy	10.1	11,113	Gas and Electric Utilities
319	Hormel Foods	8.2	19,700	Food Consumer Products
325	Thrivent Financial for Lutherans	8	2,983	Life and Health Insurance
457	St. Jude Medical	5.5	15,000	Medical Products and Equipment
500	Nash-Finch	4.8	6,410	Food and Grocery Wholesaling

2010

Number of Employees

90,843

Location Quotient

2.45

Employment in the Management of Companies cluster is more than twice as concentrated in MSP as in the nation.

Average Annual Wage

\$114,703

Average Management of Companies wages in Minneapolis-St. Paul were the fifth highest in the nation.

Private Companies

In addition to 19 Fortune 500 companies, Minnesota is also home to some of the nation's largest private companies including the nation's largest private company, Cargill, Carlson, Holiday Companies, MA Mortenson, and Andersen

2010 Management of Companies Subcluster Employment (Thousands)

New York has the largest employment within the Management of Companies subcluster, followed by Chicago and Los Angeles. Minneapolis-St. Paul has the 6th highest total employment of all metropolitan areas.



Employment data from Harvard Business School Cluster Mapping Project and US County Business Patterns. Company Data: Fortune Magazine

Minneapolis-St. Paul Management of Companies Cluster

With employment of over 90,000 in 2010, the MSP region ranks sixth nationally in the management of companies or corporate headquarters cluster. A location quotient of 2.45 indicates that employment concentration is over twice the national average—placing the MSP region sixth among its peers in subcluster employment. In addition, MSP has outpaced New York, Los Angeles, and Chicago in terms of national employment share between 1998 and 2010. Also, of the 20 top-performing regions in this subcluster, MSP ranks fifth in wages—with the average corporate employee earning nearly \$115,000 annually.



Minnesota is home to 31 of the top 1000 publicly traded firms in the U.S. The state hosts 20 Fortune 500 firms and 12 companies on the Forbes Global 2000 list for 2011. UnitedHealth Group leads this, and other top-ranked firms such as Target, Best Buy, Supervalu, 3M, CHS, U.S. Bancorp, Medtronic, and General Mills are household names. Cargill, the largest private company in the country, has flourished in the MSP region for the past century. Many international companies have also chosen the MSP region as home for their U.S. satellite operations.

The MSP region consistently ranks among the top two U.S. metropolitan areas for its concentration of corporate headquarters, vying with Connecticut for the distinction. As an additional benefit, the MSP region's concentration of corporate headquarters has spurred the demand for associated professional services that support these major firms. These highly-specialized business and professional services include but are not limited to creative services, legal services, research science services, public relations, accounting, and consulting services.

The strong base of corporate headquarters and supporting professional services in the MSP region are instrumental to the overall size, historical growth of the region, potential future growth, competitive supply chain bases, innovation, and philanthropy, as well as the presence of a skilled, highly productive workforce.

A great deal of effort and attention has been focused on MSP's corporate headquarters. Regional leaders and economic development professionals are looking at ways to leverage certain strengths in order to grow and maintain jobs; others are intent on nurturing the next generation of corporate headquarters.

Outreach to corporate leaders has revealed important insights; for instance, many in the business community believe MSP's corporate headquarters concentration provides a mutually beneficial synergy that provides a key competitive advantage; associated business organizations, executive mentorship, and access to high-quality professional services all stem from MSP's corporate headquarters concentration; and, in the words of one business leader, "The area is a jewel because of the number of great companies and good people here. The cross-pollination of corporate boards exemplifies the benefits of this region."

Cluster Competitiveness Analysis

Factor Conditions: MSP's corporate headquarters and major employers compete for the best talent they can find within or attract to the region. It is widely accepted that Minnesota's skilled, highly productive workforce and strong quality of life are two of its greatest advantages. Corporate leaders report that retaining this edge is critical for the region's future competitiveness.

Demand Conditions: The region's corporate headquarters and major employers are diverse and represent a broad array of economic sectors. The success of these firms is often tied to national and global forces, with regional economic realities often providing secondary influence on business trends and decision-making.

Related and Supporting Industries: Professional services ranging from legal, human resources, and advertising all contribute to and benefit from the success of MSP's corporate headquarters and major employers. Start-ups and spin-offs enjoy proximity to these corporate headquarter neighbors as well.

Context for Firm Strategy and Rivalry: While the region's corporate headquarters and major employers have historically competed for talented workers, occasionally recruiting from one another's ranks, these firms tend to focus their attention on major companies in other states or

countries. Thus, with few exceptions, MSP's large corporate players share supportive rather than rivalry-based relationships with one another.

Emerging Clusters of Interest/Connections across Clusters

Minneapolis-St. Paul has long been admired for nurturing a business ecosystem that fosters innovation and entrepreneurship. Many industrial innovations ranging from the aerospace industry to medical devices to supercomputers have their roots within the region. The following chapter details some emerging industries of particular interest to the Minneapolis-St. Paul regional economy. Because of their emergent nature, these industries do not perfectly align within the standardized cluster definition. Still, they are of great importance because they are likely to play a major role in how MSP is able to compete globally in the future.⁸

Water Tech

Minneapolis-St. Paul is at the forefront of water and wastewater treatment technologies. Home of industry leaders Pentair, Donaldson, and Osmonics (now owned by GE), the region is able to use its abundant water sources as a proving ground of sorts. As water shortages impact numerous regions across the globe, the sustainability of water resources is of critical importance. The water-tech sector began around a decade ago as large firms such as 3M and Pentair began to expand and diversify their businesses by purchasing smaller water treatment firms.⁹ Earnings per share are expected to grow at Pentair as a result of an increased demand for industrial water filtration equipment and pumps in addition to residential-related water-tech equipment.¹⁰ This emerging subsector, however, has long been a part of the Minnesota economy. For example, Osmonics, a firm formerly headquartered in Minnetonka, founded reverse osmosis technology in the 1960s as environmental awareness began to grow demand for environmental stewardship.

In 2011, Minnesota's Department of Employment and Economic Development released a listing of the 18 firms within the water tech sector in Minnesota. While no updated list has been released, it is expected that the number of these firms will continue to increase. These firms range from filtration to construction services to capital investment. It is apparent that there is an entire ecosystem, both natural and economic, surrounding water technology in Minnesota.

3D Printing

Minneapolis-St. Paul is home to Stratasys, the world's largest manufacturer of 3D printers and 3D production systems. Their products include 3D printers, rapid prototyping solutions, and direct digital manufacturing solutions. Because of the specialized nature of many of the region's production technology and manufacturing firms, 3D printing has largely been used for prototyping because it is less wasteful and more time-conducive for specialized one-off jobs. The Digital Fabrication Lab at the University of Minnesota has strategically positioned Minnesota students around the emerging industry.¹¹ 3D Printing has also been explored for use in the health sciences. Recently, scientists and researchers have begun exploring the use of 3D printing to print

⁸http://www.positivelyminnesota.com/Business/Locating_in_Minnesota/Research_Development_Capacity/Minnesota's_Inventive_History.aspx

⁹ <http://m.startribune.com/business/?id=206986311>

¹⁰ <http://www.startribune.com/business/186572311.html>

¹¹ <http://finance-commerce.com/2011/11/3d-printing-puts-university-of-minnesota-students-at-industry-forefront/>

tissues and organs. As a result of Minneapolis-St. Paul's strength in both 3D printing and medical devices, there could be an intersection between these two sectors in the region.

BioRenewables

Research at the University of Minnesota's Center for Sustainable Polymers has focused on advanced synthetic polymers for use as environmentally friendly, cost-efficient plastics made from natural and renewable materials. The center researches these polymers on the molecular level in order to make materials stronger and more elastic, giving them the properties admired in petroleum materials. Biorenewables have been used in a variety of commercialized products including pressure-sensitive adhesives for tape or post-it notes, foams for seat cushions, bedding or insulation, and hard plastics for items, such as cell phone cases.¹² Expansion of the advanced biofuels and biobased chemicals sector has a high potential for strong employment growth throughout Minnesota, with the industry contributing over 2,000 indirect and direct jobs in 2011. This growth occurs in three main categories: headquarters, agriculture biorefineries (manufacturing capacity for advanced biofuels and biobased chemicals that utilize agriculture based resources), and forest biorefineries (utilize forest-based resources).¹³

Robotics

Minnesota is a global leader in ground and industrial robotics, including basic and applied research institutions, established firms, and young companies. The robotics field in Minnesota stems from the region's strength in bioscience, agriculture, mining, retail, and industrial manufacturing. In addition to benefiting these traditional industries, robotics is also at the forefront of some of the state's more emerging industries such as security and defense.¹⁴

Several cluster-strengthening organizations are also being leveraged to help Minnesota's robotics industry grow. For example, Robotics Alley was founded as a way to create public and private partnerships around robotics. The Global Robotics Innovation Park (GRIP) in Minneapolis is a research park and business incubator for the entire robotics industry in the Upper Midwest and seeks to act as the hub for the entire regional industry cluster. Robotics at the University of Minnesota, particularly UMN Scout, has received national praise.

Cluster Interaction

As these emerging industries show, innovation and emergence typically occur on the fringes of clusters. This is because clusters continuously overlap with one another in new and exciting ways.

Factor conditions, such as a skilled and specialized workforce serving multiple clusters, demand conditions where competitive clusters drive innovation in other regional clusters and related and supporting industries that form a business ecosystem within the region create linkages *across* clusters.

¹² <http://finance-commerce.com/2011/10/university-of-minnesota-center-develops-earth-friendly-plastics/>

¹³ [https://www.lifesciencealley.org/content/documents/BBAM%20Documents/MN%20BioIndustrial%20Processing%20Roadmap%20%20SECTION%207%20\(Appendices%20&%20Acknowledgments\).pdf](https://www.lifesciencealley.org/content/documents/BBAM%20Documents/MN%20BioIndustrial%20Processing%20Roadmap%20%20SECTION%207%20(Appendices%20&%20Acknowledgments).pdf)

¹⁴ <http://roboticsinnovation.com/fag/>

Many of Minneapolis-St. Paul's manufacturing bases come from demand from more traditional clusters, such as medical devices and processed food. Other clusters, such as distribution services or transportation and logistics, play a critical role in the distribution and dissemination of the region's manufactured products. The MSP region also benefits from linkages with competitive Greater Minnesota clusters, which is particularly noticeable in clusters where MSP has a high concentration of headquarters but labor is done throughout the state.

Occupational Clusters in the Twin Cities Region

The concept of competitive clusters refers to the geographic co-location of industrial sectors that are related to one another. These relationships may be competitive or complementary, they may be transactional (buying and selling relationships), or due to shared resource inputs that the industries require, or due to a rich concentration of shared knowledge and skills in a given geographic area. The latter, which is captured by the idea of knowledge spillovers, has been highlighted as an important component of agglomeration economies since Marshall (1890).¹⁵ This chapter looks into the relationships among different industrial sectors in the Twin Cities metropolitan region, in particular, focusing on the potential for knowledge flow between different sectors.

Knowledge flows among firms can occur through informal social relationships among workers or through worker flows between different firms as job changes occur.¹⁶ These knowledge transfers may occur between firms within the same industrial sector or those in different sectors. Knowledge transfers can help competitors to keep up with one another; they can transfer best practices across sectors, or may spur innovation and the growth of new related sectors. In addition, the presence of a specialized skilled workforce may also help a region attract new firms that value those skills.

One of the difficulties in studying the presence and impact of knowledge spillovers is that a concrete measure of knowledge sharing among industrial sectors is difficult to identify and gather data on. One source of data researchers have used to study knowledge flows is looking at patent citation records and to see whether these citation patterns show geographical concentration.¹⁷ While this approach works well for industries where patents are regularly sought, it works less well when studying sectors where patenting and publishing may not be the norm. In addition, the approach is likely to focus on within-sector knowledge transfers and underplay knowledge transfers that may occur across sectors.

The potential for knowledge flows across basic (exporting) sectors in the Twin Cities region is analyzed by looking at similarities in occupations different sectors hire—particularly focusing on specialized workers. The existence of a skilled workforce serves as an attractor to employers sharing similarities in labor needs even when they are not operating in the same sector. The more specialized workforce two sectors share, there exists a higher likelihood for knowledge sharing through worker transfers.

¹⁵ Marshall, Alfred. *Industry and trade: a study of industrial technique and business organization; and of their influences on the conditions of various classes and nations*. Macmillan, 1920.

¹⁶ Breschi, Stefano, and Franco Malerba. The geography of innovation and economic clustering: some introductory notes. *Industrial and Corporate Change* 10.4 (2001): 817-833.

¹⁷ Examples include: Jaffe, Adam B., Manuel Trajtenberg, and Rebecca Henderson. Geographic localization of knowledge spillovers as evidenced by patent citations. *Quarterly journal of Economics* 108.3 (1993): 577-598. Also, Agrawal, Ajay, Iain Cockburn, and John McHale. *Gone but not forgotten: Labor flows, knowledge spillovers, and enduring social capital*. No. w9950. National Bureau of Economic Research, 2003.

Table 1 clarifies the sectors and skill sets that this study focuses on—sectors where the region has a competitive advantage as evidenced by the higher location quotient and jobs that are relatively specialized and high skilled. Local serving sectors as well as skills that are not specialized are not included in this analysis.

Table 1. Occupations and sectors focus of this study

Sector Skill/Occupation	Exporting Sector (LQ \geq 1.1)	Local Serving Sectors (LQ < 1.1)
High skill/specialized jobs (Varying criteria based on how many sectors employ that job class and visual elimination)	Sectors in this category are drivers of the regional economy. Potential for knowledge sharing across these sectors is studied by looking at similarities in hiring high skill/specialized job.	Not covered in study.
Other jobs	Not covered in study.	Not covered in study.

The method adopted here identifies sectors as *likely to share knowledge* when they share multiple classes of skilled workers. Though this approach doesn't provide a direct measure of knowledge transfer, through a series of steps described in the methodology section, we limit the likelihood that any two sectors are seen as related for spurious reasons. This involves the identification of relatively specialized occupation classes, as well as placing requirements on the number of occupational classes any two sectors share before identifying them as ones where knowledge flow is likely.

Data

The Minnesota Department of Employment and Economic Development (DEED) provided data for this work. The data provides detailed industry and occupation numbers for the seven-county Minneapolis-St. Paul metropolitan area on how many employees of a given occupation (identified by a SOC code) is employed in each sector (identified by a NAICS code).

The industry/occupations matrix used here has the highest level of detail possible both for occupations (6-digit SOC level) and for industries (4-digit NAICS level). However, this level of detail also means that employment data for some occupations at the 6-digit level were suppressed due to a combination of confidentiality and reliability thereby omitting 367,440 workers from the metropolitan total. Getting more complete data on employment is possible with some loss of industry detail (going down to 3-digit NAICS). However, on the basis of the loss in industrial detail that would occur, we perform the analysis with the more detailed data. In total, the data includes 227 sectors and 492 job categories and covers 1.1 million workers in the seven-county metropolitan region.

Another source of data used in this analysis is the 2010 County Business Patterns Data, which was used to identify each industrial sector's location quotient. This data was linked to the industry/occupation matrix based on NAICS code.

Methodology

Several different methods have been adopted in the literature as a way of identifying competitive clusters in regional and national economies. Many of these methods employ a combination of Economic Base Theory to identify the drivers of a regional economy coupled with other methods that are meant to identify sectors where significant relationships occur. Location quotients are used as a first step to identify “basic” (exporting) sectors in a regional economy. In other cases, identification of clusters is preceded by manually identifying sectors that are considered to be local serving (e.g., wholesale, groceries, etc.) and excluding them from the analysis. Each of these methods then adds an extension that aims to provide additional information on the relationship between the sectors active in a region's economy. These may be co-location patterns or sector-to-sector transactions. A statistical cluster analysis is often applied to evaluate either significant co-location or significant relationships based on buying and selling from each other, or from/to similar sectors.^{18 19} Transaction data has also been used to generate sector-to-sector trading networks, which were used to identify clusters.²⁰

The approach taken in this work also starts out in the same fashion as those cited above by identifying the export-oriented sectors in the region using location quotients. The analysis then explores what types of similarities exist between sectors by looking at the labor pool that they employ. To do this, the industry/occupations matrix is linked to the County Business Patterns data to filter those sectors where location quotients were below 1.1. The choice of 1.1 rather than 1 provides additional confidence in the sector's higher concentration in the region relative to its national concentration. Local serving sectors such as wholesale, retail, and waste management are also removed from the analysis.

Since our goal is to identify clusters based on knowledge sharing, we use occupation classes as a proxy for skills and knowledge. However, since some occupations are present in many sectors, using them as a basis of specialization and knowledge sharing is likely uninformative and wrong. Examples of such occupations include accounting clerks, managers, and customer service—some of which are present in over 100 sectors. Thus, a way to control for them is essential. Other occupations, such as aerospace engineers, computer systems analysts, operations research analysts, etc., are present in far fewer sectors and likely would make a better measure of specialized skills sharing.

One challenge of this approach is that it is difficult to know where the cut off for specialization is (i.e., is an occupation present in 20 sectors specialized enough to be used as a basis for clustering? or is 10 or 35 sectors the better measure to use?). The choice can affect what sectors we assume are potentially exchanging workers and knowledge. It would also change the clusters identified.

¹⁸ Porter, Michael. The economic performance of regions. *Regional studies* 37.6-7 (2003): 545-546.

¹⁹ Feser, Edward. *Benchmark value chain industry clusters for applied regional research*. Regional Economics Applications Laboratory. University of Illinois at Urbana-Champaign, 2005.

²⁰ Fan, Yingling, and Nebiyou Y. Tilahun. *Enterprising Twin Cities Transitways*. No. CTS 12-16, 2012.

Using a higher number may identify occupations that are not particularly important for transferring innovative knowledge. A smaller number may miss occupation classes that are important in the transfer of knowledge among sectors. For that reason we adopt an approach that tests a range of cutoff values for specialization.

Additionally, job sectors that are clearly generic (regardless of how many sectors they appear in) are also removed from being used as a basis of cluster identification. These, for example, include any jobs that fall under personal care and service, or food preparation and serving, which may be present in only a few sectors but also may not be directly important for a region’s competitiveness. Table 2 lists the occupational codes excluded from the analysis.

Further, among the remaining occupational classes, sectors may, by coincidence, attract one or two job classes between them. We therefore place additional requirements on how many occupations have to be shared between sectors before placing any two sectors in the same knowledge-sharing cluster. We balance the criteria on number of shared occupations against the specialization requirement described in the last paragraph by relaxing it when specialization is narrowly defined and narrowing it when specialization is relaxed.

Table 2. Occupations excluded from the analysis

SOC code	Description
21	Community and Social Services Occupations
25	Education, Training, and Library Occupations
27	Arts, Design, Entertainment, Sports, and Media Occupations
29	Healthcare Practitioners and Technical Occupations
31	Healthcare Support Occupations
33	Protective Service Occupations
35	Food Preparation and Serving Related Occupations
37	Building and Grounds Cleaning and Maintenance Occupations
39	Personal Care and Service Occupations
41	Sales and Related Occupations
43	Office and Administrative Support Occupations
45	Farming, Fishing, and Forestry Occupations
47	Construction and Extraction Occupations
49	Installation, Maintenance, and Repair Occupations
53	Transportation and Material Moving Occupations
55	Military Specific Occupations

Four sets of criteria are used and compared in this analysis to provide some confidence that the clusters identified are stable over the choice of specialization and sharing requirement. The stringent specialization criteria we use identify an occupation as specialized if it appears in five or fewer sectors only. In this case, any two sectors that attract two or more of the same specialized occupations are considered as knowledge sharing. The most relaxed specialization criterion considers an occupation specialized if it appears in 30 or fewer sectors. In this case, any two sectors are considered to be knowledge sharing if they have seven or more of the same

specialized occupations in their payroll. We also identify clusters based on ten or fewer sectors as a specialization criterion (along with a requirement that sectors share at least three of these occupations to be considered as knowledge sharing) and 20 or fewer sectors specialization with the requirement of sharing five or more of the same occupations.

To illustrate, consider the case where we have decided specialization means an occupation is part of five or fewer sectors (Case 1). In the data there are 69 occupation classes that only exist in five or fewer sectors (out of the original 492). Any given two sectors may have some of these occupation classes employed with either no overlap or with one or more of the 69 job classes being employed by them. We hypothesize that the case for knowledge sharing is stronger when sectors have more jobs they simultaneously attract than not. For this most stringent specialization criteria, we require at least three or more of the specialized jobs to be present in two sectors to identify them as potentially knowledge sharing. Table 3 presents the list of sectors identified as knowledge sharing and the strength of the relationship between any two on this list can be seen in Figure 1.

Alternately, when presence in ten sectors is used to define an occupation’s specialization, we look for an overlap in five occupations or more between sectors to define knowledge sharing (Case 2). When we require a job to be present in 20 or fewer or 30 or fewer sectors to be considered specialized, any two sectors must attract at least the same eight and ten occupations respectively to signal a strong potential for worker and knowledge exchange (Cases 3 and 4, respectively).

Table 3. Occupational cluster using 5 sector specialization criteria and 3+ occupations shared per pair of sectors for knowledge sharing

Sectors
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
Management of Companies and Enterprises
Semiconductor and Other Electronic Component Manufacturing
Insurance Carriers
Management, Scientific, and Technical Consulting Services

Table 4. Occupational cluster using 10 sector specialization criteria and 5+ occupations shared per pair of sectors for knowledge sharing

Sectors
Converted Paper Product Manufacturing
Printing and Related Support Activities
Semiconductor and Other Electronic Component Manufacturing
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
Medical Equipment and Supplies Manufacturing
Insurance Carriers
Agencies, Brokerages, and Other Insurance Related Activities
Management, Scientific, and Technical Consulting Services
Management of Companies and Enterprises

As the foregoing discussion illustrates, we have taken two steps to protect against generic jobs indicating knowledge sharing—first, by setting a cut off for occupational specialization and removing jobs that are clearly not specialized enough; and second, by requiring that sectors share multiple occupation classes before being grouped in the same cluster. In the four cases we analyze, the more stringent one criterion is, we relax the other one. Table 5 summarizes these cases and shows the number of sectors that make up the final clusters.

Table 5. Criteria for defining knowledge sharing clusters and size of final clusters

Number of sectors used to define specialization	Number of Occupations that qualify (of 492)	Min. number of shared occupations used to define relationship	Size of cluster (number of sectors included)
5	69	3	5
10	86	5	9
20	103	8	14
30	113	10	17

Tables 6 and 7 show the sectors that share labor pool similarities using each of these criteria. The types of occupations that define each cluster are given in Table 8. In addition, under each criterion the strength of the relationship between the sectors (the number of occupation classes they share) is shown in Figures 1–4, where the relationships between jobs and sectors are mapped under each criterion. The figures clarify that not all sectors in each of these clusters share a relationship with one another. For example in Figure 1, insurance carriers and semiconductor and related manufacturing are both in the first cluster but they attract different occupations. Both sectors however meet the criteria by sharing specialized occupations with other sectors in the cluster.

Table 6. Occupational cluster using 20 sector specialization criteria and 8+ occupations shared per pair of sectors for knowledge sharing

Sectors
Medical Equipment and Supplies Manufacturing
Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
Electrical Equipment Manufacturing
Insurance Carriers
Management of Companies and Enterprises
Agencies, Brokerages, and Other Insurance Related Activities
Management, Scientific, and Technical Consulting Services
Plastics Product Manufacturing
Forging and Stamping
Commercial and Service Industry Machinery Manufacturing
Other General Purpose Machinery Manufacturing
Computer and Peripheral Equipment Manufacturing
Semiconductor and Other Electronic Component Manufacturing

There is considerable consistency to the cluster members identified in this analysis though four different combinations of metrics were used in defining specialization and potential for information exchange. That is, as we allow more and more jobs to be part of the criteria for skill sharing, despite more stringent criteria for having more of these sectors being shared, sectors initially identified in Case 1 continue to meet the new requirements. This provides some confidence in regard to the actual skill sharing similarities between sectors.

Secondly, the list of sectors identified is very similar to the sectors that were previously identified in other work as important clusters by looking at transactions data. Sectors like medical equipment and supplies manufacturing, insurance carriers, management of companies and enterprises, finance (credit intermediation), have all appeared as central buyers from many other sectors in the region and defining their own clusters.²¹ The current analysis suggests that the sectors we regard as drivers of the regional economy also have a relatively strong potential for knowledge transfer and skill sharing between them.

Table 7. Occupational cluster using 30 sector specialization criteria and 10+ occupations shared per pair of sectors for knowledge sharing

Sectors
Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
Medical Equipment and Supplies Manufacturing
Insurance Carriers
Management of Companies and Enterprises
Commercial and Service Industry Machinery Manufacturing
Semiconductor and Other Electronic Component Manufacturing
Other General Purpose Machinery Manufacturing
Computer and Peripheral Equipment Manufacturing
Electrical Equipment Manufacturing
Software Publishers
Data Processing, Hosting, and Related Services
Management, Scientific, and Technical Consulting Services
Agencies, Brokerages, and Other Insurance Related Activities
Printing and Related Support Activities
Plastics Product Manufacturing
Newspaper, Periodical, Book, and Directory Publishers
Depository Credit Intermediation

²¹ Fan, Yingling, and Nebiyou Y. Tilahun. Enterprising Twin Cities Transitways. No. CTS 12-16, 2012.

Conclusion

This chapter looked at the hiring patterns in the “non-local serving sectors” present in the Minneapolis-St. Paul region. All sectors considered had a location quotient of 1.1 or greater, which means they comprise a larger share of the regional workforce when compared to their share of total employment nationally. Our analysis focused on the extent to which sectors pull from similar skill pools and the potential for knowledge flows across sectors. After removing generic job descriptions and requiring multiple shared occupation needs between sectors, we identified the region’s sectors that share specialized workforce needs. Moreover, the sectors that are identified as sharing workforce also are related based on transactional flows in other studies.

Considering that these firms are highly represented in the region (based on their location quotient) and the similarities in their occupational needs, two potential relationships can be surmised. First, the concentration of specialized workforce makes the region attractive for a wide range of sectors. In the most restrictive occupational specialization cluster we identify, the occupations being shared require engineering, electronic, and management skills (among others) that are sought by multiple sectors. Second, the shared similarities in occupational needs make it likely that one sector is enriched by the others’ presence as workforce flows transfer knowledge from one sector to another. These flows may also occur within a sector where directly competing firms are present. In cases where direct trading is taking place between sectors (e.g., the semiconductor and electronic component manufacturing sector and medical equipment and supplies manufacturing,²² where firms are part of each other’s supply chain rather than directly competing), these types of flows are likely to benefit both sectors involved by creating the conditions where the needs of transacting firms are better understood. The presence of a large number of workers in specialized fields also enables the presence of trade organizations whose members both formally and informally exchange knowledge and ideas adding to the region’s attractiveness.

Our analysis also identifies the types of specialized occupations broadly shared by the sectors that give the MSP region its competitive edge. This finding has implications for workforce development in the region. It suggests that attention should be paid to the shared workforce needs of the region’s competitive sectors and to ensure that both the quality and rate of training match the region’s needs. While all occupation classes are important to any sector’s success, the set of specialized occupations identified here serve multiple sectors. Ensuring the quality and availability of this workforce helps preserve the region’s competitive advantages. Table 7 shows that the shared occupations cover a wide range of occupations including degree-requiring statistical, engineering, or programming fields, as well as trade-oriented jobs, such as machine operators and mechanical drafters. Ensuring that the MSP region’s labor force acquires the requisite training and skills is critical. A more in-depth study of training rates in these fields and sector needs would help advance the policy discussion to ensure a ready workforce that satisfies the needs of these key sectors.

²² Fan, Yingling, and Nebiyou Y. Tilahun. *Enterprising Twin Cities Transitways*. No. CTS 12-16, 2012

Table 8. Shared occupations in each cluster (list is cumulative so that occupations used in the most restrictive cluster is also part of the next cluster)

Occupation	Used in cluster	
Compensation and Benefits Managers	Clusters based on occupations that were in only 5 or fewer sectors	
Computer Hardware Engineers		
Electrical and Electronics Drafters		
Electronics Engineers, Except Computer		
Environmental Engineers		
Environmental Scientists and Specialists, Including Health		
Logisticians		
Materials Engineers		
Medical and Health Services Managers		
Statisticians		
Training and Development Managers		
Claims Adjusters, Examiners, and Investigators		Clusters based on occupations that were in only 10 or fewer sectors
Compliance Officers		
Computer-Controlled Machine Tool Operators, Metal and Plastic		
Cost Estimators		
Cutting and Slicing Machine Setters, Operators, and Tenders		
Electrical and Electronic Equipment Assemblers		
Electrical and Electronics Engineering Technicians		
Helpers--Production Workers		
Lawyers		
Mechanical Engineering Technicians		
Meeting, Convention, and Event Planners		
Natural Sciences Managers		
Operations Research Analysts		

Occupation	Used in cluster
Paralegals and Legal Assistants	
Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic	
Prepress Technicians and Workers	
Printing Press Operators	
Production Workers All Other	
Public Relations and Fundraising Managers	
Assemblers and Fabricators, All Other	Clusters based on occupations that were in only 20 or fewer sectors
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	
Compensation, Benefits, and Job Analysis Specialists	
Computer Programmers	
Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	
Database Administrators	
Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	
Electrical Engineers	
Electromechanical Equipment Assemblers	
Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	
Grinding and Polishing Workers, Hand	
Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	
Human Resources Managers	
Industrial Engineering Technicians	
Machinists	
Management Analysts	
Mechanical Drafters	

Occupation	Used in cluster
Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	
Purchasing Managers	
Software Developers, Systems Software	
Team Assemblers	
Tool and Die Makers	
Welders, Cutters, Solderers, and Brazers	
Administrative Services Managers	Clusters based on occupations that were in only 30 or fewer sectors
Architectural and Engineering Managers	
Computer Systems Analysts	
Industrial Engineers	
Information Security Analysts, Web Developers, and Computer Network Architects	
Inspectors, Testers, Sorters, Samplers, and Weighers	
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	
Marketing Managers	
Mechanical Engineers	
Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	
Software Developers, Applications	
Training and Development Specialists	

Figure 1. Cluster based on occupations that were in only 5 or fewer sectors
 (Red are sectors Green are occupations)

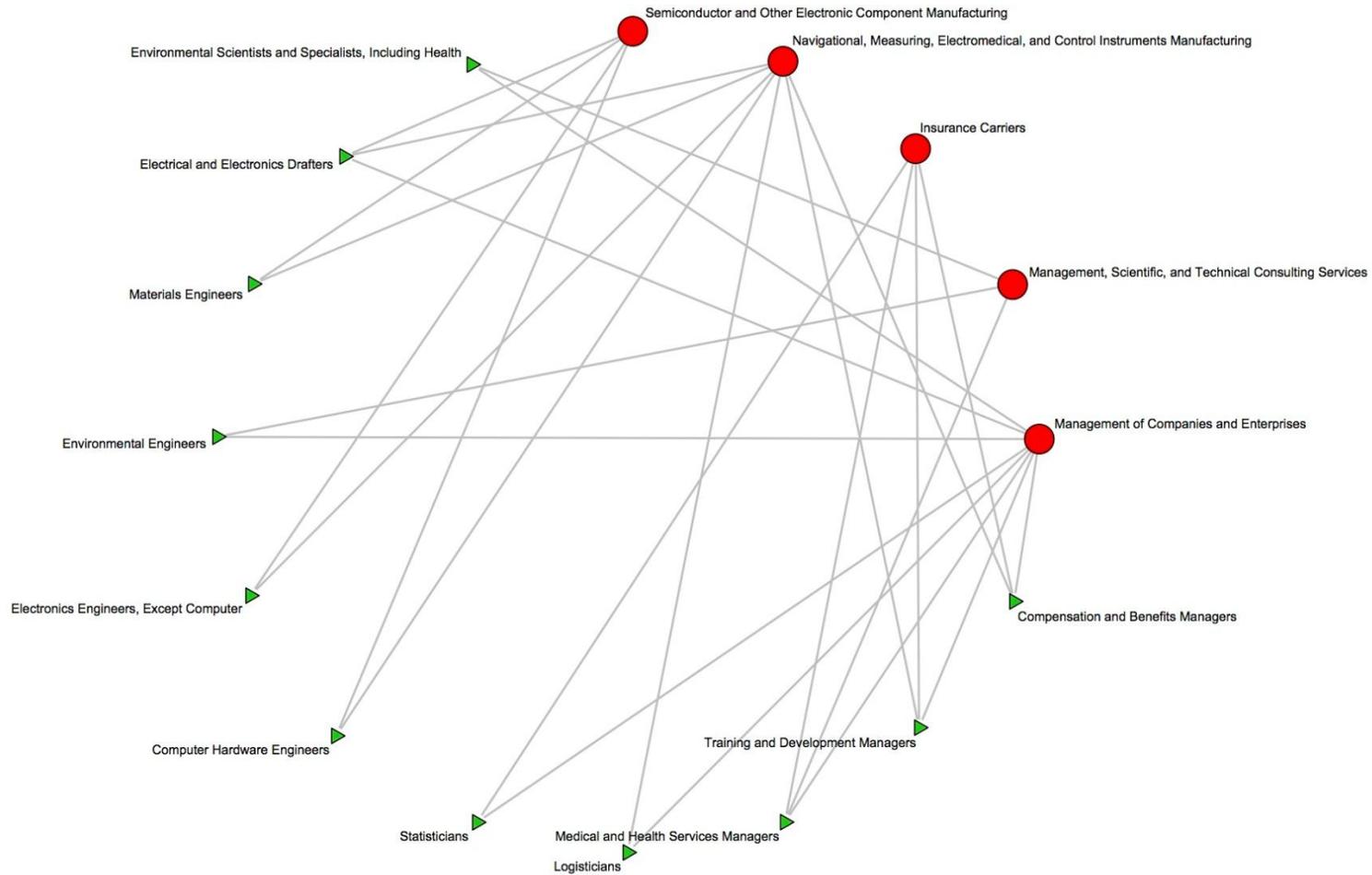


Figure 2. Cluster based on occupations that were in only 10 or fewer sectors
 (Red are sectors Green are occupations)

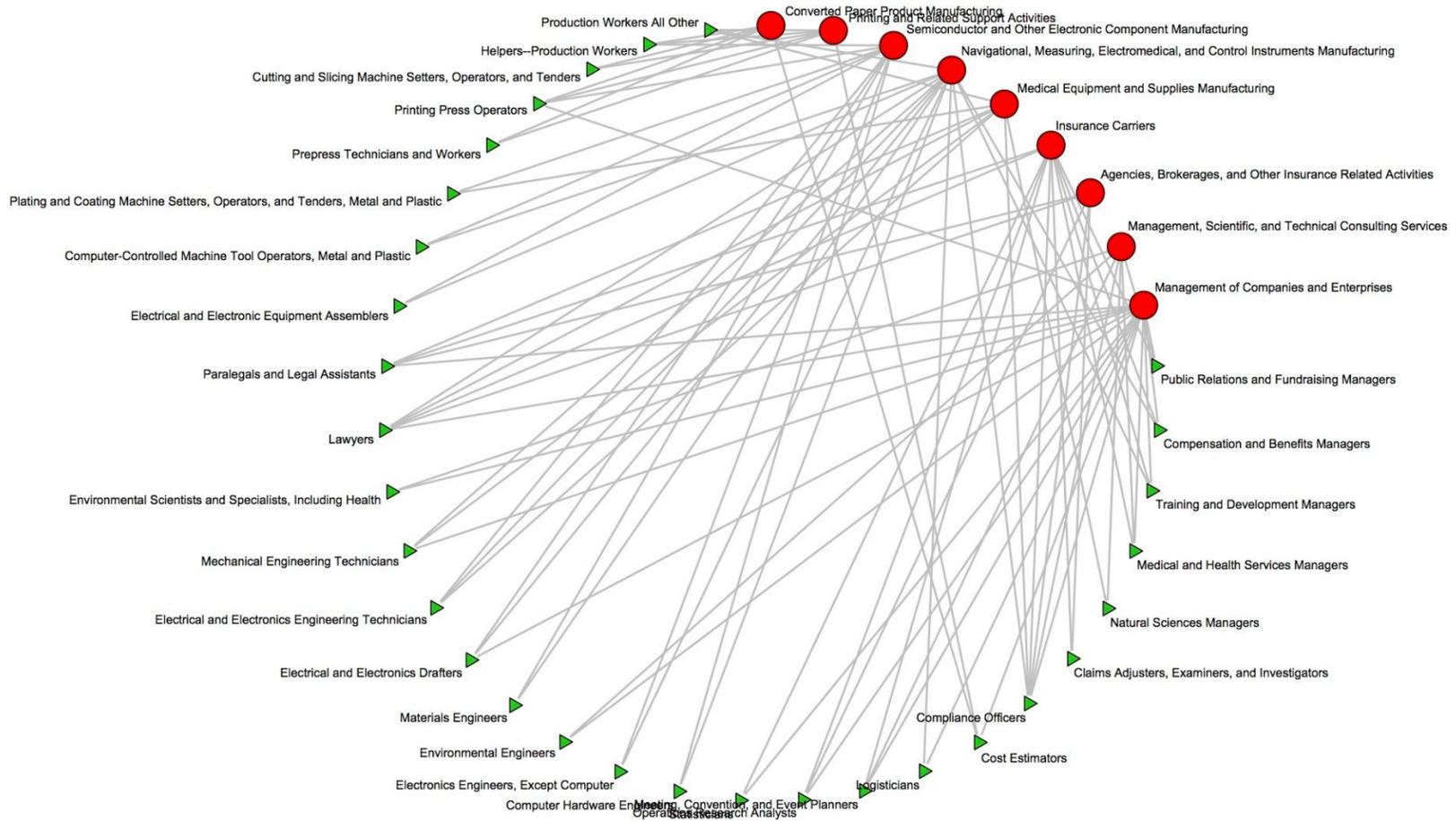


Figure 4. Cluster based on occupations that were in only 30 or fewer sectors
 (Red are sectors Green are occupations)

