GREATER MSP IT CLUSTER STUDY

Hilary Holmes, Esra Kucukciftci, John Meyer, John Mitchell, Mike Nicholas, Tim Solomonson

12/21/2011
Executive Summary

This report evaluates the presence and competitiveness of an Information Technology (IT) Cluster in the Twin Cities metropolitan area using Harvard Business Professor Michael Porter’s Business Cluster model. The report is focused geographically on the eleven counties in Minnesota and two counties in Wisconsin that make up the Twin Cities metropolitan area. This research was conducted for Greater MSP, a private-public partnership whose mission is to stimulate economic growth and prosperity in the Minneapolis Saint Paul region. The goal of this research is twofold: first, help Greater MSP understand this burgeoning industry cluster; and second, to recommend policy options to help grow and retain home-grown IT businesses and attract similar businesses to our region for the long term.

An initial focus of the report was defining the relevant industries within a potential cluster and collecting data for key indicators (concentration of employment and projected growth in employment) used to determine the existence of an IT Cluster in the Twin Cities. Our statistical analysis focused on location quotients, patent data, and employment data, including both current and projected industry employment and wages. This analysis leads us to conclude that there is an IT Cluster in the Twin Cities.

After determining the existence of the cluster, we set out to interview as many industry stakeholders as possible to determine the industry’s needs to help grow and retain IT business in the region. Several key themes emerged from these conversations. First, many industry stakeholders are either unaware or unwilling to admit that an IT Cluster exists in the Twin Cities. Second, the industry finds it difficult to attract experienced talent from the warm climates of California and Texas to the cold climate of Minnesota. Two main recommendations flow from these themes: the region needs to attract and creation home-grown IT talent and focus on entrepreneurial activity to grow home-grown IT start-ups.
Our first recommendation involves branding the Twin Cities as a center for IT innovation and excellence.

Our other recommendations involve strategies for developing home-grown talent in high schools, colleges, and even private-sector funded research labs. In addition, we promote the creation of a University Research Park immediately adjacent to the University of Minnesota’s Minneapolis campus.

In summary, the economic development opportunity presented by the Twin Cities’ IT industry is currently under developed, with lost opportunities for the region and individual stakeholders within it. Organizations such as Greater MSP can play a key role connecting the region’s IT companies, and allowing them to share information, develop talent, and support entrepreneurial activity in the sector, all of which will further grow and strengthen their competitiveness in the global marketplace.
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1. INTRODUCTION: GREATER MINNEAPOLIS-ST. PAUL IT CLUSTER STUDY

This report evaluates the presence and competitiveness of an Information Technology (IT) Cluster in the Twin Cities metropolitan area using Harvard Business Professor Michael Porter’s Business Cluster model. The report is focused geographically on the eleven counties in Minnesota and two counties in Wisconsin that make up the Twin Cities metropolitan area (which hereafter will simply be referred to as the Twin Cities.) This research was conducted for Greater MSP, a private-public partnership whose mission is to stimulate economic growth and prosperity in the Minneapolis Saint Paul region. The goal of this research is twofold: first, help Greater MSP understand this burgeoning industry cluster; and second, to recommend policy options to help grow and retain home-grown IT businesses and attract similar businesses to our region for the long term.

According to Porter, “The principal goal of a nation (or region) is to produce a high and rising standard of living for its citizens” (Porter, 2008). Technology based businesses are of particular importance to the Twin Cities’ economic growth and prosperity for two reasons. First, technology-related jobs tend to have wages significantly above average wages: IT wages in the Twin Cities are 62 percent higher than
average private sector wages (Fendos, Granholm, Leavitt, & Rothchild, 2008). Economic activity from this sector (and other export-based sectors) creates the wealth that feeds economic activity in other locally-based sectors of a regional economy, such as construction, real estate, retail, or personal services. Illustrating this point, an analysis conducted by the NY Federal Reserve showed that IT clusters in the specific areas of telecommunications, computer, and electronics have a “positive and statistically significant effect on metropolitan area GDP per capita,” while finding no evidence of “manufacturing-, agricultural-, or basic scientific-related knowledge contributing to differences in GDP per capita across US metropolitan areas” (Abel & Gabe, 2008). Second, IT has had an enormous impact on our economy in the last decade. It has transformed business activities for productivity gains at every stage of the value chain, from logistics to technology development to sales and service, and that impact is projected to continue to grow (Porter, 2008).
2. METHODOLOGY

An initial focus of the report was defining the relevant industries within a potential cluster and collecting the data for key indicators (concentration of employment and projected growth in employment) used to determine the existence of an IT Cluster in the Twin Cities. For this analysis, the Innovation and Technology Cluster for the Twin Cities was divided into two subgroups: Information Technology (IT) Industries and Advanced Manufacturing Industries. IT Industries are defined as companies involved with data management, security, movement, access, searching, and storage. Advanced Manufacturing Industries are defined as any manufacturing firm that either uses advanced technologies in its production process or have advanced technologies as an end product.

In order to narrow this report’s focus to the relevant industries comprising the IT cluster, a literature review of previous IT industry studies was used to determine an initial set of industry classifications. These classifications were then compared to the Census Bureau’s North American Industry Classification System (NAICS) codes and descriptions and categorized into one of the following three categories:

- **Core**: All industry segments which contribute directly to the management, security, movement, access, searching, and storage of data.
- **Related and Supporting**: High-tech industry segments that may share common supply chains, R&D needs, resource requirements, technical knowledge, etc that do not directly engage in the production of soft or hard IT goods.
- **Factor**: These industries provide crucial inputs into the system, clean technologies, automation/assembly technologies, testing technology, information infrastructure that facilitate IT activities, but do not directly produce soft or hard IT goods.
For a quantitative analysis, location quotients were analyzed for industries represented by these NAICS codes, as well as projected employment growth for those industries. Following the quantitative analysis, a series of interviews were conducted with prominent industry leaders, including corporate representatives and related business organizations. As a result of the interviews with these leaders, our research focused on the IT Industry in the Twin Cities.

Michael Porter’s industry analysis model, called the Diamond of Advantage, was used to contextualize this qualitative analysis of the industry cluster. The Diamond analysis was then used to develop a list of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) to the region’s IT Cluster. Finally, action steps and further investigation are recommended to Greater MSP to improve the regional competitiveness of the Twin Cities IT Cluster.
3. TWIN CITIES’ LEGACY CLUSTER: TECHNOLOGY MANUFACTURING AND IT

HISTORY OF THE IT CLUSTER

The Greater Minneapolis-St. Paul IT Cluster dates back to World War II. When the war came to a close, a new company called Engineering Research Associates (ERA) was formed in St. Paul. Started by a small group of former Navy code breakers, ERA set out on a secret mission for the U.S. military. Based in a small wooden glider factory, they began to design and build data storage systems in January 1946. By 1948, they had developed a high-speed, rotating magnetic storage system that – in function – was the first hard drive.

As these new storage systems grew in complexity, it was discovered that they would be better if they were programmable and did not have a fixed set of instructions. By 1950 ERA showcased their first computer, called the ERA 1101. Their release came at virtually the same time as a number of other firms claiming to be the first to create a computer.
Advanced Manufacturer Company Focus:

FSI International

FSI International is one company that was contacted, for perspective both as a supply factor and as a manufacturer. FSI builds machines that keep semi-conductor wafers clean throughout the process of etching and cutting. These machines are very expensive, and their manufacture is an advanced manufacturing process in itself, but without them semi-conductor chip manufacturing could not occur.

As a support factor and a manufacturer FSI’s advantages and challenges are related to the company’s location in Minnesota. They perceive relatively little benefit associated with being located in the state, but rather had developed here and remained here. The first setback FSI faces is the ability to attract talent to the area because of the northern climate, and the second is the lack of technical reputation compared to places like Silicon Valley.

FSI International is concerned with being able to attract talent to the area, because experienced professionals are more desirable than engineers straight out of school. Related to industry clustering, if more manufacturers that employ these trained professionals were located in the region more hiring could be done from within rather than from outside the state. In this way an advanced manufacturing cluster would be self-sustaining, because once companies are here employing engineers, those engineers would be able to stay in the region, supporting the companies that employ them. By empowering advanced manufacturing companies to locate and hire from within the region the problem of how to attract talent is diminished, attraction is not as important when talent is already present. This is going to be a hard goal to target; because once enough manufacturers are here to solve the problem the cluster will already be relatively strong.

FSI’s second problem is one that Greater MSP will likely have more ability to work towards solving. The region’s reputation comes into effect when FSI tries to appeal to new buyers, or show their wares in the international market: it is hard to convince a manufacturer to buy from a supplier located in Minnesota when other manufacturers are closer to manufacturing centers like Silicon Valley, Japan, and other Asian countries. In addition to the benefit of being closer to many manufacturers, these other locations have a reputation of producing high quality products and services. The opportunity here is to work towards creating a reputation of quality and reliability for the region. This could be done by attracting well-known tech companies to the region, or by campaigning to create a reputation for the existing companies, empowering them and attracting more.

ERA may have had the engineering know-how, but they did not have the marketing and sales know-how and could not sell their new computer in the open market. In ERA’s early days, they enticed talented young employees to the firm with stock options. As a result, following ERA’s success, many of their first employees were able to finance spin-off companies of their own. These included Cray, UNIVAC, and Control Data. These spin-offs grew and drew talent from the University of Minnesota and other firms in the area.

Through the 1980’s, the mainframe and supercomputer industry thrived in Minnesota. But with the advent of low cost personal computers, overseas manufacturing, integrated circuits and low cost storage, the mainframe computer became nearly obsolete. As this happened, the large computer firms in Minnesota began to disappear. Today there are still bits of the old firms left with Seagate in the hard drive market and Unisys that was essentially UNIVAC.
DRIVERS OF THE IT MARKET

PC Penetration

The PC represents one of the largest and most important user interface components for IT products worldwide. With the United State PC market close to saturation, IT service growth in this market is likely to remain slow but constant. While domestic growth is likely to be slow, other markets like China and India hold more potential for IT consumer growth as PC penetration into these markets continues to rise. Counter to PC growth trends, the emergence of smart phones, tablet PCs, 4G mobile networks, and thousands of mobile applications have created a host of new market niches which have already proven very lucrative avenues for IT expansion. Industry entities have identified mobile application design, software development, and cloud computing as emerging IT markets with high levels of growth potential. Because the mobile market (devices and applications), is where most of the IT growth is likely to occur, an industry wide shift is reorienting IT companies towards the development of these products and services. However, cloud computing still faces a major paradigm barrier (based on security, reliability, and proximity concerns) that must first be overcome before this shift can move fully into the mainstream.

Broadband Pushes Need for Networking and Storage

The evolution of data networks and the internet has closely paralleled that of PC innovation. Faster computers, an info-centric global economy, a growing world population, and a host of other factors have all driven the growth of information networks. Around the globe, corporate and private data use is skyrocketing. In the private sector, mobile device users are texting, emailing, Facebooking, downloading music, and conducting a whole host of other data hungry activities. Businesses represent an even larger segment of data use as they analyze consumer trends, track commodity prices, manage operations, and market products, in addition to supplying and managing most of the private sector content that is
consumed. All of these activities require the transmission and management of massive amounts of data. As global Internet use continues to growth, data storage, management, security, and utilization needs will only gain momentum, at least for the foreseeable future. Looking at Internet use and penetration rates around the world (see tables below,) it is clear that IT growth opportunities are rapidly expanding worldwide, particularly in Asia, Africa, Latin America, and the Middle East. The power of information, as both a tool and a commodity, should not be overlooked.

### Table 1 World Internet Use and Population: (Source: [www.internetworldstats.com](http://www.internetworldstats.com))

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>1,037,524,058</td>
<td>4,514,400</td>
<td>118,609,620</td>
<td>11.4%</td>
<td>2,527.4%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Asia</td>
<td>3,879,740,877</td>
<td>114,304,000</td>
<td>922,329,554</td>
<td>23.8%</td>
<td>706.9%</td>
<td>44.0%</td>
</tr>
<tr>
<td>Europe</td>
<td>816,426,346</td>
<td>105,096,093</td>
<td>476,213,935</td>
<td>58.3%</td>
<td>353.1%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Middle East</td>
<td>216,258,643</td>
<td>3,284,800</td>
<td>66,553,066</td>
<td>31.7%</td>
<td>1,997.0%</td>
<td>3.3%</td>
</tr>
<tr>
<td>North America</td>
<td>347,394,870</td>
<td>108,096,000</td>
<td>272,066,000</td>
<td>78.3%</td>
<td>151.7%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Latin America / Carib.</td>
<td>597,283,165</td>
<td>18,068,919</td>
<td>215,939,400</td>
<td>36.2%</td>
<td>1,037.4%</td>
<td>10.3%</td>
</tr>
<tr>
<td>Oceania / Australia</td>
<td>35,426,595</td>
<td>7,620,450</td>
<td>21,293,830</td>
<td>60.1%</td>
<td>179.4%</td>
<td>1.0%</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>6,930,055,154</td>
<td>360,985,482</td>
<td>2,095,006,005</td>
<td>30.2%</td>
<td>460.4%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Data speed is a critical limiting network characteristic that will play an increasingly important role in how the IT industry evolves in the future. There are two key fiber-optic data network characteristics that are important to consider. First, while the speed of light is the limiting factor for the transmission of data across a fiber-optic network, a more functional limit is the rate at which a light can pulse (on and off)
and (to a lesser extent) the limit to which the diameter of fiber-optic cables can be made smaller while maintaining profitability. Because a key feature of the IT industry is the efficient transmission of data, these limits, paired with existing capacity, represent a ceiling for IT industry growth. Currently IT infrastructure capacity is keeping pace with demand, but demand is difficult to forecast, making excess capacity an important consideration for IT companies when selecting a location for expansion. In addition to fiber-optic advancement, innovations in the capacity of satellite communications will also remain an important factor for IT industry growth, especially in emerging markets where Internet penetration is growing but infrastructure remains relatively immature and unreliable.

![World Internet Penetration Rates by Geographic Regions - 2011](source: Internet World Stats - www.internetworldstats.com/stats.htm)

**The Impact of Multi-Media**

According to a recent report on the Nightly Business Report, peak evening hour data use by the movie streaming giant Netflix accounts for nearly one third of total data transmitted over networks in the United States. With Apple TV, Google TV, Blockbuster’s Digital Movie Service, iTunes, YouTube, Facebook, and a nearly limitless list of digital content providers, data consumption and the support and
infrastructure needed to facilitate it are in a nearly perpetual state of expansion and upgrading. Multi-
media digital content requires the full gamut of IT support structures (software, storage, security, etc.)
to function effectively as a consumable product. With the digital multi-media market growing steadily,
opportunities abound for IT growth in these sectors.

**Data Use in the U.S.**

![Graph showing data usage in the U.S. from 2006 to 2014]

<table>
<thead>
<tr>
<th>Category</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Data</td>
<td>22</td>
<td>34</td>
<td>51</td>
<td>72</td>
<td>99</td>
<td>132</td>
<td>171</td>
<td>214</td>
<td>260</td>
</tr>
<tr>
<td>Retail Home Video</td>
<td>321</td>
<td>417</td>
<td>522</td>
<td>637</td>
<td>770</td>
<td>945</td>
<td>1183</td>
<td>1502</td>
<td>1901</td>
</tr>
<tr>
<td>Gaming</td>
<td>12</td>
<td>29</td>
<td>52</td>
<td>83</td>
<td>127</td>
<td>187</td>
<td>270</td>
<td>384</td>
<td>545</td>
</tr>
<tr>
<td>Home Backup</td>
<td>32</td>
<td>98</td>
<td>195</td>
<td>333</td>
<td>523</td>
<td>781</td>
<td>1254</td>
<td>1920</td>
<td>2841</td>
</tr>
<tr>
<td>Home Entertainment</td>
<td>192</td>
<td>435</td>
<td>760</td>
<td>1240</td>
<td>1941</td>
<td>2759</td>
<td>3720</td>
<td>4835</td>
<td>6001</td>
</tr>
</tbody>
</table>


**Upgrades for Software Demands**

The collection, management, security, storage, analysis, and application of high quality data has become
a crucial component for catalyzing business growth in all industries from retail to mining. A major
component to successful data use is the creation of ‘soft’ user interfaces (primarily software
applications) that are efficient, accurate, intuitive, and tailored to specific client needs. While
standardized software solutions (Adobe, Microsoft Office, ESRI, et al.) still command an important share
of the business market, tailored software applications that are created to address client specific demands are becoming an increasing important commodity of much of the IT industry. As the application of data increases in specificity and complexity, the IT software solutions (soft data interfaces) used to access and manipulate that data must adapt to optimize client specific data to provide a competitive edge through knowledge creation, efficiency, or some other tangible gain. This creation of client tailored solutions was identified over and over again in interviews with IT industry companies as a very important avenue of growth, or at the very least exploration.

**Early Adopters Drive Need for Additional Hardware at Home**

The ‘silent’ generation is the first generation to be born into a world saturated with high-technology and nearly unlimited access to data. This conditioning and access to technology has given birth to a generation that consumes data at a higher rate than ever before, driving high-tech industries from software development to IT infrastructure. For this generation the mobile device is quickly emerging as the new data interface of choice and as such wireless data transmission and the infrastructure to support it will play an integral and ever increasing role in the expansion of future IT business around the world.

**Economic Woes Mildly Impacting Sales**

While the current economic down turn has reduced the corporate and consumer appetite for technology spending, innovation in most high-tech industries has continued relatively unabated, a function in large part of the highly competitive nature of the industry. These two trends have created a scenario where curtailed consumers and businesses spending have resulted in large cash reserves and pent up consumer demand, a trend that IT industries have recognized and are well positioned to capitalize once tech spending picks up. A second and very important consideration that is emerging
from the economic down turn is the need for businesses to streamline marketing, sales, and production processes all of which require increases in data management, access, analysis, and transmission, a point not lost on IT industry.

**Role of Price Declines in Mass-Market Consumption**

The computing processing power of high-technology devices has risen predictably according to Moore's law which states that the number of transistors that can be placed inexpensively on an integrated circuit doubles approximately every two years. While microprocessor power has risen swiftly and predictably, the price of the high-tech devices that rely on microprocessors typically experiences much greater fluctuations in price as newer technologies are introduced to replace older ones. The speed with which new and more powerful microprocessors have been introduced combined with short periods of high pricing followed by a long period of rapid and constant price decline has created a scenario where high-tech devices are becoming more and more accessible around the globe. The same can be said for Internet services and data storage providers which are under increasing pressure as computing power increases and data demands surge to increase data capacity and create faster and more robust networks in order to allow high-tech device to communication and access data.

The graph below of world-wide data storage growth shows that the amount of storage space available (a measure of market demand) is increased aggressively in the last decade.
Rapid Growth and Rising Demand

These rapidly growing sectors have created a market that is much more diverse and far easier to enter at a much lower price point than in the past. Today a user can purchase a smart phone for around a hundred dollars and have access to much of the data that used to be accessible only on the more expensive PC and laptop user interfaces. The implications of these trends for the IT industry is three fold:

1. PCs and other user interfaces continue to increase in power they and their users will demand quicker and easier access to higher quantities of data.
2. The demand for high-tech devices increases economies of scale will make high tech devices of varying complexity more readily available worldwide increasing the market for IT services globally.
3. As high-tech devices increase in power and complexity users will demand and devices will support more complex software packages. All of these trends indicate a rising demand of IT products and services, especially in the emerging markets mentioned in previous sections.
4. INDICATORS OF IT CLUSTER FORMATION IN MINNESOTA

Location Quotient Analysis

A location quotient (LQ) is a measure that compares regional employment in any given industry divided by total regional employment over national employment in that industry divided by total national employment. A LQ of 2.0, for example, indicates that twice the number of workers are employed regionally in a specific industry compared to national employment for that industry. One of the downsides of LQ-based analysis is that the US Census Bureau and Bureau of Labor are not always able to report exact labor statistics for every sector in every region, in order to protect the security and competitiveness of individual companies in that region. By looking at the sectors with high location quotients in the Twin Cities, clusters can be found that can be supported and strengthened. While finding the clusters that have poor quotients in related sectors can be empowered or grown to aid the former.

From the beginning of the cluster study one of the concerns about the IT/Advanced Manufacturing cluster was the selection of a relevant and quantifiable line of research. This meant choosing industries and companies that were either strong in the region, or had the potential to become so. The following table identifies the location quotients for the sectors that we attributed to the IT cluster.
<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Label</th>
<th>2010 LQ for MSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>3341</td>
<td>Computer &amp; Peripheral Equipment</td>
<td>2.13</td>
</tr>
<tr>
<td>5182</td>
<td>Data Processing, Hosting, and Related Services</td>
<td>1.85</td>
</tr>
<tr>
<td>4541</td>
<td>Electronic Shopping and Mail-order Houses</td>
<td>1.62</td>
</tr>
<tr>
<td>5112</td>
<td>Software Publishers</td>
<td>1.48</td>
</tr>
<tr>
<td>5415</td>
<td>Computer Systems Design and Related Services</td>
<td>1.17</td>
</tr>
<tr>
<td>3346</td>
<td>Manufacturing &amp; Reproducing Magnetic &amp; Optical Media</td>
<td>1.07</td>
</tr>
<tr>
<td>3344</td>
<td>Semiconductor &amp; other Electronic Component Manufacturing</td>
<td>1.06</td>
</tr>
<tr>
<td>5172</td>
<td>Wireless Telecommunications Carriers (except fiber optic)</td>
<td>0.88</td>
</tr>
<tr>
<td>3342</td>
<td>Communication Equipment Manufacturing</td>
<td>0.87</td>
</tr>
<tr>
<td>5171</td>
<td>Wired Telecommunications Carriers</td>
<td>0.77</td>
</tr>
<tr>
<td>3343</td>
<td>Audio &amp; Video Equipment Manufacturing</td>
<td>0.60</td>
</tr>
<tr>
<td>5191</td>
<td>Other Information Services</td>
<td>0.51</td>
</tr>
</tbody>
</table>

*Data: Bureau of Labor Statistics*

The North American Industry Classification System (NAICS) is a system used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. economy. This report analyzed NAICS codes for companies that fall under the codes starting with “334” which includes a broad collection of computer and electronic product manufacturing.

**Trends**

The trend with these industry codes was either at or above average, which is a positive sign when looking for the presence of a cluster. Communications Equipment Manufacturing and Audio & Video
Equipment Manufacturing have below average location quotients. The latter is of less concern as it relates to companies that produce televisions and consumer electronics, which have been found to be largely outsourced to foreign nation with lower labor costs. The former is of more concern to our study, because Communication Equipment Manufacturing could be appealing to the data center and cloud computing industries which potentially could be attracted to the region.

The next common thread present in the NAICS codes selected was the appearance of several codes starting with 51. The codes beginning with these two digits are categorized as the ones related to information. Because data centers, cloud computing, and many other IT specific sectors are new and constantly changing it is difficult to group them accurately in the data provided by the Bureau of Labor Statistics. The small numbers here imply room for growth in these sectors, and demand growth if the regional advantages for data centers are to be captured.

Overall, the resulting NAICS codes that were chosen were below average in location quotients.

Moreover, the employment data was not available for Satellite Communications and Other Communications. The remaining NAICS codes do not have a common theme, but represent sectors that were considered related to the cluster. These additional codes include Computer System Design and Related Services, Wholesale Electronics and Electronic Shopping. These sectors were all deemed to either support the ability of the former industries to function, or purchase the outputs of their production.

The trends identified by investigating the location quotients of the sectors- that are designated to the cluster- show that there are strengths within the region in “soft” technology fields. This means
industries related to software and data, which are where focus in development could result in a significant growth due to regional advantages.

**Indicators of R & D Strength in the IT Cluster**

Four areas were considered as indicators of research and development (R&D) strength relative to IT for the Twin Cities region:

1) Recipients of federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (SBTT) funding - an indication of areas of applied R&D resulting in commercial technology development
2) Academic R&D funding to the University of Minnesota by major discipline
3) Minnesota’s nationally top ranking patent output areas
4) University of Minnesota academic publication statistics, identifying areas of comparative publication (and therefore research) strengths in fields relevant to IT sector R&D

**SBIR/SBTT Funding**

The Small Business Innovation Research (SBIR) program funds research and/or development conducted by small businesses whose ideas have the potential for commercialization and public benefit. Currently, eleven Federal agencies participate in the SBIR program (see Appendix B for a complete list of funding amounts and agencies). SBTT is another program that expands funding opportunities in the federal innovation R&D arena, specifically requiring formal collaboration in Phases 1 and 2 of funded research between the small business and a research institution. A concentration of firms who have passed the vigorous vetting and application process of both of these grants programs indicate areas of strength in applied R&D relative to IT.
University of Minnesota R&D Funding

The National Science Foundation measures and reports data, annually, on research expenditures in the areas of science and engineering. This measurement is regarded as the best basis for comparison of research volume among the nation’s research universities. In 2008, the University ranked 9th nationally among public universities (and 13th among both public and private universities) with $683 million in science and engineering R&D expenditures. The research funding allocation within the University of Minnesota also supports the findings and trends for the rising sectors presented in this report. The funding allocated to Computer Science and Engineering and Electrical and Computer Engineering have risen consistently between 2006-2010, with 2010 funding summing up to $6.6 million and $7.5 million, respectively. Between the two main engineering disciplines, the top R&D funding receivers in 2010 are:

- IT CSE Data Mining Databases & GIS - $1.7M
- IT ECE Fields and Photonics - $1.6M
- IT CSE Robotics & Artificial intelligence - $1.4M
- IT CSE Network Systems & Security - $1.3M
- IT ECE Computer Engineering - $1.2M
- IT ECE Control Engineering - $0.9M
- IT ECE Communications - $0.9M
- IT CSE Human Computer Interaction – $0.7M

The region’s companies have designated these research areas among those with largest employment gaps. The companies claimed that it is difficult to attract talent both to Minnesota due to climate reasons and then out of Minnesota due to higher than the national quality of life standards.

Minnesota’s Patent Output

The 2006-2010 patent output of the 13-country metro area shows an increase in patent publications in data and file structuring, storage, and processing as well as electrical communications. However, electrical components and optical systems patent outputs have declined. The IT industry related patents make up 48 percent of the patents published in the Minneapolis-St. Paul economic area, while 14 out 30
top patent publishing companies in the same economic area are players whose primary industry is IT or IT peripherals. The existing and strong industry defenders such as IBM, ADC, Honeywell, Seagate, and Imation dominate the patent outputs for semiconductor devices, memory, data processing, navigation equipment, and digital processing systems, as seen in the table below.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Hardware/Software</strong></td>
</tr>
<tr>
<td># 1 IBM</td>
</tr>
<tr>
<td># 4 Honeywell</td>
</tr>
<tr>
<td># 7 Emerson</td>
</tr>
<tr>
<td># 17 Samsung</td>
</tr>
</tbody>
</table>

Nationally, Minnesota ranks in the top ten for 9 out of 22 related industry patent publication output (see Appendix D for the full list). The rising patent output in the table on the next page indicates the rise in computer data storage, processing, and systems related industries. In order for Minnesota’s continued national competitiveness in IT cluster, Minnesota’s software and user interface related patent rankings must improve.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DP: Database and File Management or Data Structures (Data Processing)</td>
<td>6</td>
<td>341</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Multicomputer Data Transferring (Electrical Computers and Digital Processing Systems)</td>
<td>13</td>
<td>223</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Communications: Electrical</td>
<td>8</td>
<td>176</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Static Information Storage and Retrieval</td>
<td>7</td>
<td>144</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>DP: Financial, Business Practice, Management, or Cost/Price Determination (Data Processing)</td>
<td>15</td>
<td>132</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>DP: Generic Control Systems or Specific Applications (Data Processing)</td>
<td>7</td>
<td>96</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Virtual Machine Task or Process Management or Task Management/Control (Electrical Computers and Digital Processing Systems)</td>
<td>7</td>
<td>44</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Electricity: Conductors and Insulators</td>
<td>10</td>
<td>43</td>
<td>Increasing R&amp;D</td>
</tr>
<tr>
<td>Electrical Audio Signal Processing Systems and Devices</td>
<td>9</td>
<td>41</td>
<td>Increasing R&amp;D</td>
</tr>
<tr>
<td>Automatic Temperature and Humidity Regulation</td>
<td>1</td>
<td>25</td>
<td>Increasing R&amp;D</td>
</tr>
</tbody>
</table>

**Bibliometric Indicators**

Rankings based on the number of citations of scholarly works associated with individual universities has come to serve as an indicator of the relative quality of the research of an academic institution as a whole, or for individual areas of research. Known as “bibliometric indicators,” these indicators measure the frequency with which individual publications are cited in the works of others. (Mulcahy, 2009)

These bibliometric indicators are measures of the quality, impact, and significance of a research institution. The UMN ranks #7 in Computer Science and in the top ten in three other fields of study closely related to IT industry needs: #2 in Mathematics, #7 in Material Science and #9 in Engineering.
5. THE TWIN CITIES IT CLUSTER

IT Industry Growth Projections

National, state, and regional growth projections are important assessment tools for anticipating the growth potential of the IT industry, both in terms of occupational and industry trends in the coming decade. Growth or contraction of either field is of course a relative factor and so comparisons must be conducted across geographic scales in order to provide a clearer picture of how the regional IT industry is doing compared to state and national levels.

According to Minnesota’s Department of Employment and Economic Development (DEED), growth in Computer and Mathematical Occupations (SOC 150000) from 2008 to 2018 at the state and Twin Cities Seven-County Metro Area (TCSCMA) will be lower than at the national level, but will still be strong. (This is represented in the table below).

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>22.1 %</td>
</tr>
<tr>
<td>Minnesota</td>
<td>13.5 %</td>
</tr>
<tr>
<td>7- County Twin Cities Area</td>
<td>13.7 %</td>
</tr>
</tbody>
</table>

Data: MN DEED

However, Computer and Mathematical Occupations (SOC 150000) is a generic sector classification and does not tell the full picture of what is happening specifically within the IT industry. Within key IT occupations, the percent change between estimated 2008-2009 employment levels and projected 2018-2019 employment figures within select IT industry sectors at the national, state, and seven-county level is shown below.
Looking at industry projections for the NAICS codes discussed in the previous section, MN-DEED projects national core industry sectors to grow by an average of 23.66 percent compared to just 0.43 percent in the state and 6.26 percent in the seven-county metro area. Within the related and support industry sectors, national projections show a 15.91 percent increase in employment. State and regional figures are fairly comparable with 10.95 percent and 9.59 percent growth projections respectively. In terms of factor industry sectors, there is an across the board decline with national projections showing a -8.74 percent decline, state projections at a -9.02 percent decline, and regional numbers dropping by approximately -15.07 percent. Within the IT industry, the percent change between estimated 2008-2009 industry employment levels and projected 2018-2019 employment figures within select IT industry sectors at the national, state, and seven-country metro level is shown below.
Wage Composition

An initial look into the IT cluster wage composition using the tools provided by Porter does not show a clear advantage or disadvantage in the Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Area. However, sub-cluster data available on the Porter web site can provide more information than data on the cluster as a whole. The figure below shows that the following sub-clusters all have higher annual wage rates in the Minneapolis-St. Paul metro area than the national averages:

- IT: Computers,
- IT: Electronics & Assemblies,
- IT: Peripherals, and
- Analytical instruments: Process Instruments
An additional consideration when looking at all this figure is that all but the education and knowledge creation: the Educational Institutions sub-cluster is above the national average wage in 2009 of $40,711. The range of average to high paying jobs in the sub-clusters can be attractive to potential job seekers. A recent DEED survey has concluded that these jobs are hard to fill and that many employers would hire more employees if they were available. The conclusion drawn from this wage data is that more workers must be trained or attracted for high paying jobs that already exist and are going unfilled.
6. THE DIAMOND OF ADVANTAGE

Factor Conditions

Talent Development

A recurring theme from more than a dozen interviews with IT companies was the overwhelming concern with the development of highly skilled, innovative, and adaptable IT talent. The swift and frequent change inherent in IT technologies (both soft and hard) and high levels of competition require IT companies to constantly adapt their strategies to differentiate their products and provide a ‘best fit’ option for their clients. The swift nature of the IT industry necessitates the hiring of employees who have immediate capabilities and an inherent understanding of not only IT principles, but problem solving skills, general business knowledge, and the ability to create innovative (new) solutions/products.

A range of companies, universities, and professional organizations are making efforts to bolster the labor pool in order to strengthen the Twin Cites as an IT center. Advance IT Minnesota is an important leader in IT talent development, created in 2006 as a Minnesota Center of Excellence. Existing or planned IT talent development programs include:

- **IT Career Discovery Network’s MN iSTEM version 2.0**: This program is designed to promote matching of students with current internship opportunities and provide resources to encourage companies to offer internship opportunities in STEM fields.
- **MNC3**: Minnesota Cyber Security Career Consortium includes Symantex, Thompson Reuters, Larson Allen, Wells Fargo and is working to increase the availability of talented IT professionals in local talent pools.
- **Collegiate Cyber Defense Competition**: A collegiate level information security competition that challenges students to take on real world cyber security challenges to develop skills and share ideas.
- **Secure 360 Conference**: Seeks to enhance the knowledge, skills and professional network of the security community by offering forums on important security topics and industry concerns.
- **Lumens Campus Adoption Program**: A distance learning and professional development resource offering custom IT education and training opportunities for IT professionals looking to sharpen existing skills or retain. Offered currently in 21 institutions.
Innovative New Business Strategies
Maverick Software Consulting

Maverick Software Consulting is one local company that is leading the charge to create a more effective and fluid IT talent pipeline for large organizations while simultaneously becoming a successful IT business in its own right. Maverick works with local IT companies to identify their specific talent needs and then pairs them with college sophomores and juniors in IT fields, creating long term (two years or more) internships at their secure, on-campus facilities. These internships provide a range of mutual benefits to both companies and students, including:

- Good wages and full time employment during the summer
- Secure on-campus locations
- Onsite IT managers
- Long-term internships
- Long-term relationships between companies and students maintains a “talent pipeline”
- Costs similar to off-shoring programs allow companies to hedge risk associated with off-shoring IT operations.

Starting with just ten students on the Minnesota State University Campus, Maverick now employs 110 students on nine higher education campuses, several of which are located in the Twin Cities: The University of Minnesota, University of St. Thomas, Metropolitan State University, Bethel University, and Macalester College.

These IT centers serve several large Twin Cities corporations and have resulted in the transition from internship to full time employment for 150 students since its creation in 2006, a 100 percent placement rate. Companies like Maverick streamline the process of IT talent acquisition, reduce lag time, and improve immediate productivity by exposing IT students to IT industry demand early on, making them more effective employees immediately after graduation.

- **MnSCU Lumens User Round-Table:** A month forum where industry professionals and IT students can ask questions, share information, and learn.
- **MN IT Workforce Commons/Collaborative:** A voluntary network of people from business, professional associations, education, non-profit and governmental agencies, work together to increase the capabilities and number of IT professionals working in Minnesota.
- **Computer Geek U:** An IT and technology after school academy working to increase student interest in IT and technology fields as career choices.
- **MN IT Careers Discovery Network:** A direction setting program linking IT students with the appropriate IT career paths, specifically those in high demand.

These programs are working at different levels from K-12 to professional development as a comprehensive approach to create, maintain, and expand a layered pool of localized IT talent now and into the future through education, competition, employment experience, and collaboration. Other conferences and professional engagements put on by Advance IT MN and the Minnesota High Tech Association (MHTA) offer opportunities for professional and collegiate networking, collaboration, and joint workforce development opportunities.

**Education: IT Related Programs and Degrees in Minnesota**

Innovation and rapid change are hallmarks of the technology industries, especially the IT industry in the Twin Cities. With the frantic pace of product evolution, highly educated college graduates are at the top of the list of IT industry needs, a topic that emerged frequently during interviews with industry
companies. Educational experience in mathematics, software production, computer programming, information management and security, computer sciences and engineering, robotics, nanotechnology, and electrical engineering all play a role in the IT industry.

The colleges and universities of the Twin Cities offer a wide range of IT-related education programs, displayed in the following table:

**IT Related Programs in Minnesota Colleges**

<table>
<thead>
<tr>
<th>Computer Science</th>
<th>Computer Science</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Computer Information</td>
</tr>
<tr>
<td></td>
<td>Computer Programming, Specific Applications, Support</td>
</tr>
<tr>
<td></td>
<td>Computer Systems Analysis</td>
</tr>
<tr>
<td>IT/Networking</td>
<td>Information Science and Technology</td>
</tr>
<tr>
<td></td>
<td>Management Information Systems</td>
</tr>
<tr>
<td></td>
<td>Computer Systems Networking &amp; Telecommunications</td>
</tr>
<tr>
<td></td>
<td>Network &amp; System Administration</td>
</tr>
<tr>
<td>Engineering</td>
<td>Computer Software Engineering</td>
</tr>
<tr>
<td></td>
<td>Computer Engineering</td>
</tr>
<tr>
<td></td>
<td>Electrical, Electronics, &amp; Communications Engineering</td>
</tr>
<tr>
<td></td>
<td>Manufacturing Engineering</td>
</tr>
<tr>
<td></td>
<td>Materials Engineering</td>
</tr>
<tr>
<td></td>
<td>Nanotechnology</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td></td>
<td>Mathematics and Statistics</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
</tr>
<tr>
<td></td>
<td>Mathematics and Computer Science</td>
</tr>
<tr>
<td>Technical</td>
<td>Robotics Technology/Technician</td>
</tr>
<tr>
<td></td>
<td>Science Technology Technicians</td>
</tr>
</tbody>
</table>

These programs represent a cross-section of the different fields of expertise required by the IT industry and are emblematic of the inherent complexity of the industry and its products and services. Using the above fields of study, we investigated the availability of educated college graduates in the Twin Cities in the year 2010. Of the over one hundred and fifty educational institutions within forty miles of the Twin
Cities, the following institutions were evaluated on the number of 2010 graduates they produced for the fields of study listed above.

<table>
<thead>
<tr>
<th>Four-Year Public Universities</th>
<th>Four-Year Private Universities</th>
<th>Two or Four-Year Community &amp; Technical Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Minnesota Twin Cities</td>
<td>Augsburg College</td>
<td>Anoka Technical College</td>
</tr>
<tr>
<td></td>
<td>Brown College</td>
<td>Century Community and Technical College</td>
</tr>
<tr>
<td></td>
<td>Carleton College</td>
<td>Dakota County Technical College</td>
</tr>
<tr>
<td></td>
<td>DeVry University</td>
<td>Hennepin Technical College</td>
</tr>
<tr>
<td></td>
<td>Dunwoody College of Technology</td>
<td>Inver Hills Community College</td>
</tr>
<tr>
<td></td>
<td>ITT Technical College</td>
<td>Minneapolis Community and Technical College</td>
</tr>
<tr>
<td></td>
<td>University of St Thomas</td>
<td>North Hennepin Technical College</td>
</tr>
<tr>
<td></td>
<td>Walden University</td>
<td>St Paul College</td>
</tr>
</tbody>
</table>

From these eighteen institutions, more than 1,850 students graduated with degrees or certificates in IT related fields in 2010. The breakdown of educational attainment levels in these fields is as follows: Top degree fields in terms of the number of graduates were:

- Electrical/Electronics/Communications Engineering (361),
- Computer Science (304), Computer Systems Networks and Telecommunications (237), Management Information Systems (189), and Mathematics/Statistics/Computer Science (159), and Information Science and Technology (142). All together, these graduates represent approximately 5.5 percent of the total graduates of these eighteen institutions for 2010.

<table>
<thead>
<tr>
<th>IT Degrees in Minnesota</th>
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</thead>
<tbody>
<tr>
<td>Type of Credential</td>
</tr>
<tr>
<td>Certificates</td>
</tr>
<tr>
<td>Associates degrees</td>
</tr>
<tr>
<td>Bachelor’s degrees</td>
</tr>
<tr>
<td>Master’s degrees</td>
</tr>
<tr>
<td>Doctorate degrees</td>
</tr>
</tbody>
</table>
Of the eighteen institutions studied, the University of Minnesota claims significant percentages of the graduates in these fields as a whole and within each degree type. Of total degrees, the U of M claims approximately 41.7 percent of the total, 72.6 percent of Bachelor’s degrees, 59.6 percent of Master’s degrees, and 81.4 percent of Doctorates. Due to the significant presence of degrees awarded by the University of Minnesota-Twin Cities, it can be viewed as a barometer of IT education trends in the Twin Cities. A more comprehensive study of graduation trends in these programs over a longer period of time would be a useful metric for gauging the level of interest in these fields for the Twin Cities. Additionally, a historical review for the emergence of new university IT degree fields would represent another mechanism for gauging the growth and evolution of IT education in the Twin Cities.

Within the U of M, research funding represents a key factor input, which will boost the U of M’s capacity to educate young IT professionals. With research and development also playing a pivotal role in the IT industry cluster, research institutions like the U of M will play a pivotal role in providing the ideas and innovation needed for future industry growth. One sign of growing potential for innovation in the Twin Cities is the U of M’s rank of 25th in total endowment funds out of the top 120 post secondary education institutions in America. In 2009, the U of M’s total endowment totaled some $2,070,002,200 dollars (NCES, 2010). Perhaps more striking is that the U of M is one of only three major universities not to see a drop in their endowment from 2008 to 2009, behind only the University of Iowa in total growth, with 84.8 percent to 129 percent growth respectively (NCES, 2010). This growth has also occurred during a time when national endowments to all U.S. Institution have shrunk by 21.1 percent from 2008 to 2009 (NCES, 2010). The U of M’s rank of ninth in total enrollment out of the top 120 post secondary education institutions (including online colleges) will continue in unison with the range of community,
technical, and private institution to provide an educated workforce for the Twin Cities' IT cluster (NCES, 2010).

**Access to Capital for Growth of the IT Industries: Venture Capital**

Venture capital (VC) investment is an important measure of economic growth and potential, as it is a proxy for innovation within an economic sector or geographic region and is associated with job creation. IHS Global Insight estimates that VC-backed companies generated revenue equal to 21 percent of US GDP and employed 11 percent of the U.S. workforce in 2010. (National Venture Capital Association, IHS Global Insight, 2011) Nationally, VC investment peaked in 2000 with the bursting of the tech bubble, hit a six-year low in 2003, and then largely stabilized and has grown since, albeit with a dip again in 2009. (PwC, 2011) Total VC investment in 2010 was up to $23.4 billion, and through three quarters of 2011 is at $21.2 billion. (PwC, 2011)

Minnesota ranked 14th nationally in average total VC investment from 2005 through 2010, but ranked 5th nationally in VC investment per capita. (SSTI.org, 2011) More specifically, from 2003 to 2007 Minnesota ranked 5th in the growth of per capita investment in seed and early stage companies – a key indicator of access to early-stage capital for entrepreneurs. (PwC, 2008) Minnesota is also home to a significant number of VC firms: There are over 25 VC firms in the Twin Cities metropolitan region, with the top ten VC firms in the region managing $16.1 billion in capital and $13.2 billion in investments. Despite these bright spots, 2010 saw a big (48%) drop in VC investment in Minnesota to $140 million, the lowest total in 15 years. (Meland, 2011)

Nationally, Software and IT services have been strong growth industries, bringing in over one-quarter of all VC investment during 2011. Software earned 28.9 percent of total national VC investment in Q3 of
2011, while IT services brought in 7.9 percent. (PwC, 2011) In the Midwest, software’s share of VC investment was even higher, with 40.9 percent in Q3 of 2011, while IT services claimed 4.5 percent. (PwC, 2011) A number of the Twin Cities-based VC firms are focused on investing in IT or software related start-ups: 47 percent of the deals made by the top five Twin Cities-based VC firms are in IT or software companies. (Minneapolis/St Paul Business Journal, 2011) Although many of these firms are investing heavily in IT and software start-ups, many of the companies that they are investing in are based elsewhere, predominately in California.

**IT Infrastructure**
Fiber Network in Minnesota

Source: Enventis, Hickory Tech.

Source: Positively Minnesota, “Economic Overview and Industry Strengths of Minneapolis-St. Paul”
Demand Conditions

In general, demanding local customers drive cluster participants to compete, typically improving product or service quality and leading to increases in productivity. However, most of the direct demand for the products and services produced by the local computer-IT cluster is not local in nature, but national or international. For example, 72 percent of Seagate’s sales of hard-disc drives are made outside of North America. Greater than 60 percent are purchased by computer manufacturers, none of whom assemble computers in the Twin Cities Metro area. Indeed, almost all of the manufacturing of IT products
design locally – such as hard drives made by Seagate, Micron, or Imation – is done in Asia, not in the U.S. Factor conditions seem to play a much stronger role in the presence of the computer-IT cluster in the Twin Cities.

**Related and Supporting Industries**

The following are some of the primary industries that are complementary to the IT industry. These categories represent the fastest-growing consumer-based computer technologies.

- Input devices, such as keyboards, mice, and trackballs
- Display technologies, such as LCD and CRT monitors
- Storage hardware, such as hard drives, CD and DVD burners
- Home networking hardware, such as routers, modems, and Wi-Fi equipment
- Computer memory, which includes internal memory sticks only (RAM).
- Display technologies, home networking equipment, and storage media lead the way in terms of unit sales

Minnesota-manufactured exports data show some very positive performance, indicating that export were up ten percent to $4.7 billion in the second quarter of 2011, while U.S. manufactured exports increased 15 percent. Exports of electrical machinery products increased 27 percent (up $142 million) between the first quarters of 2010 and 2011, and 22 percent (to $698 million) between the second quarters of 2010 and 2011. Among the growing product segments were integrated circuits (driven by a $26 million gain in exports to the dominant market, the Philippines) and telecommunications equipment (where growth was widespread and included Italy, Japan and Germany).

Some of the other IT related and supporting industries are financial institutions, secure building constructors, and innovators in IT peripheral component manufacturing. The banking industry is a key consumer of IT services, both in-house and for subcontracted IT companies as well. Secure buildings play a role in a specific sector of the IT cluster, providing a defense against hackers and viruses from outside the building – a basic necessity to information security companies. Companies such as Entegris,
FSI International, and Rimage are innovators in IT hardware and peripherals and the technology used to make them. The presence of these related and supporting firms is a benefit to the IT cluster, as they can work with the companies that are making future tools for them to use and have input on the future end-consumer goods being planned.

While much manufacturing happens internationally, IT companies have headquarters and research facilities in the Minneapolis-St. Paul region. This can result in partnerships with research and production related companies, which can lead to more IT jobs in the region as well as growing companies that use hybrid manufacturing models. The hybrid manufacturing model is one in which high tech manufacturing and research happens in the U.S., while lower tech manufacturing or assembly happens in a production facility located elsewhere, often in Asia.

**Industry Structure and Competitive Rivalry**

As with any industry that relies heavily on high tech systems and inputs, the IT and peripheral clusters require a high level of innovation in order to maintain a competitive edge in the market. As new ideas are introduced into the marketplace, the players will rely heavily on their personnel to position the firm as the leader of the pack within their industry as they push their idea or product to market. This emphasis on the employee demands a system to recruit the top players from the local to the international employee pool. In a strong R&D world, a simple idea may require a very small minority of people that have the specialization and skills required to fulfill the position. If a firm is developing a tangible product (i.e. new solid state hard drives,) they may require that local and regional suppliers have the ability to rapidly adapt to design changes and shortened lead times in order to position themselves as first to market with a new product.
As a result of the go-to-market life cycle of products, intellectual property (IP) is a top concern for the IT industry. When developing new software or hardware, firms need to protect IP from being captured by other firms and flooding the market with low cost alternatives. By protecting IP, firms can charge a higher price for their goods in order make a return on R&D investment.

**Government Policies**

The Department of Employment and Economic Development (DEED) and the Office of Science and Technology (OST) were consulted to provide the state’s perspective on this industry. Neither DEED nor OST have specific goals or policies that target IT. There have been various actions, loans and grants that have been used to attract or retain companies from the cluster, but these were enacted to keep high paying jobs. High paying jobs are a goal for both offices, but the industry type and regional interaction of industry participants is not a high priority for either organization.

One of the opportunities identified by government actors in the cluster is the need for a cultural change in the region to provide more support for the businesses that make up the IT and Cluster. The state dedicates a relatively low amount of funding to developing business in the region. As an example, DEED has a revolving loan fund with a budget of $30 million, while some states have been known to spend this much on attracting individual businesses. Although financial incentives would allow for competition with other regions in attracting companies, currently city and county governments cannot afford such incentives for cluster growth. Most counties and cities will need to work to attract growing companies that value regional strengths rather than financial incentives.
7. SWOT ANALYSIS FOR THE TWIN CITIES IT CLUSTER

Strengths

- Minneapolis-St. Paul ranks 12th among 363 metropolitan areas nationwide in economic strength
- Greater MSP as a regional entity promoting unified IT industry development
- Fiber-Optic Networks/Infrastructure: According to Forbes, Minneapolis is the 11th “most wired city” in the country
- Minneapolis-St. Paul ranks fifth nationally for transportation infrastructure.
- Low Cost of Living
- High quality of life: Minnesota ranks fifth nationwide in the 2008 Camelot Index, based on the economy, health, education, crime, society and government. Minnesota is the fourth most livable state in the country, based on 44 indicators such as crime rate, unemployment and income.
- Concentration of Corporate Headquarters
- Research University: Minneapolis-St. Paul ranks 11th among 379 U.S. metropolitan areas for education.
- Minnesota has the third highest labor force participation rate in the nation at 72.9%.
- Minneapolis-St. Paul ranks sixth among large areas (more than 1 million people) for young professionals (29-44).
- Diverse Post-Secondary Education System
- Centralized Location to East and West Coasts
- Secure and Isolated Geographic Location for disaster recovery related purposes
- Limited exposure to natural disasters
- Long History of IT and Technology companies

Weaknesses

- High level of competition for talented employees - not enough STEM graduates
- Lack of well-rounded IT skill sets among employees
- Lack of University Business Incubator
- Lack of governmental awareness of potential for IT industry growth/expansion
- Poorly organized economic development efforts
- Limited access, exposure to, and connections with venture capital(ists)

Opportunities

- Increased connections between industry members and universities
- Increased connections among industry members
- Increased connections between industry members and professional organizations
- U of M Research Park and Business Incubator
- Making connections between IT Cluster and Financial, Insurance, Credit, and Corporate Headquarters
- The state has 3.0 science and engineering graduates per 1,000 population compared to 2.6 for the country however MN does not generate sufficient STEM concentration.
Threats

- More aggressive recruitment from other locations
- Competition with other locations for IT talent
- Poor Corporate Tax Environment
8. FUTURE RECOMMENDATIONS FOR A COMPETITIVE REGIONAL IT CLUSTER

Foreign Company Attraction Opportunities

A next step that the region can take in order to grow the regional IT Cluster advantage is to attract foreign companies related to IT. Greater MSP could take action to create “brand” the region that would attract foreign manufacturers and IT companies who are looking to expand into the U.S., but have not yet decided on a location. Many foreign industry members are concerned with quality of life and regional strengths when considering expansion locations, compared to companies from within the country that are most often motivated by monetary incentives. This regional branding strategy has many benefits including attracting new business rather than pulling from somewhere else and being low cost alternative to incentives. A regional branding campaign can also improve the attitude of the local population in regards to big business attraction.

Create a University Research Park at the University of Minnesota

A University Research Park (URP) is an office park adjacent and affiliated with a research University that offers space and support services (such as mentoring and financing) to start-ups trying to turn University generated discoveries and innovations into successful businesses. There are approximately 180 URPs in the U.S. and Canada, employing more than 300,000 people (Battelle, 2007). URPs have a good track record incubating and retaining start-up firms in their communities. For example, fifty-nine URPs reported graduating 759 firms from a park incubator from 2002 to 2007, and of these:

- 62.5 percent remained in the region,
- 15.1 percent were acquired or merged,
- 12.8 percent went out of business, and only
- 9.6 percent left the region (Battelle, 2007).
The most successful URPs have also been very effective drivers of economic development in their regions and states. As an illustration of this point, two independent economic analyses were done on the URPs at the University of Wisconsin and Purdue University. These URPs have had the following economic impact in their respective regions:

<table>
<thead>
<tr>
<th></th>
<th>University of Wisconsin-Madison</th>
<th>Purdue University Research Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of firms</td>
<td>126</td>
<td>216</td>
</tr>
<tr>
<td>Direct employment</td>
<td>3,419</td>
<td>3,856</td>
</tr>
<tr>
<td>Annual Payroll (All Park firms)</td>
<td>$220 million</td>
<td>$238 million</td>
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<tr>
<td>Average salary of Park employees</td>
<td>$64,310</td>
<td>$63,460</td>
</tr>
<tr>
<td>Average salary statewide</td>
<td>$39,000</td>
<td>$38,330</td>
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<tr>
<td>Total employment statewide (direct and indirect)</td>
<td>9,300</td>
<td>9,600</td>
</tr>
<tr>
<td>Total economic impact statewide (direct and indirect)</td>
<td>$825 million</td>
<td>$1,300 million</td>
</tr>
</tbody>
</table>

Source: [http://www.universityresearchpark.org/newsroom/](http://www.universityresearchpark.org/newsroom/)

In addition to Purdue University and the University of Wisconsin, all of the major land grant universities in the upper Midwest have developed URPs, including the University of Illinois, the University of Iowa, Iowa State University, Michigan State University, the University of Michigan, Ohio State University, and Penn State University,

**A Model URP - The University of Wisconsin-Madison URP**

Not all URPs have been created equal, and qualitative differences in the design, structure, and management of any individual URP will determine its impact on a regional economy. The most successful URPs are not just office parks where University researchers try to turn their ideas into
successful companies, but spaces that provide the essential, integrated support services that make the difference between success and failure for early-stage companies. Those essential services include the following: entrepreneurial mentorship programs, access to early-stage capital, legal and financial advise, IT support services, and networking opportunities. The URP at the University of Wisconsin-Madison has earned recognition as a model institution, making the list of “12 Business Incubators Changing the World” by Forbes Magazine (Nelson, 2011). This is a model that the University of Minnesota-Twin Cities should emulate.

The URP at Madison houses two start-up incubators: the MGE Innovation Center and the Metro Innovation Center. The MGE Innovation Center contains office and laboratory space for roughly 70 early-stage companies in an 113,000 square foot facility. Other buildings house later-stage start-ups or mature companies, as well as companies offering supporting services strategically recruited by the management of the URP to create an atmosphere ideal for growth. The supporting companies include capital investment (two venture capital funds and three angel investment groups), legal services (two firms specializing in providing legal counsel to start-ups), financial services (firms offering retirement, asset management, and insurance for small companies), health care and dental services, and even on-site childcare (University Research Park, University of Wisconsin-Madison, 2011).

URP management also started and funds an entrepreneur mentorship program, The Madison Entrepreneur Resource, Learning and Innovation Network, known as MERLIN Mentors. MERLIN Mentors is comprised of experienced business leaders who volunteer their time, knowledge and experience to help convert entrepreneurs' ideas into developing companies (University Research Park, University of Wisconsin-Madison, 2011). MERLIN fosters growth in the number and quality of Madison
area start-up enterprises by matching new entrepreneurs with experienced business people.

In addition, the URP is complemented by the Wisconsin Alumni Research Foundation (WARF). WARF commercializes research produced by University of Wisconsin researchers, invests the proceeds of such commercialization efforts, and use the added value from their investments to fund further scientific investigation at the University of Wisconsin. WARF has:

- Obtained 2,300 U.S. patents on inventions created by UW-Madison faculty and staff
- Given $1.24 billion to UW-Madison to fund research, programs and initiatives
- Support more than 57,070 research projects, including 1,500 in 2010-2011
- Sponsor scores of named professorships, including 52 in 2010-2011
- Fund thousands of graduate fellowships, including 145 in 2010-2011 (WARF, 2011)

**Minnesota Science Park**

The Minnesota Science Park Corporation, a nonprofit 501©(3), has proposed a URP for the U of M on a 32 acre parcel adjacent to the Biomedical Discover District. The project is planned in two phases. Phase I would create the Minnesota Accelerator, a 60,000 square foot incubator. Its location immediately adjacent to the Biomedical Discovery District would be an attraction for biotech companies within the first phase of the project. For example, The Center for Magnetic Resonance Research (CMRR) is a globally unique asset within the Biomedical Discovery District that has already garnered the interest of several prospective tenants of the planned Accelerator. According to Peter Bianco, one of the leaders of the Minnesota Science Park Corporation, two household “global brands in the digital imaging industry” approached his organization about locating within the proposed Park, specifically to be located adjacent to the CMRR (Bianco, 2011). One of these companies planned build their own facility and bring 300 jobs to the Park immediately (Bianco, 2011).
Thus, tenants at the proposed MN Science Park would likely initially be biotechnology-based start-ups, but many of these businesses are involve data intensive research and development, and are therefore highly dependent on IT. In fact, two major computer/IT sectors, software (with a 13.5 percent share) and computer hardware (with an 11.0 percent share) make up nearly 25 percent of all URP jobs, representing the two largest sectors of employment in all URPs nationwide (Battelle Technology Partnership Practice, 2007).

**Technology Shift**

In the Twin Cities metro area there are several industry wide shifts occurring in the IT sector. First there is a shift from disc to solid state data drives. This shift is accompanied by several benefits. First solid state memory is significantly more stable, predominantly from a lack of moving parts. Second this type of data storage allows for data access at significantly higher speeds, meaning more data can be used and transmitted more swiftly. A trade-off for this speed and stability higher levels of excess heat, as compared to traditional disc drives. These characteristics have several implications for the Metro.

First, this change in technology has been acknowledged by several of the IT industry companies that have been interviewed to date. These companies are discussing the potential new market opportunities that this emerging technology can facilitate and potential in-roads that can be made into new market segments. This new technology can help facilitate “cloud computing” by allowing for faster and more efficient data access from peripheral locations throughout the network (in this case, anyone with web access across the globe). With leading solid-state memory companies like Micron, Imation and IBM, located in the Twin Cities metro, there is a significant opportunity to cooperate with other data and network management companies like Unisys, Cisco Systems, and Cray Research to create innovative new data center products and processes tailored to the range of data intensive industries located in the
region. With large regional clusters of insurance, banking, and corporate headquarters in the Metro area, there is significant potential in the region to create one to one relationships with these entities where data center needs for major industries can be developed and modified on the fly, creating an innovation and feedback mechanism benefiting both sides. Exploiting these potential relationships and emergence of this new technology will be key to the successful maintenance and cultivation of this industry.

**Environmental Conditions**

The stability of the metro area, in terms of natural disasters, national security, and weather patterns makes the area an ideal testing and operations area for data center operations. Adding to the environmental and geographic benefits inherent in the area is the extensive network of communications infrastructure, particularly fiber optic networks that are already in place in the metro area. The Twin Cities metro area also has several well-established telecommunication service providers fostering competitive pricing in the telecommunication services market. This competitive pricing combined with a fiber optic network that is operating significantly under capacity represents a substantial resource for the location of new data centers and related IT industry entities.

**International Intellectual Property Law Growth**

Intellectual property rights are a concern of high tech designers and manufacturers who invest huge amounts into creating new innovations, but risk losing a lot of money if foreign competitors are able to copy their techniques. This has created situations in which foreign competitors do not need to pay for research, a first advantage, and then gain a second advantage in being close to the manufacturers located in foreign countries. This creates an incentive for research and design groups to locate in foreign countries near manufacturers to mitigate at least the second advantage. The opportunity here for
Greater MSP is to offer support, either monetary or in name, to groups that are already fighting to strengthen international laws to allow companies to protect their designs and be competitive in foreign markets no matter where their design happens. This would allow research groups to locate in the region with less risk.

**State Match of Venture Capital Funds**

IT is both vertically and horizontally complementary to the advanced computer and peripherals manufacturing industry. The enterprise customers increasingly prefer a one-stop-shop solution which incorporates software and hardware. The growth of the IT industry is heavily dependent on venture capital investment availability. IT investments in general have short success/fail cycles, low capital, and small team requirements. A successful example of a state-wide initiative where the state significantly impacts capital availability is in Wisconsin. The state has allocated a very small amount of their pension fund to match local venture capital (VC) funds investing in Wisconsin based businesses. The approximately $40 million amount was in the order of 0.0001% percent of their total pension funds, a very insignificant portion but a very important investment vehicle for Wisconsin start-ups. This matching of funds effectively and rapidly doubled the flow of VC capital. Venture Capitalists also liked the lower risk aspect of this arrangement.
Match Making

In order to grow the interlinks between the industry companies, the state could put together networking events. The leadership and/or backing of a really high profile industry professional such as Brian Dunn (the CEO of Best Buy) or Robert Stephens (founder of Geek Squad) may enhance the momentum of the grassroots movement. Another example is the networking and collaborative engagements that Matt Geiser, the founder of MHTA, organizes for start-ups working out of CoCo Minneapolis. If high profile experts were to take the lead in any technology related movement, Minnesota would be likelier to attract foreign investment. Another example of a regional initiative can be found in Austin, Texas - the location of the biggest national gaming conference or in Omaha, Nebraska, where national technology conference was organized at the regional level. As a result of this regional scale cooperation, both cities are able to attract Silicon Valley investors to their region. Many of these events only take a few high profile keynote speakers to be successful and make an impact. Along with national conferences, states get the opportunity to showcase the entire ecosystem of its high tech industry, which could be a one-stop-shop enterprise solution for the major OEM enterprise customers (networking, storage, data centers, services etc.)

Other potential focal areas for IT industry growth

- More institutions like MN Angel Network to attract more capital.
- Direct cloud computing related initiatives.
- Attract the young talent leaving Facebook, Microsoft, Google etc. transitioning into their next stage in life.
- Angel investor tax credits
- Single factor sales apportionment
- No property tax on personal property or inventory
- Sales tax exemptions
- Workforce training grants
APPENDIX A: IT Cluster NAICS Codes And Descriptions

3341 Computer & Peripheral Equipment:
This industry sector includes establishments engaged in manufacturing and/or assembling of computer mainframes, personal computers, workstations, laptops, computer servers, computer terminals (connected to a mainframe), computer storage devices that allow the storage and retrieval of data from a phase change, magnetic, or optical media, and other peripheral devices. Computers and peripherals are a key segment in the IT industry, providing users with a physical interface useful for accessing, manipulating, utilizing, organizing, and archiving data through, thereby making data useful for business and other applications.

3342 Communication Equipment Manufacturing
This industry sector comprises establishments primarily engaged in manufacturing wire telephone and data communications equipment, radio and television broadcast and wireless communications equipment, GPS equipment, antennas, threat detection systems and monitoring devices, remote control units, and signals. This segment of the IT industry is the physical apparati that provides the infrastructure, both wired and wireless, over which data is transported.

3344 Semiconductor & other Electronic Component Manufacturing
This industry sector manufactures bare printed circuit boards, semiconductors and related solid state devices, electrical capacitors, electronic resistors, electronic connectors (such as coaxial, cylindrical, rack and panel, pin and sleeve, printed circuit and fiber optic), and the assembly of these component onto printed circuit boards. It segment of the IT industry supplies a large majority of the internal components of for the user interface and data management devices used in the industry.

5112 Software Publishers
This industry sector comprises establishments primarily engaged in computer software publishing or publishing and reproduction. Establishments in this industry carry out operations necessary for producing and distributing computer software, such as designing, providing documentation, assisting in installation, and providing support services to software purchasers. The importance of this segment is continually increasing as the industry becomes more complex and takes on more operations and tasks. A good example of this new phenomenon is the medical industry’s transition from analog to digital records, a process which requires the development of new software to more fully utilize the patient
data to improve treatment, processing, insurance claims, and safety. This industry is closely tied to the Manufacturing and Reproducing Magnetic and Optical Media sector, and opportunities for vertical integration are common.

3346 Manufacturing & Reproducing Magnetic & Optical Media
This industry sector is engaged in the manufacturing of magnetic and optical recording media, such as blank magnetic tape, blank diskettes, blank optical discs, hard drive media, and blank magnetic tape cassettes and the mass reproducing of computer software, audio, and video materials on these recording media for distribution. This segment supplies key data storage media and works in concert with the Semiconductor and other Electronic Component Manufacturing segment to provide the internal components for most of the physical user interfaces (computers and work stations).

5182 Data Processing, Hosting, and Related Services
This industry sector provides infrastructure for hosting or data processing services. These establishments provide specialized hosting activities, such as web hosting, streaming services, application hosting, application service provisioning, or general time-share mainframe facilities to clients. Data processing establishments provide complete processing and specialized reports from data supplied by clients or provide automated data processing and data entry services. The primary importance of the segment is in cloud computing services. These services are particularly importance to small organizations looking to expand operations with limited capital investment and for larger organization that are looking to rapidly expand operational in order to capture market segments that are time sensitive. In these instances outside organizations can quickly and relatively cheaply capitalize on “for rent” computing and data processing and hosting infrastructure, dramatically reducing lag times and technology costs.

5415 Computer Systems Design and Related Services
This industry sector is a complement to both the Software Publishing and Manufacturing & Reproducing Magnetic & Optical Media sectors. This sector engages in writing, modifying, testing, and supporting software to meet the needs of a particular customer, planning and designing computer systems that integrate computer hardware, software, and communication technologies, on-site management and operation of client computer systems and/or data processing facilities, computer disaster recovery services, software installation, and other services. This sector is perhaps the most essential sector of the
greater industry, functioning to integrate and manage the other sectors provisions into an effective and usable data utilization machine. Because this segment of the industry works intimately with the products of the other core industries it acts as a key point of feedback for other industry sub-sectors entities. If this sector is healthy, the potential for IT industry innovation and technical advances is much higher as members of this sector translate end users needs and technical concerns into usable feedback for other core IT sectors.

**Related or Supporting Industries:**

**3343 Audio & Video Equipment Manufacturing**

This industry sector comprises establishments primarily engaged in manufacturing electronic audio and video equipment for home entertainment, motor vehicles, and public address and musical instrument amplification. This industry sector shares common input and output factors and operational needs with many of the core IT industry sectors, including assemble technologies and equipment, electrical components, skilled employees, marketing, advertising, distribution, utility needs, regulatory concerns. There are opportunities to share costs, create innovation partnerships, increase talent pools, integrate technologies, and improve institutional relationships.

**3345 Navigational, Measuring, Medical, & Control Instruments Manufacturing**

This industry sector is engaged in manufacturing instrumentation for measuring, metering, displaying, indicating, recording, transmitting, and controlling industrial process variables and testing the characteristics of electricity and electrical signals. Additional sector activities include the manufacturing of instruments and instrumentation systems for laboratory analysis of the chemical or physical composition or concentration of samples of solid, fluid, gaseous, or composite material, the manufacturing and/or assembling of clocks, watches, timing mechanisms for clockwork operated devices, time clocks, time and date recording devices, and clock and watch parts (except crystals), as
well as tracking, guidance, and other instrumentation. Again this industry sector shares common input and output factors and operational needs with many of the core IT industry sectors. More importantly, this sector supplies a large portion of the data collection devices, which enable the rest of the IT industry to exist. There are opportunities in this sector to integrate data collection techniques and equipment with other sector’s data security, management, and transmission techniques and equipment.

**5191 Other Information Services**

This industry sector comprises establishments primarily engaged in 1) publishing and/or broadcasting content on the Internet exclusively or 2) operating Web sites that use a search engine to generate and maintain extensive databases of Internet addresses and content in an easily searchable format (and known as Web search portals). The publishing and broadcasting establishments in this industry do not provide traditional (non-Internet) versions of the content that they publish or broadcast. They provide textual, audio, and/or video content of general or specific interest on the Internet exclusively. This sector provides an important interface for data transmission networks between public and private entities, providing easy access to data for clients, potential customers, employees, and other entities and agencies. This sector is and will continue to be a major factor in the cloud computing revolution that is currently emerging in the IT industry.

**4251 Wholesale Electronic Markets, Agents, and Brokers**

This industry sector is comprise of both Business to Business Markets and Wholesale Trade Brokers. Entities in this sector distribute the physical technologies and users interface technologies from producers to consumers and represent another important consumer feedback mechanism in the industry cluster.
4541 Electronic Shopping and Mail-order Houses

Similarly to Wholesale Electronic Markets, Agents, and Brokers (NAICS 4251), this industry sector engages in similar distribution activities; however their offerings utilize industry technologies to facilitate distribution, rather than distributing the physical industry products. This sector offers a much wider range of consumer products and as such represents a strong connection to the larger consumer market in terms of consumer shopping trends and interface desires.

Factor:

5171 Wired Telecommunications Carriers

This industry sector is comprised of establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. This sector (as with the others below) is important to the IT industry because it provides the transmission infrastructure through which the industry conveys its primary commodity, data. Because of the large costs of network infrastructure, individual companies very rarely ever own their own private data networks, much in the way trucking companies do not own the interstate highway system. These networks are run similar to public utilities in which access can be obtained at a cost relative to the amount of traffic moved across the system for a company within certain proximity. It is this requirement of proximity to infrastructure that distinguishes this sector from the other “wireless” sectors. While proximity requirements can place limitations on this sector, wired networks are generally known to have significantly higher levels of capacity and a much lower cost relative to the amount of data moved as compared to “wireless” telecommunication networks.
5172 Wireless Telecommunications Carriers (except fiber optic)

This industry sector is engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. This sector provides a significant advantage in terms of mobility but can be limited by environmental conditions and connectivity issues. This sector also has greater limitations in the volume of data that can be transmitted as compared to wired communications networks. While proximity needs are significantly reduce as compared to wired networks, the requirement to be “within the network” infrastructure represents a proximity barrier that the Satellite Telecommunications sector does not have.

5174 Satellite Telecommunications

This industry sector engages in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications. This sector is a “downstream” telecommunications supplier to the IT industry, and represents a sort of supporting industry within the supporting industries category. As speed and mobility are both key growth areas in data transmission in the IT industry, this sector may be an area of growth in the future. On prominent characteristic of this sector is the extremely high up front capital costs incurred during infrastructure development, construction, and deployment resulting in a much higher relative cost when compared to wired and wireless data transmission networks.

5179 Other Telecommunications

This industry sector is a supplier to a supplier sector engaged in purchasing access and network capacity from owners and operators of telecommunications networks and reselling wired and wireless telecommunications services (except satellite) to businesses and households. This sector functions to
manage supply and demand relationships within the wired and wireless data network with industry wide relevance being largely limited to network pricing.
## APPENDIX B: SBIR & STTR Funding Received by Twin Cities Companies (2006-2010)

<table>
<thead>
<tr>
<th>Program</th>
<th>Agency</th>
<th>Recipient</th>
<th>IT Category</th>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBIR</td>
<td>DOD</td>
<td>Adventium Enterprises, LLC</td>
<td>software dev</td>
<td>2008</td>
<td>$100,000</td>
</tr>
<tr>
<td>SBIR</td>
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<td>DOD</td>
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<td>SBIR</td>
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<td></td>
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**SOURCE:** [http://www.sbir.gov/past-awards](http://www.sbir.gov/past-awards)
Federal Agencies Participating in SBIR/STTR Grant Programs

Departments of Health and Human Services (DHHS)

Department of Agriculture (USDA)

Department of Commerce (DOC)

Department of Defense (DOD)

Department of Education (DoED)

Department of Energy (DOE)

Department of Homeland Security (DHS)

Department of Transportation (DOT)

Department of Environmental Protection Agency (EPA)

National Aeronautics and Space Administration (NASA)

National Science Foundation (NSF)
## APPENDIX C: National Patent Output Rankings

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<tr>
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<td>DP: Database and File Management or Data Structures (Data Processing)</td>
<td>6</td>
<td>341</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Dynamic Magnetic Information Storage or Retrieval</td>
<td>2</td>
<td>337</td>
<td>Defending Cluster - needs attention</td>
</tr>
<tr>
<td>Optical Waveguides</td>
<td>3</td>
<td>287</td>
<td>Increasing R&amp;D - could be for medical equipments</td>
</tr>
<tr>
<td>Memory (Electrical Computers and Digital Processing Systems)</td>
<td>4</td>
<td>262</td>
<td>Defending Cluster - needs attention</td>
</tr>
<tr>
<td>Measuring and Testing</td>
<td>2</td>
<td>223</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Multicomputer Data Transferring (Electrical Computers and Digital Processing Systems)</td>
<td>13</td>
<td>223</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Error Detection/Correction and Fault Detection/Recovery</td>
<td>8</td>
<td>220</td>
<td>Stagnant - defending industry leaders</td>
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<td>Communications: Electrical</td>
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<tr>
<td>Electrical Connectors</td>
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<td>Declining R&amp;D</td>
</tr>
<tr>
<td>Electricity: Electrical Systems and Devices</td>
<td>7</td>
<td>145</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Static Information Storage and Retrieval</td>
<td>7</td>
<td>144</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>DP: Financial, Business Practice, Management, or Cost/Price Determination (Data Processing)</td>
<td>15</td>
<td>132</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Electricity: Measuring and Testing</td>
<td>8</td>
<td>119</td>
<td>Declining R&amp;D</td>
</tr>
<tr>
<td>Optics: Measuring and Testing</td>
<td>7</td>
<td>114</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Semiconductor Device Manufacturing: Process</td>
<td>15</td>
<td>107</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Optical: Systems and Elements</td>
<td>8</td>
<td>99</td>
<td>Declining R&amp;D</td>
</tr>
<tr>
<td>DP: Generic Control Systems or Specific Applications (Data Processing)</td>
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<td>96</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>DP: Software Development, Installation, and Management (Data Processing)</td>
<td>8</td>
<td>87</td>
<td>Declining R&amp;D</td>
</tr>
<tr>
<td>DP: Vehicles, Navigation, and Relative Location (Data Processing)</td>
<td>10</td>
<td>55</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Communications: Directive Radio Wave Systems and Devices (e.g., Radar, Radio Navigation)</td>
<td>11</td>
<td>47</td>
<td>Stagnant - defending industry leaders</td>
</tr>
<tr>
<td>Virtual Machine Task or Process Management or Task Management/Control (Electrical Computers and Digital Processing Systems)</td>
<td>7</td>
<td>44</td>
<td>Rising cluster, Increasing R&amp;D</td>
</tr>
<tr>
<td>Electricity: Conductors and Insulators</td>
<td>10</td>
<td>43</td>
<td>Increasing R&amp;D</td>
</tr>
<tr>
<td>Electrical Audio Signal Processing Systems and Devices</td>
<td>9</td>
<td>41</td>
<td>Increasing R&amp;D</td>
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<tr>
<td>Automatic Temperature and Humidity Regulation</td>
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<td>Increasing R&amp;D</td>
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Appendix D: The Minnesota River and Silica Sand

The Semiconductor and PV industries make up about 10 percent of the world’s silica market, with aluminum and silicone taking up 50 percent and 40 percent respectively. Silica is in high demand, and the pure grade that is required for semiconductors is increasingly rare in the market because of this. Additional sources must be found or created or a material “bottleneck” may quickly be seen. The price of silicon, the main component used to make semiconductors, is on the rise, doubling in price between 2005 and 2008 to end at $1.45 a pound. Part of the reason for this dramatic cost increase is the rapidly increasing demand for the base component silica, a product used in aluminum, silicone, and photovoltaic cells.

The sand in the Minnesota River Valley contains a portion of silica. Mining companies have entered the Wisconsin area to mine for this sand, which is being described as “the new gold rush.” The key here is finding out if the sand in the River Valley has the necessary purity to be used in the creation of silicon. This point could be the difference in being able to use the sand as a regional strength, and starting point for creating many mining, shipping, refining, and wafer creation jobs within the cluster. Any further research would have to be completed by a group or company with the appropriate technology and capacity.

In looking at the cost of producing semi-conductor wafers, the product that the actual electronic circuits are carved onto, there are a wide spread of costs with the largest portion assigned to cost of goods sold. While this figure is not solely dedicated to the cost of silicon, there are many gases and other materials used in the production and etching, the figure leads to looking towards finding cheaper sources of the main component.
When looking at the process of converting silica sand into the semiconductor wafers that advanced manufacturers use there are six steps. These steps include refining the sand, and then taking the silica and turning it into crystals and then a usable crystal log that is cut into wafers. This process can span several companies or be done in tandem in single larger plants, but the meaning is the same, if mining and wafer production can both be pulled to the region it would create multiple jobs compared to other industries, because of the specialized talent required in each step.

In a growing industry with natural resource demands that are not being met, Greater MSP has a real opportunity to attract companies and jobs to the region, supporting research and manufacture of electronic products. The first step in capturing this prize is to look into the sand in the Minnesota River Valley and determine if it would be viable for silicon production. If it is possible to attract industries that can use this sand as a resource in semi-conductor manufacturing, the region would be able to attract supporting industries as well.

The hindrance to this strategy is that much of the Minnesota River Valley is protected against development. This is due to wildlife and wetland conservation and protection acts that protect the environment in the region. Additionally there are portions of the valley that are dedicated to Native American reserves and would provide additional difficulties before use. These are further factors that would have to be considered by Greater MSP before the location and resources become available for use.

**Silica Sand as a Natural Resource**

Another potential strategy is further research on the possible silica resources located in the Minnesota River Valley. The silica industry is growing and demand for silica can be a factor in multiple industry
clusters including advanced manufacturing and biochemistry. This strategy is one that could be taken at a relatively low cost compared to the potential benefit. If the tests show that silica is present in pure enough quality that it is usable for semiconductors then mining companies will rush here without the need for many incentives, the increasingly demanded, but shortly supplied, sand would be a big pull all by itself. If this happens there would only need a small amount of work needed to attract semiconductor manufacturers to open branch plants here to take advantage of the silica being produced.
APPENDIX E: LOCATION QUOTIENT CHART

MSP Change in LQ and Employment 2006-2010

Source: Bureau of Labor Statistics Census Data
APPENDIX F: IT INDUSTRY RELATIONSHIP DIAGRAM
Works Cited


Minnesota Department of Employment and Economic Development. "Employment Outlook."


<http://www.cbi.umn.edu/resources/MHHC/>.


<http://nces.ed.gov/collegenavigator/?q=University+of+Minnesota&s=all&id=174066#programs>.
University of Minnesota. "Archived Budget Office Documents." Archived Budget Office


Office of Budget and Finance, 2007. PDF.

Office of Budget and Finance, 2009. PDF.

University of Minnesota. FY11 Research Support Pool: 2008-2010 Sponsored. Minneapolis, MN:
Office of Budget and Finance, 2010. PDF.