Chicago 2030
Findings on the Midwest and Its Potential as a Technology Cluster
A Message from the Co-Chairs:

We are pleased to present for your consideration “Chicago 2030: Findings on the Midwest and Its Potential as a Tech Cluster.” This report was developed as a way of assessing the feasibility of the greater Midwest to receive recognition for its undeniable role in national and global economic growth and development.

As part of the greater community, we hope to garner your feedback and ideas with respect to the growth of the Midwest moving forward. Our findings include an analysis of the greater Midwest that focuses on regional strengths, along with a framework and specific strategies for the attraction and retention of talent and emerging-growth firms.

Success will be determined in large part by the collaborative efforts between multiple stakeholders from the various metropolitan regions that collectively form the Midwest. This work involved input from over 100 individuals from diverse sectors, including manufacturing, agriculture, healthcare, life sciences, venture capital, and public policy. We view such diversity as a key driver for Chicago and the Midwest moving forward over the next decade.

Many organizations have contributed to the development of our research. In particular, we would like to thank the University of Illinois and Academy for Entrepreneurial Leadership for their generous financial support. In addition, we would like to acknowledge our interviewees, World Business Chicago, our research staff, and reviewers from PwC, KPMG, and Mercer for contributing to a powerful document that can serve to grow and sustain a vibrant Chicago and Midwest.

Our world faces challenges at a broad level, ranging from food production to environmental change to the need for improved healthcare. We believe the Midwest is uniquely poised to contribute to the improvement of the human condition and realize a global impact. We view this pivotal moment in our region’s history as one of opportunity and hope you will join us in realizing its full potential.

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Overview

Context

Chicago’s history as a city of innovation and economic prominence can be traced back to the 1800s. Not only as a transportation center for the United States, but also as a key venue for manufacturing, Chicago’s growth throughout the 20th Century has led to a wide clustering of industries we see across the Midwest today. Coupled with this growth has been the presence of numerous other metropolitan areas and hubs across the Midwest, from Indianapolis and Detroit to Madison and Champaign-Urbana. Together, the region serves as an important hub for not only advanced technologies, but also industries critical to the human condition, from agriculture to healthcare.

As we emerge from a period of economic challenge, we are confronted with a more global economy, along with constraints on a local, regional, and national scale. The imperative for multiple stakeholders to align around common themes, from talent attraction and retention to the promotion of scalable enterprises, has never been greater. Only through efforts that combine the strengths of universities, industries, and the public sector can investments in our region be fully realized.

History, Framework, and Methodology

In the fall of 2010, Accenture and the City of Chicago commissioned a research group from the University of Illinois to conduct a comparative analysis of 17 different research clusters around the world. The goal was to assess the best practices on a global scale, while also determining the feasibility of such a framework for Chicago and the Midwest. Following several months of vigorous analysis, the report concluded that:

“A successful research cluster should increase the regional GDP through fostering constructive relations between researchers and business, advancing industry through technological developments, establishing job opportunities, creating new companies and augmenting established companies, and linking proximate universities, hospitals, research and business centers.”

Beginning in the spring of 2013, discussions began amongst researchers from our 2010 staff with regard to writing an updated report on our findings. Over the last several years, the Chicago region has been home to an economic renaissance. The continued entrepreneurial churn, coupled with greater recognition of the importance of innovation, is evidenced by initiatives such as UI Labs, MATTER, 1871, and ChicagoNext, to name a few. On a greater scale, the Midwest has seen the growth of efforts to support early-stage investments, from the Sprint Accelerator in Kansas City to BioEnterprise in Cleveland.

Building off of the work of thought leaders including Brad Feld, Carl Schramm, and Michael Porter, as well as localized models such as the Plan for Economic Growth and Jobs and GO TO 2040, we envisioned a framework that could best capture the interactions of an entrepreneurial environment while taking into account the myriad of stakeholders.1 2 3 4 5 As a result, we developed a model that serves to

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capitalize on the strengths of the Midwest in four key areas: startups, established firms, universities, and government. All four have an important relationship in an entrepreneurial ecosystem, through roles ranging from technology transfer at universities and other research institutions to regional partnerships at the government level. Startups interact with any number of additional stakeholders, including investors, mentors, and incubator facilities, in addition to professional services and established firms serving as potential customers or partners.

Figure: Technology Cluster Framework

Derived from *The Entrepreneurial Imperative* by Dr. Carl Schramm

Paramount to our direction was the desire to apply such a framework internally to the Midwest; that is, to capture the collective perspectives of entrepreneurial activity here in the Midwest, along with documenting a direction to move the Midwest forward. Our mission was to conduct an assessment of Midwest challenges and opportunities, particularly focused on industries identified in 2010 as core to the economic backbone of the region: agriculture, biotechnology and life sciences, healthcare, and advanced manufacturing. A useful metaphor for the Midwest is the regional transportation network, which is, in many ways, a patchwork quilt of hubs and spoke, ranging from major cities such as Chicago and Indianapolis to small communities such as Ames, Iowa and Madison, Wisconsin. Given the geographic dispersion and industry breadth, our intent was to create a document with actionable insights, while also addressing the needs of a diverse audience.

As such, our model for gathering perspectives was two-fold. We sought the insights of large, established firms; professional services firms; venture capitalists and investors; entrepreneurs; individuals in public policy; and academia, in regards to opportunities and challenges for Chicago and the greater Midwest in the coming 3-5 years. Additionally, we sought to garner the perspectives of young adults in regards to the Midwest as a hub for entrepreneurial activity and innovation. We aimed to gather the sentiment of our future workforce en masse as a way of highlighting ways that can attract and retain our talent here in the Midwest, thus avoiding the “brain drain.”

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Our timeline was driven by a desire to establish initiatives that can be undertaken in a finite amount of time, while also addressing the imperative for regional growth in both the near-term and long-term. We acknowledge that a successful economy rests upon the need for strong social services and infrastructure. We strongly recommend continued discussions on both local and regional levels with respect to issues such as transportation, education, social welfare, and quality of life for citizens across the region. However, our scope focuses on specifically addressing the need to attract and retain talent and scalable enterprises here to the Midwest as a way of ensuring long-term economic growth. In this regard, we view our work as complementary to other, noteworthy initiatives.

![Midwest Regional Transportation Network](image)

**Figure: Midwest Regional Transportation Network**

Our report begins by conducting an in-depth inventory of the resources currently present in the Midwest to support and nurture an entrepreneurial ecosystem within agriculture, biotechnology / life sciences, healthcare, and manufacturing. We have broken biotechnology / life sciences and healthcare into two distinct categories, notably due to the variance in funding mechanisms, timelines for commercialization and business models. These analyses include the aggregated perspectives of over 100 executives from around the region, coupled with quantifiable ways of benchmarking the Midwest as hub for innovation.

Following our industry analyses, we highlight the results of a survey distributed to 20,000 University of Illinois students in the spring of 2014 with respect to their sentiment on the Midwest for entrepreneurial activity. This pilot run will be expanded in the fall of 2014 to include institutions across the Midwest as a way of assessing regional strengths and opportunities for improvement.

We conclude with a series of broad findings culled from discussions with all stakeholders and interviewees and present three recommendations for attracting and retaining both firms and talent here in

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the Midwest. Given the importance of a regional approach, we emphasize strategies that can capitalize on the strengths of regional hubs throughout the Midwest, while also encouraging greater linkages between stakeholders across varying metropolitan areas and industries. With many initiatives underway, this report seeks to create goals that can aggregate such efforts across a common framework to advance both local and regional strategies. Through careful analysis and planning, Chicago and the region will be able to capitalize on the economic potential already present and ensure continued growth in the coming decades.
Biotechnology
Executive Summary

The Midwest Region historically has done well in the biotechnology industry with particular focus on medical devices, pharmaceuticals, and diagnostics. Through extensive research, we have identified 20 biotech corporate giants located in the Midwest with market capitalization of over $200 million; 39 incubators evenly spread across the region to assist startups commercialize research findings and products; one-third of governmental grants are dedicated here to support academic and commercial research; in 2013, Midwest venture capital funding surpassed the New York Metro and New England regions in becoming the third largest venture fund recipient. Moreover, seven of the world top 50 biotech universities nurture more than 7000 bioscience talents every year in the Midwest Region.

The Midwest has shown great potential in terms of resources. However, after interviewing more than 60 key stakeholders in the biotechnology industry, with support of secondary data, we identified four main challenges that hinder the process of turning Chicago as the biotech hub. The first challenge is resource dispersion. Although the entire Midwest region has abundant resources, many are fragmented and have limited public exposure. This creates a significant information gap and misallocation of resources, which can be better utilized if organized and managed in a greater scale. The second challenge is funding. Illinois lacks sophisticated angel investors who are willing to invest in unfamiliar, high-risk, longer turnaround industry such as biotechnology. Moreover, the conservative culture many Illinois investors share lowers the likelihood for startups to raise sufficient funding to support ongoing operations. One unique challenge we have identified among entrepreneurs is that, unlike their counterparts in Silicon Valley or New England, they have a unique perception of failure. Once the startup fails for the first time, Illinois entrepreneurs tend to think it as an ultimate failure. Thus, very few of them will choose to start over again. The last challenge is talent outflow. Though Illinois is particularly excellent in nurturing talented biotech students, the state has difficulties in retaining them as most of them will move to the coasts for more opportunities.

However, Chicago has the capability to resolve these issues and becomes the hub for biotechnology startups. As a transportation center for the Midwest and the country, Chicago can serve as the pivotal point to attract and retain all resources to establish a biotech hub serving the entire Midwest Region. From 2009 to 2012, venture funding that went into Illinois increased 209%. In addition, nine major biotech corporations are located right in Illinois, many of which have venture branches to look for investment opportunities. They can serve as magnets to attract startups to cluster around the Chicagoland area to promote the entrepreneurial environment.

We believe that with a coordinated effort on resource aggregation and distribution, coupled with greater publicity of Midwest assets, there is significant potential for fostering an entrepreneurial culture for the biotechnology industry in the Midwest.
Industry Overview

Industry Introduction

The biotechnology industry is based upon biology, harnessing cellular and molecular processes to develop products that help improve the health of humans and the planet. In modern day business, United States biotechnology has become a highly lucrative industry of more than $200 billion. In 2013, CNBC reported that venture capitalist investment of $4.5 billion in biotechnology was second to only software investment at $11 billion. As a whole, biotechnology alone composed almost one sixth of the $29 billion dollars invested through venture capital.

For the purpose of this report, we have broken down biotechnology industry into three segments: medical devices, diagnostics, and pharmaceuticals. These biotech segments employ approximately 1.5 million people, making it the largest market for biotechnology products in the world.

With continued innovation in healthcare, the medical device sector continues to prosper through areas such as orthopedics, prosthetics, cardiology, and wound care. Both technology systems and medical devices increased in investment of private equity during year 2013.

Diagnostic technologies include imaging, detecting, quantifying, and decoding the signals produced by the body on a daily, monthly or yearly basis. Molecular resonance imaging (MRI) and computed tomography (CT) scans are two commonly implemented diagnostic machines, but these are limited to the signals that they can detect. Therefore, the diagnostic industry revolves around the relationship between the method of detection and the detection process itself.

In the biotechnology industry, pharmaceuticals differ from conventional drug makers because they utilize natural ingredients, as opposed to synthetic ones. Drugs are manufactured in a living system, for instance, a microorganism, plant or cell. Although the FDA inspection process is complex and rigorous, approved products can be extremely profitable, creating a competitive environment for both aspiring entrepreneurs and established corporations.

Regional Perspective

The Midwest Super Cluster includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. Biotechnology in the Midwest has become a center for bioscience employment in the United States. According to the Midwestern Governors Association (MGA), the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, and Wisconsin employ approximately 22% of the total US biotechnology jobs. In particular, states such as Minnesota, Ohio, and Indiana are home to an impressive resume of industry-leading corporations.

Through businesses like Medtronic, 3M, St. Jude Medical, and Mayo Clinic, Minnesota boasts one of the strongest medical device industries in the nation. Between 2002 and 2006, Minnesota registered 2,333 patents in medical devices. Furthermore, the biotechnology industry grew by 11% more than the national average over the ten-year span from 2000-2010.

Ranked fourth nationally in biotechnological strength by the Business Facilities Magazine, Ohio is home to over 1,000 bioscience related entities including medical device companies such as ViewRay, PerkinElmer, and Cardinal Health. Many of these companies specify in concentrations such as bioinstrumentation, cancer and cardiovascular research and treatment, genomics, genetics, and neurology. Therefore, much of this research is conducted in medical laboratories; and as seen in the table above, there is an evident rise in employment and overall establishments found in the Midwest.

Generating approximately $14 billion a year in medical devices, pharmaceuticals, and healthcare delivery, Indiana has also become one of the nation’s leaders in life sciences. The state houses corporate powerhouses like Eli Lilly, Biomet, Cook Group, Inc., and Zimmer. The Indiana University School of Medicine is the second largest medical school in the United States. In 2010, the university helped the Midwest produce a total of 140,000 degrees in biological science, with an additional 3,200 doctorates.

**Biotech in Illinois/Chicago**

With approximately 81,000 bioscience jobs, Illinois is a hub for research and development in the Midwest. Illinois ranks first as a hub for diagnostics, imaging and medical/orthopedic devices and the Midwest is the second largest pharmaceutical hub in the nation. In 2011, the Midwest generated $98.6 billion worth of biotech economic output. In the same year, the biotechnology industry in Illinois alone contributed $2.9 billion in state and local taxes. Likewise, the city of Chicago has become one of the world’s leaders in biotechnology sales with $47.5 billion and 50,000 bioscience employees as part of approximately 2,000 establishments.

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Ranked as the number one city for air travel and distribution, Chicago has access to three airports in the metro area, as well as opportunities for product shipment by truck, rail, and intermodal containment. With 1,600 foreign firms and $46 billion in foreign investment, Chicago is a center for international business.\(^{11}\)

Named as the number one urban medical center, Chicago boasts a wide range of hospital connections, specifically Rush University, the University of Chicago Medical Centers, Northwestern University, and Argonne National Laboratory. Furthermore, Illinois has five bioscience incubators (Chicago Technology Park, University Technology Park at Illinois Institute of Technology, University of Illinois Research Park, Chicago Innovation Mentors and Chicago Biomedical Consortium) to empower biotechnology entrepreneurs in Illinois with great resources and connections to key stakeholders in the industry.

**Biotech Cluster Framework – Stakeholder Analysis**

**Investors**

35% of all National Institutes of Health (NIH) grants and 33% of the nation’s research and development (R&D) spending occur in the Midwest.\(^{18}\) Government funding in this area helps build the foundation for investable projects; however, venture capital funding lags in comparison with the Silicon Valley or Boston area. However, as shown below, Midwest surpasses NY Metro and Texas, which are also well-known startup clusters. In addition, venture capital funding in Illinois had increased 209% from 2009 to 2012.\(^{19}\)

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![2013 Q4 Venture Fund (in million)](chart.png)

**Source:** PwC MoneyTree

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The graph below shows the number of funding opportunities and the total amount of funding into the Midwest region from 1997 to 2013. There is a significant increase in investment since 2007. Even during and after the 2008 financial crisis, total funding was sustained in the $400 million - $750 million range; although there has been a downward trend in funding since 2010.

Startups

Most startups tend to cluster around universities and incubators to maintain an easy access to wet labs, equipment, and connections with potential and existing investors. As seen in the graph below, medical devices is the most popular biotechnology sector for startups in the Midwest Region, with the second highest being pharmaceuticals. Currently, the largest challenge Midwest biotechnology startups face is to raise funding beyond seed level without having to relocate to intensive funding regions such as the Silicon Valley or Boston area. However, numerous startups that chose to stay or move in the Midwest have shown promise due to generous support from local incubators. Case studies presented in the next section will provide more details regarding some of the most successful biotech startups in certain regions of the Midwest.

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**Incubators**

The purpose of an incubator is to help a startup commercialize its product or research and connect it with interested investors in the area. In some cases, the incubator may connect the startup with investors across the nation. The Midwest encompasses 39 incubators in total. These incubators are evenly distributed across Midwestern states, with the largest number of incubators in Illinois and Ohio (seven incubators each). Some university-owned/affiliated incubators focus mainly on helping university researchers commercialize their research.

One of the most successful incubators in the Midwest Region is BioEnterprise in Cleveland, Ohio. This incubator focuses on healthcare companies and helps commercialize bioscience technologies. Currently, it serves 170 companies and is the largest job creator in Cleveland.  

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**Education**

The Midwest Region owns a great and diverse talent pool. Seven universities within 125 miles of Chicago host top ten engineering and business programs. The Midwest has seven universities that are ranked World Top 50 Biotech Universities\(^\text{22}\). These universities attract talented students and nurture them into outstanding researchers and future entrepreneurs. More specifically, the Chicago area grants over 7,100 degrees in biotech-related sectors every year\(^\text{23}\).

**Magnet Companies**

The Midwest Region has 20 biotech companies, each with a market capitalization of over $200 million; many of them have roots in Illinois. Companies such as Abbvie and Baxter maintain venture arms to look for opportunities to invest in and acquire startups. Since they are industry leaders in venture investments, they are sophisticated enough to quickly understand a startup’s business model and make a reasonable judgment concerning its legitimacy. In recent years, some companies started moving their research and

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\(^\text{22}\) Center for Science and Technology Studies (CEST); Thomson Scientific (SCI/SSCI/AHCI); Milken Institute, *World Top 50 Biotech Universities*

\(^\text{23}\) World Business Chicago, Chicago Science & Technology Profile. PDF file.
development departments to the coasts in order to acquire and attain more human capital. This movement has created difficulties for the Midwest to retain human capital.

Case Studies

Chicago, IL—ImmuVen

Founded in 2008, ImmuVen is a biotechnology company that focuses on creating new, revolutionary techniques to treat disease including cancer, infections, and auto-immune disorders, particularly through the use of T-cell receptors and their ability to recognize foreign antigens. From April of 2009 until August of 2010, Doctor’s David Kranz and Patrick Schlievert gained sufficient seed funding until being awarded the National Institute of Health (NIH) grant for the development of a therapeutic treatment for staph infections. Shortly thereafter, in September of 2010, the company became a small startup at Enterprise Works in Champaign, Illinois. Kranz, who has already sold a previous company to Abbott Labs in 2002, and Schlievert have since executed licenses with both Abbott Labarories and the University of Illinois at Urbana-Champaign.

Over the past three years, ImmuVen has been awarded three further grants from the NIH. The first, awarded in February of 2011, was a Small Business Innovation Research (SBIR) grant and was aimed at further developing ImmuVen’s treatments for staph infections. The second, awarded in April of 2012, was an SBIR Phase II grant for their research involving Staphylococcal aureus toxins, normally not exceeding any more than $1 million in expenses of the course of two years. The final, most recent grant, was an SBIR Phase I grant awarded in August of 2012, and was given to develop assays to detect for Staphylococcal aureus toxins.

Cleveland, OH--ViewRay

Cleveland, OH, the second largest city in the state of Ohio, is developing into a global hub for the bioscience industry. The bioscience industry accounts for 15% of Ohio’s total economic output. Moreover, all bioscience industries are represented in Cleveland, with over 1,345 bioscience entities. Cleveland’s major segments include cardiovascular, medical imaging, pharmaceutical and medical device manufacturing, and polymers are among the top regional clusters in the world. Expect to see continued growth in Cleveland especially, in the areas previously mentioned, as companies continue to be attracted to Cleveland’s high levels of funding and participation from National Institutes of Health (NIH) and Universities in Ohio including Ohio State, the University of Cincinnati, and Case Western Reserve University. In 2011, funding from NIH awards topped $710 million beating out Michigan ($655 million), Indiana ($216 million) and just below Illinois ($779 million). In 2011, the national average per state was approximately $440 million.

BioOhio, founded in 1987, is the most prominent association in Cleveland and Ohio. This organization and its membership focuses on the development and promotion of bioscience research, education, and business by leveraging the assets and network that Cleveland and Ohio has created as a result of the developing cluster. The recent expansion, a 25% membership increase in BioOhio since 2007, can be attributed to BioOhio’s specific focus on facilitating growth in the biomedical supply chain in Ohio. A key resource BioOhio offers to companies in the Cleveland region is the Bioscience Resource Directory, which is the most comprehensive directory of biotech companies, organizations, research centers, suppliers, and other service providers.

Cleveland and the state of Ohio are especially attractive to young, expanding bioscience companies because of its powerful and fully connected network of large companies, research universities, hospitals, and incubators like BioOhio. Ohio is home to 17 of the top 228 hospitals in the nation with the Cleveland Clinic receiving the 4th best ranking in the country. This couples with over 225 different venture capital investments in 261 bioscience companies, and participation by magnet pharmaceutical firms such as Philips Healthcare, Steris, and Battelle. Significant amount of expansion in the region has facilitated in attracting at least 380 new biotech organizations in the region from 2007-2011, 45% of which come from the Cleveland region.

ViewRay Inc. is a privately held medical device company, founded in 2004 in Gainesville, Florida, that is developing and producing a cancer treatment radiotherapy using magnetic resonance imaging (MRI). It is the first and only biotech startup of this nature. Before relocating to Cleveland, OH in 2008, ViewRay received $3 million in Series A funding and private investment fund Synogen (Gainesville, FL), and later raised $25 million in Series B funding. Russell Donda of Synogen was the founding CEO of

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ViewRay. The firm moved to Cleveland, Ohio in 2008 to be in a cluster of medical imaging and technology companies.

In Cleveland, ViewRay closed its Series C funding in 2012 for $45 million. It started its Series C funding in 2010, receiving $20 million led by Siemens Venture Capital and investors in the fund include Aisling Capital (New York, NY), Fidelity Biosciences (Cambridge, MA), Kearny Venture Partners (San Francisco, CA), OrbiMed Advisors (New York, NY), and Siemens Venture Capital (SVC) GmbH (Munich, Germany). ViewRay has partnered with Siemens AG, and Healthcare Sector to develop, supply, and test the MRI radiotherapy. ViewRay has also received assistance and benefits from the MRI Technology Enabling Expansion of MRI into Radiotherapy Guidance Project that has been funded and supported by the State of Ohio, Department of Development and the Third Frontier Commission.

ViewRay has begun to use its MRI radiotherapy system to treat patients at the Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine in St. Louis, Mo. The Siteman Cancer Center is one of the top cancer facilities in the nation and is the only Comprehensive Cancer Center in Missouri as designated by the National Cancer Institute. Siteman is also the only member of the National Comprehensive Cancer Network. Other members of the NCCN are located in Chicago, Ann Arbor, Columbus, and Nashville, which are all closer in proximity to Cleveland than St. Louis.

Kalamazoo, MI—ProNai

Even though Michigan began emphasizing the biotechnology sector later than other states, it had a plan for the industry to prosper. More than 550 biotech and life science firms are incorporated in Michigan. After lifting the ban on stem cell research, Michigan joined 46 other states that can legally experiment on cells pulled from human embryos. In addition, Michigan also focuses on commercializing stem cell research. In 2009, Wayne County Stem Cell Commercialization Center opened in 2009 right after the ban was lifted.

Since Michigan has three state-funded universities taking the lead on the academic research side of the biotechnology industry, Michigan presents many opportunities for researchers. The University of Michigan accounts for 53.5% of the academic research conducted. Moreover, Michigan State University accounts for 24.4% and Wayne State University 20.9%.

In addition to its university resources, Michigan also presents well-established various incubators. These incubators includes MichBio (Ann Arbor, MI), Ann Arbor SPARK Central Incubator (Ann Arbor, MI), Central Michigan University Research Corporation (Mt Pleasant, MI ), and Southwest Michigan Innovation Center/BRCC (Dr, Kalamazoo, MI ). MichBio (Ann Arbor, MI), for example, regularly educates the biotech industry stakeholders; provides product industry intelligence and business referrals and advocating public policies that help the biotechnology industry as a whole. In addition, MichBio uses its leverage as a leading incubator with industry suppliers to provide the researchers with a 15% lower cost of material.

Furthermore, Michigan and its incubators are dedicated to help the startups to increase the opportunity to network with the magnet company. The annual MichBio Expo in Detroit, Michigan serves this purpose. The attending parties include the three major universities and many magnet companies such as PHrMA, Tryker, Dykema, Pfizer and Johnson & Johnson.

ProNai Therapeutics, Inc. is a biotech startup that is pioneering a new class of drugs that target genomes responsible for causing cancer in the early stages. The company was founded by pharmaceutical

researchers and scientist who are experts in the field of nucleic acid research in cancer. Founded in 2004 and located in Kalamazoo, MI, ProNAi began Phase 1 clinical testing for its top drug PNT2258 in September of 2010. The safety and efficacy results from the Phase 1 testing were presented at the European Organization for the Research and Treatment of Cancer (EORTC) in November 2012. Phase 2 trials are currently ongoing.

ProNAi is privately held and has raised $15 million in equity and convertible notes from institutional investors. The investors that have helped finance ProNAi are Apjohn Ventures (Kalamazoo, MI), Grand Angels(Holland, MI), the Michigan Strategic Fund/MEDC (Lansing, MI), the Biosciences Research Commercialization Center (Dr, Kalamazoo, MI), Sigvion Ventures (Ann Arbor, MI), Amherst Fund (Ann Arbor, MI), and BlueWater Angels (Midland, MI). It is important to note that all of the institutional investors listed above are primarily located in Michigan with the exception of Sigvion Ventures which is located in Chicago, IL. This clearly demonstrates that proximity plays a major factor in funding and the startups major success.

**Madison, WI-- Zurex Pharma**

Wisconsin’s most well-known biotech resource is the University Research Park on the campus of the University of Wisconsin - Madison. Many of the tenants in this research park receive collaboration and support from a unique biotechnology organization called BioForward. This organization provides networking opportunities, supports public policy backing the development of biosciences in Wisconsin and greater collaboration among bioscience firms in Wisconsin. Furthermore, Wisconsin has an incubator in Wauwatosa called the Milwaukee County Research Park. Even though Wisconsin has less prominent magnet companies to attract startups, their culture of collaboration and facilitation through BioForward has propelled them as a leader within biotech in the Midwest. A case of BioForward’s initiative and success with Zurex Pharmacy, a biotech and pharmacy startup, will be outlined in a succeeding section.

Madison, Wisconsin is home to the University of Wisconsin - Madison and its University Research Park. This research park has 37 buildings with more than 1.8 million square feet of office and laboratory space. Over 50 of the 126 current tenants are biotechnology startups. This is a unique strength for this incubator as it has a majority of its focus on furthering innovation and commercialization of intellectual property within the biotech industry. On the contrary, more diversified incubators may not provide the curtailed real-estate facilities and services that the UW-Madison - University Research Park provides. A majority of the biotechnology firms are focused on the life and biosciences sector. Smaller, private-sector biomedical companies are attracted to University Research Park in Madison because of the collaboration fostered by BioForward. Likewise, the University Research Park is home to emerging companies likes Cell Line Genetics, Exact Sciences, FluGen, and Imbed Biosciences. Forbes even listed the University Research Park as one of 12 Business Incubators Changing the World. The research park is even expected to double in size in the long-term, even with local competition from the Milwaukee County Research Park.

A strategic alliance the aforementioned incubator maintains is its relationship with BioForward. BioForward is a member-driven association and is a collective voice for Wisconsin’s bioscience

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35 "About The Park" University Research Park (URP) - University of Wisconsin - Madison, Web. 5 Mar. 2014.
industry. They promote appropriate legislation that promotes a positive business climate, attract investors and potential partners to Wisconsin, provide customized expert advice on funding and resources and provide tools to acquire top human capital. BioForward was instrumental in promoting Zurex Pharma, a biotechnology startup based out of Middleton, WI. This will be discussed in detail in the following segment.

A smaller and less acknowledge biotech incubator in Wisconsin is the Milwaukee County Research Park. Even though it only consists of 25% biotechnology companies, it has a central and logistical location. It is only 15 minutes from the Mitchell International Airport and adjacent to the Medical College of Wisconsin and the Milwaukee Regional Medical Center. The Medical College of Wisconsin, located in Milwaukee, also contributes significantly to the development of the bioscience industry in Milwaukee.

Zurex Pharma, located in Middleton, WI, is a specialty pharmacy and biotech company with the objective to design new products that better prevent infections on surgical site wounds and catheter-related infections. In 2011, the firm formed the subsidiary Zurex PharmaAgra with the intention to apply their same technology and products to the agricultural industry, specific to the dairy market.

In May of 2012, Zurex Pharma received $6.2 million in Series A funding from Baird Venture Partners (Milwaukee, WI), the State of Wisconsin Investment Board (SWIB) (Madison, WI), Wisconsin Investment Partners (Madison, WI), Peak Ridge Capital (Madison, WI), and other investors. Peak Ridge Capital is based in Boston, yet funded Zurex Pharma out of its Madison office. The firm is also associated with, and receives assistance from, the Wisconsin Technology Council, the Greater Madison Chamber of Commerce, and BioForward.

BioForward’s support and collaboration allowed Zurex Pharmacy opportunity to network with the aforementioned venture capital firms. Note that Series A funding is typically one of the toughest funding stages to pass because of the intellectual property progression and expectations for biotech firms. Without their support, Zurex Pharmacy may not have been able to secure the same amount of funding and success as they did.

**Louisville, KY-- ApoVax**

Louisville, Kentucky, is the largest city in the state of Kentucky and is estimated to be the 27th largest city in the United States based on 2010 census numbers. Although Louisville and the state of Kentucky have not maintained the perception of being a hub for bioscience and startup companies in the past, the city does have a solid foundation to build upon with its exceptional universities conducting research and focusing on facilitating small business bioscience ventures. The state of Kentucky supports small business incubators with locations at 11 major cities placed strategically throughout the entire state. In Louisville specifically, the most notable incubators sponsored and in conjunction with the University of Louisville are MetaCyte Business Labs, LLC, and Nucleus.

MetaCyte, a for-profit subsidiary of the UoFL foundation, uses its team of managers and industry experts to develop, manage, and invest in startup companies in the Louisville area. MetaCyte’s staff focuses on organizational development and management helping startups reach early milestones and

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secure funding, while its team of industry experts works with the companies on research and development. Since 2002, the incubator has helped secure $16 million in funding for its 11 portfolio companies, created 40 high-paying job positions, and returned over $11 million to the University of Louisville for research.

Nucleus 45 spun off in 2008 from the Nucleus Life Sciences and Innovation Center and is a major incubator that has committed itself with the University of Louisville to raise a capital investment of $2.3 billion over the next 20 years. The goal is to support its initiative to transform Louisville into an epicenter of innovation and economic development in the biotech industry. The main focus of Nucleus in order to drive this growth is the development of a research park in a 30-block property owned by the University of Louisville in downtown Louisville. This new Nucleus Innovation Park is intended to drive connectivity, research, and development by clustering companies and researchers in the industry by offering all types of labs, office space, and a campus-like atmosphere that facilitates collaboration and communication.

Theses incubators 46 are connected and supported by the Kentucky Cabinet for Economic Development’s Department of Commercialization and Innovation (DCI). DCI works with startup companies and business incubators to help connect them to large-scale companies with an interest in venture capital and research and development, and universities and other interested entities using its 12 offices strategically spread across the state. DCI, like the incubators its supports, is focused on providing small business consulting and advice, as well as assistance in fundraising efforts to startups in the region.

ApoVax 47, Inc., originally ApoImmune, was incorporated in June, 2001, and is a small biotech startup focused on developing immunotherapies to strengthen the immune system in order to fight life-threatening disease. The company was founded by Dr. Haval Shirwan after he developed the technology at the University of Louisville, and the technology platform operated by ApoVax is licensed by the University of Louisville. To date the company has raised over $8.4 million in private funding and state grants, which has allowed it to develop its top product since 2005 and has begun Phase I clinical trials as of June 2012.

Key to the development of ApoVax has been the state grants it has received from the National Institutes of Health (NIH), the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (SBTT) and matching funding from DCI and private investors. The startup has been successful enough to be awarded funding every year since its inception in 2001, providing it with consistent cash inflows in which facilitate continued research, development and growth. ApoVax was MetaCyte’s first investment and has benefitted from the strategic partnership with MetaCyte since 2002. The success of ApoVax since 2002 helps demonstrate both the irreplaceable value incubators provide to small businesses, as well as Louisville’s capability to be a regional hub and cluster of bioscience startups and innovation.

**Minneapolis/ St. Louis Park, MN—CVRx**

Minnesota has a rich history of turning local innovation and entrepreneurship into Fortune 500 companies 48. Moreover, Minnesota is a leader in the production of medical devices. Medical device production makes up 77% of Minnesota’s biotechnology industry. Pharmaceuticals, R&D in the life sciences and medical and diagnostic laboratories make up the remaining segments of the biotech industry. Minnesota was second only to California in the number of medical device jobs, yet maintains high growth rates and higher efficiency metrics than its other regional peers. Minnesota also contains successful associations affiliated with development of biotechnology in Minnesota.

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48 Minnesota’s Competitive Position in the Biobusiness Technology Industries. 2011. PDF
LifeScience Alley is the largest state-based life sciences trade association in the U.S.\textsuperscript{49} For 29 years, LifeScience Alley has enabled business success for its affiliates by: promoting development of federal and state legislation for biosciences, supporting advances in research and protection of intellectual property, fostering industry innovation and collaboration and several other strategies. The BioBusiness\textsuperscript{50} Alliance is a strategic and valuable tool for Minnesota’s biotech industry. This alliance, based out of Minneapolis, is a non-profit subsidiary of LifeScience Alley. The BioBusiness Alliance is intended to grow and secure Minnesota’s position as a global leader in the life science industry by assisting in the growth of established and emerging industries, and attracting new companies, talent and capital.

University Enterprise Laboratories (UEL)\textsuperscript{51} is home to 27 tenants with a mix of early stage, life science companies along with other technology or medical based businesses and university departments. UEL provides facilitated access to research resources and expertise, especially in the areas of research discovery, development and commercialization. Through its relationship with the University of Minnesota, UEL positions its tenants for world-class status.

A differentiated and valuable resource Minnesota has is The Minnesota Angel Network (St. Louis Park, MN). This network is made up of a board of advisors who launched their Company Development Program. This program provides advisory services to early-stage bioscience companies, prepares entrepreneurs for the rigors of funding acquisition from multiple sources and facilitates networking between bioscience startups, business partners and potential funders. The Minnesota Angel Network is a subsidiary of LifeScience Alley.

Minnesota’s largest biotech magnet is Bio-Techne, formerly Techne Corporation\textsuperscript{52}. Techne Corporation announced it would operate under the trade name, Bio-Techne, as of February 2014\textsuperscript{53}. Bio-Techne Corporation is engaged in the development, manufacture and sale of biotechnology products and clinical calibrators and controls. Furthermore, they aid in drug discovery efforts and provide the means for accurate clinical tests and diagnoses. Bio-Techne has over 1,000 employees nationwide, $311 million in annual sales and $29 million in research and development as of its 2013 annual report.

An example of Minnesota’s ability to forge starts-ups into future biotech magnet companies is CVRx Incorporated. CVRx is a privately held medical device company, founded in 2001 in Minneapolis, MN\textsuperscript{54}. CVRx has developed Barotism neo (Rheos), an implantable technology designed to treat hypertension and heart failure\textsuperscript{55}. Furthermore, its products include a Rheos implantable pulse generator that provides control and delivery of the Rheos technology; and Rheos carotid sinus leads, which conducts energy from the Rheos implantable pulse generator to the left and right carotid arteries. CVRx has received very successful rounds of Series A, Series B and Series C funding. CVRx first received $8 million in Series A funding in June of 2001 from New Enterprise Associates (Timonium, MD), Sightline Partners LLC (Bloomington, MN), ABS Ventures (Waltham, MA) and other disclosed investors.

Series A through Series C funding led to over $60M in total funding. Series B funding includes $22 million from New Enterprise Associates, Sightline Partners LLC, InterWest Partners (Menlo Park, CA), ABS Ventures and Frazier Healthcare Ventures (Menlo Park, CA; Seattle, WA). In May of 2006, CVRx received $30.1 million in funding from the same set of funders except for the addition of Kearny Venture

\textsuperscript{51} For UEL Tenants, Business Success Is as Critical as Technical Success.” University Enterprise Enterprises. Web. 2 Mar. 2014.
\textsuperscript{52} Techne Corporation. Annual Report 2013. 2013. PDF
\textsuperscript{54} "Company Overview of CVRx, Inc." Businessweek. Web. 2 Mar. 2014.
\textsuperscript{55} "PeHUB » CVRx Closes $29.6m Financing." PeHUB. Web. 1 Mar. 2014.
Partners (San Francisco, CA). Most recently, CVRx received $29.6 million in private funding from New Enterprise Associates and Johnson & Johnson to process its device through clinical studies. It is important to note the alliance with Johnson & Johnson as they are the industry leader in the production of medical devices. This exemplifies the attraction industry leaders, such as Johnson & Johnson, can have in a biotech startup from the Midwest. This attraction was only possible through the excellent business environment Minnesota promotes. Furthermore, CVRx was able to attract prominent venture capitalists from both the west and east coasts.

Moreover, CVRx formed an alliance with DaVita HealthCare Partners as part of $12 million in Series F funding. Through this strategic alliance, the two companies will collaborate on marketing strategies and clinical research to make CVRx's Barostim device available to new patient demographics.

St. Louis, MO-- Akermin

St. Louis, Missouri succeeds as a hub of biotech innovation through its combination of top-ranking medical schools and hospitals. Schools such as Washington University School of Medicine and St. Louis University School of Medicine not only attract aspiring and ambitious intellectuals, but also offer teaching hospitals for their students to undertake industrial and applicable experiences before entering the workforce. Such locations, like Barnes-Jewish Hospital, St. Louis Children’s Hospital, Carinal Glennon Children’s Hospital, and St. Louis University Hospital, give real-world opportunities to students that many other cities cannot provide.

Other opportunities to found in the St. Louis area are the headquarters of Ascension Health, the largest non-profit health system in the country; SSM Health care, which operates seven hospitals in the area; Southern Illinois University Pharmaceuticals; the Logan College of Chiropractics; Mercy Hospital – the region’s largest birthing center; and ranked 9th in the country for integrated health care by Modern Healthcare, St. Luke’s hospital, and the Missouri Baptist Medical Center. Furthermore, Missouri (and consequently St. Louis) is home to pharmaceutical and diagnostic firms such as Quest Diagnostics, Pfizer, bioMeriux, Sanofi-Aventis U.S., Pharmacia & Upjohn, and Midwest Research Institute. In addition, Missouri also has connections to research firms such as Sinclair Research Center, Stowers Institute, St. Luke’s Regional Labs, Inovatia Laboratory, and ABC labs. MedDev manufacturers such as Tyco Healthcare Group, Meridian Medical Tech, Bausch & Lomb, Bio-Medical Application, and Cardinal Scale are all prime contributors to the St. Louis biotech industry as well.

Missouri ranks 19th in biomedical exports nationally, with a majority of its industry found in pharmaceuticals and medicine as opposed to medical devices. BioSTL, a $30 million commitment by local St. Louis organizations, brings together stake-holders to promote innovation that builds on St. Louis’ world-class medical and plant bioscience entrepreneurship. MOBIO, the Missouri Biotechnology Association, is an association of corporations, universities, research institutions, and service companies working statewide in nonprofit trade and devoted to the growth of the biotechnological economy in Missouri. MOBIO’s effort to support research commercialization enhance bioscience education in the pre-college environment and improves biotechnology public policy goals. The Technology Acceleration Program (TAP), managed by Missouri University of Science & Technology, manages a portion of patent royalties as seed money for new ventures.

Akermin, Inc., founded in 2003, is developing commercial polymer technology for improved efficiency in the removal of carbon dioxide from industrial gas streams. Shelley Minteer and Nick Akers invented the

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technology at Saint Louis University. Akermin is currently testing their system for the first time at the National Carbon Capture Centre in Wilsonville, AL. The firm is led by President and CEO Barry Blackwell who is a founding member of the St. Louis Arch Angel Network.

Akermin first received seed funding in March 2004 from Saint Louis University and BioGenerator a privately funded non-profit incubator that assists bioscience startups in the St. Louis Region. The company completed its Series A round of funding in October 2005 with investments from Chrysalix Energy, Arsenal Venture Partners, Prolog Ventures and members of the St Louis Arch Angels. Chrysalix is located in Canada, Arsenal has offices in Michigan and Ohio and Prolog is local in St. Louis. Additional Series A funding was received in 2007 as well. The firm then completed its Series B funding round in 2009 with additional contributions from its initial investors and new investments from the Malaysian Life Sciences Capital Fund, and Emerson Ventures Inc. Emerson is a global manufacturing and technology company with a venture arm that made it Akermin’s first corporate strategic investor. Grants and contracts from the US Army, Air Force Office of Scientific Research, the National Science Foundation and the US Department of Energy, have also provided funding for the startup.

Indianapolis, IN—EndGenitor

Indiana not only has leading academic researchers and facilities but also is the home to development and research of the following magnet companies: Eli Lilly and Company, Cook Group, Biomet, DePuy, Zimmer, Roche Diagnostics, Dow AgroSciences and Covance. In addition, Biotechnology Industry Organization (BIO) rated Indiana as one of five states that ranked “First Tier” in every significant indicator of a successful life science industry.60

The leading academic research center in Indiana - Indiana University, the IU School of Medicine, Purdue University and the University of Notre Dame, captured hundreds of millions in both federal and private philanthropic grant dollars to help further their research. Like other top-tier universities, Indiana’s universities also provide incubator centers that help the startup companies grow and help network for business connections and funding. Since Indiana has such big footprint in the biotechnology industry, one of its research centers, IUETC (Indiana University Emerging Technologies Center), formed a consulting company. This consulting company is designed to help startup companies comply with FDA regulation.

One of largest incubators in Indiana is the BioCrossroads (Indianapolis, IN). The BioCrossroads (Indianapolis, IN ) combines four function into one organization: investing, connecting, educating and marketing. BioCrossroads operates their own venture capital fund, which have over $140 million in assets under management. BioCrossroads also provide their stakeholders to the industry partners and network them with potential investors.61

Founded in 2005, EndGenitor Technologies, Inc. is a startup who develops therapies for life-threatening disease using adult stem cells. EndGenitor is based in Indianapolis near the Indiana University-Purdue University Indianapolis (IUPUI) campus in the Indiana University Emerging Technologies Center (IUETC). EndGenitor Technologies is managed by the two scientific co-founders Dr. Mervin Yoder and Dr. David Ingram and two experienced biotech professional Ron Henriksen and Dr. Carlos Lopes. The firm is currently in the preclinical stage of development and hopes the pre-clinical studies will confirm predictions and allow EndGenitor to move into clinical trials.

The firm has raised $5.8 million in funding from angel investors and incubators. The Indiana University Research and Technology Corporation (IURTC) (Indianapolis, IN) provided seeding funding for

EndGenitor Technologies. The IURTC was founded in 1997 at Indiana University to provide startups and early business development out of IU with resources, a network and funding. In 2003, IURTC created the Indiana University Innovation Center – Indianapolis, which is a business incubator with the mission to assist and establish new life and health sciences companies. The focus of the innovation center and the eight others that have been established since, is economic development. Centers have been established in Bloomington, Evansville, Fort Wayne, Gary, Kokomo, New Albany, Richmond and South Bend and there purposes range from providing office and laboratory space, facilitating investments and funding, networking and connecting students to small-business owners, to improving the region's healthcare infrastructure.

Challenges

There are numerous challenges in developing a biotech Cluster in Chicago. The Midwest and Chicago face challenges that include (but not limited to): information asymmetry, a lack of funding for biotech startups, a risk-averse culture that can create barriers for entrepreneurship and business development. This combination of challenges has prevented the full potential of biotech growth within Chicago and the Midwest.

Resource Dispersion

Our interviews with various stakeholders have indicated that there is a significant information gap regarding all the resources Chicago and the Midwest Region have. Startups in smaller metropolitan areas are unaware of biotech opportunities and events held in Chicago, St. Louis, and other regional “hubs.” On the investment side, magnet companies’ venture branches are unaware of activities happening in incubators across the region. Investors from outside Midwest have less knowledge about the growth of biotech startups within than more well-known biotech regions such as Boston and California. Resources fragmentation exists as many of the most-developed resources serve only specific, localized university-centric clusters. Moreover, it is time- and resource-consuming for investors to identify, assess, and contact startups who are located in over 20 different small clusters across the Midwest. Many funds are attracted to St. Louis’s Cortex cluster because it is a means of “one stop shopping”. The aggregation of resources and ability for better consolidation of industry activity would attract a larger presence of regional and national investors, as well as enable greater publicity for the region as a whole.

Funding

As capital and funding are the lifelines for successful ventures and startups, a strong network and willingness from venture capitalists and angel investors are essential for developing a biotech cluster. Unfortunately, the Midwest and Chicago have traditionally lacked sophisticated angel investors who understand the business models for biotech industry. One Chicago-based biotech startup believes that biotech entrepreneurs are leaving Chicago due to a lack of funding. As a result of, it has sought funding from investors outside of Chicago and Illinois, including other Midwest states in order to continue beyond seed stage capital.

Historically, Midwest investors are more conservative than peers on the East or West Coast. This culture is also a large reason why ventures from the Midwest are unlikely to fund risky biotech startups. A successful biotech firm may take 15+ years for a product to reach the market and anywhere from $50 million to $100 million in funding. This amount of risk is not cohesive to the Midwest culture, as several
interviewees have pointed out. In alignment with conservative investment attitudes, venture capital executives want to see a finished and proven product before they provide funding.

**Risk for Entrepreneurs in the Midwest**

Along with the conservative risk profile of people from the Midwest, the riskiness of entrepreneurship within biotech is comparatively higher than other career ventures or even startups in other industries. For example, those graduates with life science degrees may seek careers with magnet companies to assure a healthy salary and secure job. Likewise, college students who are pursuing entrance into a medical school are unlikely to digress from this path because the structure of entrance path and academic rigor of the curriculum. Furthermore, cultural issues surrounding the mindset that “one failure is equal to an ultimate failure” remain pervasive despite the resources designed to de-risk starting a biotech firm.

**Talent Outflow**

In addition to all the challenges listed above that have caused talent outflow to the coasts, many major Midwest based biotech companies moved their R&D facilities out to the coasts. Moreover, when they acquire a Midwest biotech startup, the tendency is to relocate the company to already-established research centers, such as those on the coasts. Talented engineers are among the greatest assets Midwest has; however, the removal of students trained in the life sciences and biotech remains a threat to the viability of a startup ecosystem.

**Opportunities**

**Centralized Talent Attraction and Retention**

Six universities in the Midwest are among the world top 50 biotechnology universities according to the Center for Science and Technology Studies (CEST); Thomson Scientific (SCI/SSCI/AHCI); and Milken Institute. The Midwest educates talented students and future entrepreneurs. If the Midwest is able to retain this talent, this could act as a catalyst for growth in the biotech industry. Moreover, the development of an entrepreneurial spirit could be developed within Midwest Universities and encouraging the growth of biotech startups and the demand for a centralized technology cluster.

**Magnet Company Concentration**

Nine giant biotech corporations with market capitalizations over $1 billion have their headquarters and/or research facilities in the Midwest region. Some of these corporations have their headquarters located in the Chicagoland area: Abbott Laboratories (Abbott, IL), Abbvie (North Chicago, IL) and Baxter International Inc. (Deerfield, IL). These companies can act as magnets to attract startups to cluster around the Chicagoland area. Likewise, magnet companies can take a leadership role in forming beneficial asymmetric partnerships with startups that match with their own product and service lines.

**Incubators Rising**

There are more than 20 incubators and university research parks available in the Midwest region to provide facilities, mentors, and connections to angel investors and venture capitalists. Likewise, incubators can better educate and inform angel investors about the biotechnology industry to promote
more investments. Note that many angel investors are unwilling to invest in biotech because of their uncertainty with the industry and complex knowledge required. Incubators are spread evenly throughout the Midwest; this proximity provides a huge opportunity for startup companies to get immediate access to appropriate resources. Some of the most prominent Midwest incubators include: Chicago Technology Park, Cleveland Clinic Innovation Center, University Enterprise Laboratories and Purdue Research Park.

Collaborative Efforts among Stakeholders

In recent years, every stakeholder has been actively creating opportunities to build connections with one another in order to promote this biotech entrepreneurial culture and lead Chicago to become the Midwest hub for biotechnology. Midwest Research University Network (MRUN) and Chicago Biomedical Consortium create alliances among academic institutions to foster commercialization of university research. Midwest Council of State Biotech Associations and Coalition of State Bioscience Institutes (CSBA/CSBI), and Midwest Governors Association (MGA) focus on bridging between the state government and industry groups such as startups and magnet companies in order to develop an adequate infrastructure to support the current industry growth. From the investment perspective, Mid-America Healthcare Investors Network (MHIN) brings the two main stakeholders—startups and investors together to not only provide venture funding, but also encourage syndication of financing and sharing of resources among startups.

Conclusion

The Midwest as a biotech hub can solve both the resource dispersion and funding issues. By providing mechanisms for aggregating and distributing resources to emerging-growth firms, not only can the industry become more attractive for investors, but also change the cultural mindset related to risk in starting and growing biotech firm. However, the goal could not be achieved with a lack of publicity and ultimate collaboration of all the programs and bridging organizations. By engaging large firms, universities and research institutions in this process, talent outflow will decrease while drawing on positive job growth here for the region. With abundant opportunities, Chicago and the Midwest have since devoted efforts and resources in hosting and encouraging the formation of multiple initiatives to bring this entrepreneurial ecosystem alive.

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Executive Summary

Healthcare technology innovation throughout the Midwest possesses the opportunity for growth. In order for expansion to occur, existing stakeholders and resources must mobilize and become more accessible. Collaboration between current healthcare and investment silos offers the ability to develop a fostering environment for innovation and discovery.

Collectively, the Midwest has the chance to act as a super hub for healthcare innovation. Key healthcare players and stakeholders are based in different cities and states across the region. The presence of nationally ranked medical and business colleges offer abundant high-skilled talent pools. Federal funding throughout the Midwest also allows for greater resources available to entrepreneurs; resources like common ground working environments with necessary technology and tools. The existence of established healthcare firms, both clinical and technological, have the potential to act as sources of mentorship and investment.

With nationally ranked hospitals and universities spread across the Midwest, there is opportunity for expansion through pipelining of talent, capital and mentorship. Given its central location and proximity to resources, Chicago is poised to become the hub for healthcare technology innovation. The value proposition of the Midwest is the presence of numerous cities and states with specific skills and expertise that can be utilized through a structured hub-and-spoke framework. Investment and capital resources can be deployed to researchers and entrepreneurs across the region, while early-stage firms and established industry leaders alike can foster a culture of innovation and sustainable economic growth through the attraction and retention of local talent.
Industry Overview

Introduction

The healthcare industry represents a significant portion of the U.S. economy. The U.S healthcare system accounts for more than $2.5 trillion in annual expenditures, which is nearly 20% of the nation’s GDP. The U.S. Bureau of Labor Statistics estimates that growth in the industry will create 3.2 million new jobs between 2008 and 2018. The healthcare industry is an aggregate of many different industries and sectors, and is comprised of private, public and voluntary organizations. The healthcare industry broadly includes medical equipment, pharmaceutical companies and health insurance firms.

Academic medical centers, hospitals and research laboratories provide care and serve as a platform for innovation. The industry consists of a highly skilled workforce that includes physicians, nurses, and technicians. Industry subsectors include academic medical centers, nursing & residential care facilities, in-patient care and ambulatory care, among others. Academic medical centers provide advanced treatments, have research agendas supported by annual funding from the National Institute of Health, and act as anchors for regional life sciences clusters. The health services industry is connected with both the biopharmaceutical and medical device industries which presents a source of growth and innovation across sectors.

According to McGladrey 2013 yearly review, private equity deal flow in the healthcare industry in 2013 decreased from past years. There were 280 deals completed during the year but there was a drop in capital investment. Venture capital investing in healthcare over the past decade has been very consistent. From 2007 to 2012 the capital invested varied in a tight range of $7.3 billion and $8.7 billion. The annual VC healthcare rounds have remained stable within 35 deals from one year to the next. Opportunities and strengths in healthcare technology innovation are present across the entire Midwest, from Ohio to Minnesota to Missouri.

Minnesota

Minnesota, particularly the city of Minneapolis is a hub for the healthcare industry in the Midwest. Healthcare venture investments in 2013 for the region show Minneapolis, Minnesota leading all major Midwest metropolitan areas in healthcare venture investments. Minneapolis has attracted 227.7 million in venture investment and has 74 companies utilizing the investments. The amount of capital coming directly from venture investments is a great resource startups of Minneapolis can utilize during growth stages.

Minnesota is home to several healthcare accelerators and incubators. In 2012 a Minnesota medical technology accelerator was launched in Minnesota, which specializes in medical devices. Given the state’s historic strength in medical devices, the health accelerator Inceptis LLC will primarily focus on

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65 Ibid
67 Ibid
69 Ibid.
Class 2 medical devices\textsuperscript{71}. One health technology incubator currently operating in the Twin Cities of Minneapolis and St. Paul Minnesota is FocusStart. This is a medical technology development company that accelerates the process of development of new medical devices for emerging companies, and assist in evaluation, selection, and development to exit for products\textsuperscript{72}.

The Mayo Clinic is a premier academic medical research center based in Rochester Minnesota and is a resource to utilize for a healthcare hub. It is approximately 80 miles away from the twin cities of Minneapolis-Saint Paul and conducts a wide range of clinical research. In 2012 research statistics involving the Mayo Clinic showed that Mayo Clinic received $634 million in research funding, $386 million from the government, foundations & industry, and $248 million Mayo Clinic Funds and benefactor gifts. As a result there was 2,686 new protocols reviewed by the institutional review board, 8,968 active human research studies, and 5,672 research publications and review articles in peer-reviewed journals\textsuperscript{73}. There is a significant amount of clinical research being conducted at this center, and assets from this center can be utilized to serve as a resource for a healthcare hub.

\begin{figure}[h]
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\includegraphics[width=0.5\textwidth]{mayo_clinic_funding.png}
\caption{Mayo Clinic: Research Funding(in Millions) 2012}
\end{figure}

\begin{itemize}
\item Government, foundations and industry
\item Mayo Clinic funds and benefactor gifts
\end{itemize}


Cleveland, Ohio

Cleveland has the opportunity to become a hub for the healthcare technology innovation. Cleveland is taking advantage of regional assets to rebrand the area as a healthcare hub that attracts industry talent to the region. Biotech, medical devices and health information companies will be the primary sectors of interest. A few main factors are present that can cultivate rapid growth for this area. There is significant support from entrepreneurs that are embedded in start-ups. The vision for a healthcare hub is present within the state; and there is still a large untapped investment opportunity for health and information technology.

Regional Strengths, Resources, and Initiatives

The area has a vast amount of companies that can provide resources and help facilitate the industry growth for Cleveland. Cleveland is home to one of the top healthcare systems in the nation: Cleveland Clinic. Cleveland Clinic is an academic medical center that served over 5.5 million patients in 2013 while providing medical education and clinical research. Additionally, Cleveland Clinic is home to a laboratory based clinical biomedical research that received $163 million in total grant & contract revenue for research in 2013. Other major healthcare systems that are based in the region include: OhioHealth, Nationwide Children’s Hospital and the Mount Carmel Health System.

BioEnterprise is one resource for innovation that can serve as a model for other cities around the Midwest. It serves as an initiative for recruitment, business formation, and acceleration specifically for a few emerging firms in medical device, healthcare services, and biotechnology to promote company success. BioEnterprise provides a growing firm with access to resources including: a network of Venture Capital and Private Equity firms, grant funding opportunities, relationships with research & clinical institutions, business development, bioscience guidance & management and support in partnerships. Since 2002 BioEnterprise has created, recruited and accelerated over 170 companies,

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\( ^{75} \) Ibid


raised over $1.5 billion in new funding by these companies, collected over $210 million in revenue with technology offices, and had over 540 technology transfer deals with industry partners. 

One state program that has been successful in promoting and cultivating an atmosphere of growth is the Ohio Capital Fund. The Fund was established to help increase private investment in seed or early stage development for Ohio based companies. The Ohio Capital Fund has obtained $150 million of commitments from private resources for investment in qualified venture capital funds. These Venture Capital funds commit to invest at least half of the Ohio Capital Fund dollars in Ohio-based companies, corporations and individuals. By making commitments to VC funds, the Ohio Capital Fund acts as a catalyst to promote venture capital investment in promising Ohio companies.

Cleveland has constructed a health-tech hub for innovation. The Cleveland Health-Tech Corridor (HTC) is a 3-mile 1600-acre location devoted for early-stage biomedical, healthcare, and technology companies. HTC has partnered with organizations that share their mission in providing innovation. HTC provides access to major world-class healthcare institutions, nine business incubators, academic centers, and over 130 high-tech companies located in this hub. HTC engages 9 neighborhoods, over 50,000 students and more than 50,000 medical and technical employees. $450 million is supplied in annual research, $4000 provided in clinical trials and $3.8 billion has been secured since 2007.

Cleveland Challenges

The Cleveland area is attracting significant capital for funding of new healthcare technology enterprises; however, funding remains an issue of growing importance. Without an infusion of venture capital, healthcare technology startups are at risk if they do not secure Series A funding. Most of the venture investment goes to funding startups which require less capital compared to mature healthcare technology firms. Funding is available from different sources such as grants, innovation funds, or angel investors. Unfortunately, many startups within Ohio are now looking for Series A funding. Because Ohio has a limited amount of active venture capital firms, local sources of funding are limited, and competition for the funding is high among emerging enterprises.

Kansas City, MO

Kansas City is an example of Midwestern resources being allocated for the advancement of innovation and the local economy. The region includes an ideal combination of the presence of established healthcare systems, established firms and sources of capital such as the Kauffman Foundation and venture capital firm ThinkKC.

With many changes being seen throughout the entire healthcare ecosystem in the United States, it is worthwhile for entrepreneurs to seek out environments where industry leaders, healthcare industry investors, and healthcare magnet companies co-exist. Kansas City is one area that is currently working to develop a fostering ecosystem in healthcare technology. Kansas City is home to several health centers including the Truman35(3,5),(999,987)
Medicine and Biosciences as well as the University of Missouri School of Medicine. The region is also home to healthcare technology company Cerner Corporation, an electronic medical record vendor. Cerner is a magnet company that employs over 9,000 engineers, computer scientists and health care professionals. Like-industry companies will follow large, established firms for several reasons, the largest of which is talent attraction and retention.

Kansas City is also home to the Kauffman Foundation, the country’s largest private foundation dedicated to advancing entrepreneurship and innovation. With an estimated asset base at $2 billion, the foundation seeks to improve entrepreneurial endeavors through investing and education. With such a presence and influence in Kansas City, the Kauffman Foundation is a resource that has developed into a noteworthy network. The foundation looks to invest in start-up companies, but it also offers educational opportunities for entrepreneurs through weekly teaching meetings, classroom instruction, online curriculum and making them aware of resources that exist in their communities. Entrepreneurs in healthcare can learn business administration skills through the resources provided by the Kauffman Foundation.

An established technology firm with significant human and financial capital is Sprint Telecommunications. While they may not have previously been associated with the healthcare technologies industry, Sprint recently invested into a partnership with TechStars to build a mobile health technologies accelerator called Sprint Accelerator. The accelerator received a significant amount of funding from Sprint. TechStars is an established name in technology entrepreneurship. The value proposition of Sprint Accelerator is to provide an incubator environment by offering entrepreneurial mentorship as well as angel and venture capital investing, all specifically within the realm of Mobile Health Technology.

In Kansas City, TechStars is a consortium consisting mainly of venture capitalists, mentors who have experience in the healthcare technology industry, and serial entrepreneurs. TechStars has a network of resources for available, specifically in technology. TechStars is an established name in technology entrepreneurship, while Sprint has a leading network and infrastructure to sustain mobile applications.

**St. Louis**

Situated at the confluence of two great North American rivers ---the Mississippi and the Missouri – St. Louis is the 18th largest metropolitan area in the United States. Today, thanks in large part to regional universities and key Fortune 500 corporations; St. Louis has developed into a national hub for research and development.

St. Louis, the second-largest city in Missouri, has more than 2.6 million people, while boasting the sixth lowest cost of living rate in the nation. It is home to several corporate headquarters and 19 Fortune 1,000 companies in various sectors including health care, biotechnology, consumer goods, financial services, utilities, and manufacturing. Nearly 40 colleges, universities and technical schools contribute to producing the region’s strong workforce. The median household income is $51,985, with median home price $121,900. Because of the competitive rate and lower cost of living rate in Saint Louis, it has been consistently ranked among the nation’s most affordable and best place to live and raise family.

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St. Louis is home to renowned, world-class academic medical centers, hospitals and research institutions where clinical and research breakthroughs take place every day. For example, Goldfarb School Of Nursing at Barnes-Jewish College is located on the campus of Washington University Medical Center, along with Barnes-Jewish Hospital; St. Louis Children’s Hospital; Washington University School of Medicine; St. Louis College of Pharmacy.

St. Louis also affiliated with BJC HealthCare, the state's largest employer and one of the largest nonprofit health care organizations in the United States. BJC delivers services to residents primarily in the greater St. Louis, southern Illinois and mid-Missouri regions through 13 hospitals and multiple community health locations. The region also is home to several other academic medical centers and research facilitates that offer numerous collaboration and employment possibilities.

There are a few key reasons why St. Louis has been successful in fostering entrepreneurship. These contributing success factors include:

- **Local Support from the community:** Washington University in St. Louis and Saint Louis University offer nationally respected entrepreneurship programs. The students and graduates are highly talented and knowledgeable, and the program’s incubators and accelerators are yielding high-potential startups. It has also gained support from other group such as the IT Entrepreneurs Network and Innovate VMS, and angel capital activity. BioStl is another example of an initiative aimed at collaboration between multiple local stakeholders, from universities to private sector firms. “BioStl has focused on building elements that support entrepreneurs, and has been both the umbrella and the catalyst of all these activity”.
- **Growth of local VC firms:** Several early-stage tech VC firms, like Cultivation Capital, have opened their doors, complementing the established later-stage venture and private equity firms already in operation here. This provides local investors the chance to reinvest in their hometown communities.
- **Attracting entrepreneurial talent:** Local St. Louis accelerators are wisely offering modest prizes and grants to companies that move their operations. Arch Grants and Capital Innovators have both been successful in convincing entrepreneurs to relocate to St. Louis for $50,000 worth of funding. The quality of each of their respective classes of startups continues to improve, elevating the local talent level for an incredibly modest investment per company.
- **Supportive community:** St. Louis has a supportive environment where entrepreneurs are around each other and helping each other. In the year 2013, the city birthed a host of impressive venture-backed companies such as Appistry, CrowdSource, LockerDome, and Bonfyre. And government leaders recently announced a plan to raise $100 million over five years from local companies, investors, and foundations to help entrepreneurs start and grow their business in St. Louis.

Since 2001, St. Louis has grown to nearly $1 billion in bioscience venture capital under local management. However, a growing number of startups in St. Louis still require more capital funds. According to Donn Rubin, president and CEO of BioSTL, “Now that can support seed and pre-
seed investments for life science startups, the next challenge is round A.” St. Louis regional study conducted in 2013 declared that St. Louis needs $500 million to fund its entrepreneurs over the next five years. However, the region already maintains a critical mass of startups and capital efficiency that can greatly help the city raise enough sufficient capital.

Figure: St. Louis Biotech District, Courtesy of Cortex St. Louis

Resources across St. Louis include the following centers, institutions, and incentives specifically designed to support emerging-growth firms:

- **T-Rex**: A world-class venue providing the startup entrepreneur with low cost & flexible enterprise space, while serving the region with quality programming and inspiring community. Two years after inception, T-Rex occupies 80,000+ square feet and growing. It is now home to 80+ startups, iTEN, Capital innovators, Cultivation capital, SixTThirty, Arch Grants and home to many other entrepreneurial activity including Startup Weekend and StartLouis.

- **CORTEX**: The CORTEX is a nonprofit formed in 2002 by Washington University in St. Louis, BJC Healthcare, University of Missouri – St. Louis, St. Louis University, and the Missouri Botanical Garden. The district has completed or has under construction 1 million square feet of new and rehabilitated space that represents a $350 million investment. The master plan for the district includes $2.1 billion of construction, over 4.5 million square feet of mixed-use development, a new MetroLink light-rail station and 13,000 permanent technology-related jobs.

- **LAB 1500**: a place where seasoned and aspiring entrepreneurs can come together to develop business ideas. Members have the ability to work in different environments. The traditional co-working space with communal tables makes collaboration with coworkers and other members easy, while the lounge is relaxed and quiet. The facility and its classroom are also available for members to rent for meetings, classes and events.

- **Helix Center**: The Helix Center Biotech Incubator lab provides 33,000 SF of wet and dry lab space and offices for bioscience research entrepreneurs and biotech innovators. The incubator is geared toward fast-growing companies and entrepreneurs in the early stages of research in the plant and life sciences and in the commercialization of new technologies.

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• **CIC:** CIC, the largest innovation center in the world, is officially expanding in St. Louis. CIC signed a 15-year lease with Wexford Science & Technology to occupy a majority of the second floor at the “@4240” building in Midtown. 101

• **UM Research Park:** The University of Missouri System’s statewide network of research parks attract new startup companies from university research efforts, as well as firms across Missouri and throughout the world, representing ideas in a wide range of disciplines and spurring quality job creation.102

• **Arch Grants:** Arch Grants seeks to create a more robust startup culture and infrastructure in St. Louis. To increase employment growth and establish St. Louis as a place where entrepreneurs want to start and grow their businesses, Arch Grants offers startups funding in the form of grants and supports the startups as they remain or transition to downtown St. Louis.103

### Chicago Strengths

#### Chicago Academic Institutions & Medical Centers

Chicago has many resources that support an increase in opportunity for healthcare technology innovation. One major strength of Chicago is the presence of renowned, world-class academic medical centers and prestigious research institutions. As of 2011, there are 18 major institutions located within Chicago with 153,707 registered students, from these 18 institutions there is a total of 42,288 degrees conferred as a result104. In 2012, there were 23,644 health services within Chicago, further broken down by 189 hospitals, 18652 ambulatory healthcare services, 958 nursing & residential care, and 3846 social assistants. In total, 527,547 people were employed in this industry.105

Chicago is home to one of the largest concentrations of medical research centers in the United States. Chicago area universities were awarded nearly half of a billion dollars in research support from the NIH in 2011, more than double the amount given to the Mayo Clinic, and more than six times the amount awarded to the Cleveland Clinic106. Major academic institutions based in Chicago enroll nearly 60,000 students and grant more than 24,000 degrees in healthcare related fields on an annual basis.107 The University of Chicago, and Northwestern University are two examples of prestigious research universities. These institutions can foster clinical and research breakthroughs in healthcare. An example of this research is through the Northwestern University Feinberg School of Medicine in the Center for Education in Medicine’s Innovations Lab. The Innovations Lab is a modeling, prototyping, and production laboratory, and collaborates with members within the medical school108. Projects are geared to medical needs and some projects already completed by the lab include: a Cricothyrotomy trainer, Dermatology model and lumbar puncture cartridges109.

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101 The @4240 building is part of the $186 million second phase of development at CORTEX, which also includes construction of a $45 million office building for BJC HealthCare and major infrastructure improvements.
107 Ibid.
109 Ibid.
Collaboration: Baxter Northwestern Alliance

The Baxter Northwestern Alliance Collaboration Agreement was founded in January of 2009 to promote multidisciplinary research and innovation. In this initiative, Baxter funds research-collaborated projects at Northwestern University and activities will focus on new therapeutics, biomedical and device engineering, biomaterials and drug-delivery technology. Over a three-year collaboration period, Baxter funded more than 20 research projects for the university. Examples include: an antibacterial coating to help prevent device related infections, and an automated system that checks IV bags. The Baxter Northwestern Alliance, is an example of the benefits of collaboration between research universities and businesses.

Chicago Environment for Start-ups

The Illinois Medical District (IMD) and Chicago Technology Park (CTP) are two locations that are fostering a startup environment. IMD is an environment that includes 560 acres of medical research facilities, labs, a biotech business incubator, raw development area, universities and more than 40 healthcare related facilities. IMD has the goal of fostering economic development through its supporting research and development facility. IMD adds $3.4 billion to the economy of the Chicago region, most from the impacts of the University of Illinois at Chicago and Rush University on educational attainment in the region. The IMD’s universities spend about $392 million on research and combined are responsible for 20-30 patents per year.

Chicago Technology Park (CTP) is a 56 acre area within the IMD that serves as a space offering growth for healthcare technology startups. CTP provides university resources, supplies equipped infrastructure, and offers programs for business development services. CTP has successfully graduated over 25 firms into the local economy. Companies in CTP include those in drug discovery and delivery, medical devices and testing, genomics, nanotechnology and others who collaborate with premier medical facilities for research and design. The unique environment of IMD and CTP provides a valuable resource for healthcare technology startups, and is an opportunity for Chicago to better connect the commercialization of medical research to the greater entrepreneurial ecosystem.

One noteworthy organization that provides mentorship to early-stage firms is Chicago Innovation Mentors (CIM). CIM aids university-based and new technology innovations ventures. CIM matches early-stage commercialization projects with a network of experts that serve as mentors. CIM’s focuses include biomedical, healthcare and science based ventures. As of February 2014, CIM has 180 mentors and has mentored 100 venture teams, five of which have graduated the program, and are currently working with 74 active teams. Mentors assist in the development of new ventures, and devote time to provide support, perspective and guidance to the mentees. The Chicago Innovation Mentors are a resource that can be taken advantage of for any prospective startup located in Chicago.

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Funding

Chicago has a number of active angel and early-stage investor groups. There are over 7700 individual angel investors in the Chicago greater Chicago area.\(^\text{116}\) Chicago also has more than ten Angel investor groups, including Hyde Park Angels, Irish Angels, and Wildcat Angels. The Chicago angel community, while growing, remains small and somewhat fragmented, and this is reflected in investment deals. Increasing deal syndication, while also exposing the angel community to fundable opportunities within healthcare innovation, can serve as a catalyst to attracting early-stage health-tech startups.

Chicago is improving in investors and entrepreneur education along the way. In recent years the development of incubators in Chicago can be seen with efforts such as Healthbox, and the Health Technology, and Innovation facility. Their importance to the development of startups in Chicago cannot be understated, especially given the goal of consolidated access to disparate resources and stakeholders.

Chicago & Regional Fragmentation

The fragmentation of healthcare resources in Chicago and the Midwest has acted as a barrier to healthcare and healthcare technology innovation in the past. As previously discussed, there are significant stakeholders, capital and other resources dispersed throughout the Midwest. Different strengths are found in different cities, making the success of the Midwest for a healthcare innovation ecosystem dependent on linkages between metropolitan areas.

NIH Funding by Region (2013)

![NIH Funding by Region (2013)](image)

Significant obstacles have developed in Chicago and the Midwest through fragmentation of stakeholders and resources. Entrepreneurs have found convenience in relocation to the coasts; presence of investor understanding in healthcare industry startups as well as mentorship has driven some bright Midwestern minds out of the area. The Midwest has the opportunity to rise collectively through collaboration. For

example, National Institute of Health grant funding in the Midwest, collectively, is greater than Northeast and even California. 117

Chicago’s geographic location provides opportunities to develop as a hub for healthcare innovation, with the metropolitan area accounting for many assets in the healthcare industry, such as:

- Home to 121 hospitals. Of the 121, 35 are listed as top national hospitals in the United States. 15 of the top ranked hospitals specialize in cancer research 118
- Chicago boasts the largest concentration of doctors in the United States 119
- Six schools of medicine call Chicago home, including the Pritzker School of Medicine (University of Chicago), Feinberg School of Medicine (Northwestern), University of Illinois College of Medicine, Rush Medical College, Stritch School of Medicine (Loyola) and Rosalind Franklin University of Medicine and Science
- Major federal research labs (Fermilab and Argonne)
- Second largest pharmaceuticals hub in the United States 120

Of the major hospital systems in Chicago, the university hospitals offer unparalleled opportunities for healthcare innovation through collaboration with business and engineering schools, entrepreneurs, and established life science firms.

Chicago Opportunities and Recommendations

Overview

Observing the significance of Illinois and Midwestern research, the National Institute of Health invests considerable amounts of capital into the Universities, Laboratories and Hospitals here at home. 121

![Graph showing NIH Awards by Location and Organization for 2013](image)

**2013**

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120 Ibid.
Investment in research also fosters for the development of a talent pool of well-trained scientists and engineers, which in turn enables an increase in high quality, high-wage jobs and giving Illinois a real competitive edge. As talent attraction and retention is a substantial issue in Chicago, Illinois and the Midwest, there is opportunity for a solution through the utilization of sustainable federal investment in local research.

**Collaboration Case Studies**

At Argonne National Laboratories, the US Department of Energy recently pledged $120M to the Joint Center for Energy Storage Research, or JCESR. The JCESR is a high-powered syndicate of universities, national laboratories and private sector partners working to develop more sustainable batteries for transportation and power/energy sources.\(^\text{122}\)

There is more to measure than the immediate economic impact of innovation. Consider the pharmaceutical drug, Lyrica, invented by a Northwestern University professor and now the most effective treatment for chronic pain and seizures. The drug generates billions of dollars in annual sales. However, these numbers fail to illustrate even greater value - the improved quality of life and increased productivity of millions of people around the world.\(^\text{123}\)

**Economic Impact**

Research opportunities created by a willingness to invest federal dollars in discovery and innovation will have a tremendous short-term impact on Illinois' great scientists and engineers. However, the real gain or loss will be felt in every sector of our economy, for years or even decades to come.\(^\text{124}\)

**Current Structured Resources in Chicago**

The intersection of medicine and business provides a nurturing environment for entrepreneurship and innovation. In Chicago, partnerships between academic medical centers and colleges of business currently exist. An example of cooperation in entrepreneurial spaces is at Northwestern University. Northwestern has created an interdisciplinary program, called NUvention, that brings together students from the Kellogg School of Management, McCormick School of Engineering and Applied Science, Northwestern Law and the Feinberg School of Medicine. In this collaborative, students make commercially viable business models in medical technology or patient care and experience the entire entrepreneurial cycle. Students contribute their area of expertise to the project continuum.\(^\text{125}\)

A similar program is being enacted at the University of Chicago—The Chicago Innovation Exchange (CIE). The CIE is opening up physical space in Hyde Park for students, faculty and entrepreneurs outside of the university to come together. Here, innovators will be able to work in proof-of-concept, business incubation and collaboration opportunities. Some key parties include Argonne National Labs, the Polsky Center for Entrepreneurship and Innovation, Booth School of Business and the University of Chicago Pritzker School of Medicine.\(^\text{126}\)

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\(^\text{123}\) Ibid.

\(^\text{124}\) Ibid.


These partnership efforts created by universities to bring together individuals from varying industries for the purpose of healthcare technology innovation are creating ideal conditions for entrepreneurs. Although the positive economic impact is difficult to measure, the future success of startups as a result of incubation builds connections and creates high-talent jobs. The expansion of the practices seen at NUvention and the Chicago Innovation Exchange into proximate universities will allow for even greater healthcare technology discovery, and subsequently, economic growth and return on investment. NUvention and CIE are experiencing significant interest from the entrepreneurial community, and the same interest has the potential to be sparked at neighboring universities in neighboring cities.

**Growing Framework**

The construction of Matter illustrates the city’s interest in healthcare and biotechnology discovery and innovation. 1871 also provides common ground for entrepreneurs, investors and other resources to come together in technology spaces. Incubators and accelerators offer transparency in health innovation. By filling in the spaces between startups and investors, programs like iBIO Propel and Chicago Innovation Mentors and allow for an increase in exits for healthcare technologies. Similarly, the Chicago Life Sciences Consortium (CLSC) is another example of Chicago’s interest in becoming a healthcare technology and biotechnology hub for innovation. The CLSC consists of industry leaders in healthcare and the life sciences with a mission to stimulate life science investment, research and education by bridging public, private and NGO sector boundaries in Chicago. The goal is to act as a source of incubation and acceleration for early and middle stage healthcare and life science companies and entrepreneurs.127

**Conclusion**

The necessary pieces to become a healthcare technology hub currently exist in Chicago and across the Midwest. Talent, academic and medical institutions, capital, incubators, accelerators and entrepreneurship are present in several major cities, with the potential to create an even larger entrepreneurial mindset if such resources are properly deployed. Therefore, it is important to increase linkages between cities and stakeholders, thus spawning an increase in entrepreneurship and innovation. The growth of the healthcare innovation ecosystem in the Midwest is poised to have positive impacts on the local, regional and national economy, while simultaneously improving the quality of healthcare for millions of individuals across the United States and around the world.

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Executive Summary

Because of the growing disintermediation between end consumers and the rural origins of much of their food, agriculture industry’s importance often becomes an afterthought and taken for granted. However, in many ways, agriculture is the base roots and lifeblood of the United States that has fueled global success. The Midwest has played an integral part in the national strength of agriculture as 45% of the total U.S. agricultural exports are developed from the region while using only 21% of total U.S. land. Furthermore, 83% of soybean, 85% of feed grains, 51% of wheat, and 60% of live animal exports derive from the same North Central Region. With these key strengths in mind, we conducted extensive primary research through numerous interviews of individuals across all spectrums of the agriculture entrepreneurship ecosystem to determine the feasibility of an agricultural technology cluster in the Midwest.

From our research, we identified a series of key strengths and opportunities for the agriculture community to capitalize upon for future regional and industry growth. The biggest regional strength identified through research is the spread of industry-leading agriculture companies in the Midwest including firms such as Deere & Company, Monsanto, Cargill, ADM, Pioneer, General Mills, Kellogg’s, and Kraft to name a few examples. Overall, 35 agriculture firms in the Midwest earn over $2BB in annual revenue. When coupled with 7 of the top 30 agriculture and forestry colleges in the world, the Midwest has the necessary corporations and renewing of talent for the creation of a regional agriculture and entrepreneurship hub.

However, with great opportunity come challenges. As noted in interviews with industry experts, the agriculture industry must overcome several key challenges including a lack of venture capital, linkages as to the activity of large firms, and the breadth of geographic locations spread across the Midwest. Through regional networks and collaboration spaces, many of the startups can obtain the needed capital for expansion and smaller firms can learn about the key challenges faced by large firms. A collaborative and cluster approach to leverage the current industry strengths of agriculture in the Midwest can lead to the development of a global agriculture entrepreneurship cluster centered in the Midwest.

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129 Ibid
130 OneSource
Industry Overview

Introduction

Most people do not consider where their food comes from. Some people think meals come from the grocery store; others from fast food restaurants. Often the correct answer is the fertile land of the Midwest, which produces most of the country’s corn and soybeans. The robust farming industry in the central states lays a strong foundation for the region’s agriculture related industries, such as manufacturing for farming equipment, crop science, and food processing.

For the past 50 years, a focus on farm efficiency has brought about a paradigm of shifting technological innovations and advancements that have changed the way food is grown and produced in the United States. Since the introduction of commercial fertilizer, advanced farming equipment and genetic materials, a theme can be observed — a decreasing number of farmers producing increasing amounts of agricultural commodities. In 1960, roughly 15 million farmers existed, accounting for 8 percent of American workforce. By 2007, the NASS Census indicated only 3 million farmers existed, of which one-third or 1 million were located in the Midwest. Contrary to the decline in the number of farmers, production has increased dramatically. Images 1 through 6 below show production and yield trends of Midwest corn and soybeans from 1960 to 2013. In the Midwest, corn production has more than tripled while maintaining the same acreage. Similar increases in per acre yield can be observed in soybean production as well; with increasing acreage, soybean production is now more than five times the 1960 production level. The escalation of production and technology advancement cannot be more astonishing — for the next 50 years, as Monsanto indicated, more food must be produced than ever in the past 10,000 years combined.

The amount of yield per acre observed in both soybeans and corn has grown at a relatively constant rate, which will continue into the foreseeable future, if not increasing further as demands for both crops are expected to rise. With a growing and increasingly affluent world population, mechanisms that will further increase agricultural production and sustainability will be highly valued. An area of research performed domestically in the U.S., as well as in foreign countries, is precision agriculture as a method to increase efficiency. Innovations within precision agriculture and other emerging technologies could become disruptive innovations in their own industry while also providing nourishment to billions of humans across the globe. Because of the Midwest’s unique situation of not only having large companies located in the region but also the farm fields that utilize advanced agricultural technologies, a regional tech cluster should be formed to best aid the development of these advantages as the demand for agricultural services sharply increases in the future.

Midwest Corn Acreage from 1960-2013

Midwest Corn Production

Corn Yield Measured In Bu./Acre from 1960-2013
Midwest Corn Yield Measured In Bu./Acre

Midwest Corn Production from 1960-2013

Midwest Soybeans Acreage

Soybeans Production from 1960-2013
Midwest Opportunities

The agricultural industry, centered in the Midwest, currently has a total value of around $125 billion while also providing the opportunities of 2.4 million related job positions.\(^{136}\) New technological innovation in the industry is about to emerge in (but not limited to) novel health, specialty crops, biofuels, and other bio-based products. Each of these innovations has the potential to create thousands of jobs and attract thousands of knowledge-based companies. In addition, the Midwest area also presents optimal opportunities for fundamental scientific research support, translational support mechanisms, including land-grant agricultural experiment stations and extension services. Currently, there are 12 member institutions in the North Central Cooperative Extension Association (NCCEA). Various county extension agents are offering education to local farmers in order to let them serve as the primary unbiased link between the farm and new technologies and production practices.\(^{137}\) The Midwest has more than 226 million acres in cropland, 86 million acres of pastureland, and 17 million acres of woodland. This area covers over 80% of the United States’ corn and soybeans, as well as the majority of the nation’s wheat, sunflower, canola, and sorghum. In addition, the Midwest area produces 46% of the nation’s cattle, 87% of corn, and 83% of soybeans.\(^{138}\) These characteristics of the region poise the Midwest as the ideal spot to host and facilitate a world-leading technology cluster focused on the development of agricultural technology.

![USA Agricultural Productivity in the Midwest](image)

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\(^{137}\) Ibid

\(^{138}\) Ibid
<table>
<thead>
<tr>
<th>Farmland(1000s)</th>
<th>North Central Region</th>
<th>Percentage of U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmland</td>
<td>342,587</td>
<td>37%</td>
</tr>
<tr>
<td>Cropland</td>
<td>226,171</td>
<td>56%</td>
</tr>
<tr>
<td>Woodland</td>
<td>17,205</td>
<td>23%</td>
</tr>
<tr>
<td>Pastureland</td>
<td>86,166</td>
<td>21%</td>
</tr>
<tr>
<td>Total land Area</td>
<td>480,218</td>
<td>21%</td>
</tr>
<tr>
<td>Number of Farms</td>
<td>806,300</td>
<td>37%</td>
</tr>
<tr>
<td>Crops</td>
<td>67,732,260</td>
<td>45%</td>
</tr>
<tr>
<td>Animals</td>
<td>53,742,944</td>
<td>39%</td>
</tr>
<tr>
<td>Services and Forestry</td>
<td>13,154,651</td>
<td>35%</td>
</tr>
<tr>
<td>Total Agricultural Output</td>
<td>134,629,855</td>
<td>41%</td>
</tr>
</tbody>
</table>

**Total and Total Agriculture Commodity($1000s)**

<table>
<thead>
<tr>
<th>Cattle and Calves</th>
<th>20,130,804</th>
<th>46%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>36,661,158</td>
<td>87%</td>
</tr>
<tr>
<td>Soybeans</td>
<td>24,878,810</td>
<td>83%</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>6,706,927</td>
<td>28%</td>
</tr>
<tr>
<td>Total Agricultural Commodities</td>
<td>125,968,737</td>
<td>44%</td>
</tr>
<tr>
<td>Eggs(units in thousands)</td>
<td>42,379</td>
<td>47%</td>
</tr>
</tbody>
</table>

**Top 5 Agricultural Exports($ in millions)**

| Soybeans and products | 14,638 | 83% |
| Other(see source)     | 1,515  | 12% |
| Feed grains and products | 10,191 | 85% |
| live animals and meat | 5,371  | 60% |
| Wheat and products    | 4,404  | 51% |
| Total Agricultural Exports | 43,111 | 45% |

**Figure: USDA-ERS Data on Agricultural Productivity in the Midwest**

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Farms throughout the Midwest act as the key base from which many other supporting companies have arisen. In 2009, the Midwest area contained more than 88,000 companies supporting the farms through manufacturing and supplying agricultural inputs such as seeds, fertilizer, insecticides, farm equipment, etc. Farms also provide materials for agricultural and forestry processing services such as grain milling, oilseed crushing and lumber milling, value-added manufacturing of food, nutrition, and other health products, as well as the production of industrial products from bio-mass including fuels, chemicals, materials, paper and textiles.\textsuperscript{140}

In addition to Midwestern farms creating demand for supporting industries, many of the leading global seed, food, and machine manufacturers are located within the Midwest. As a result, the Midwest region functions as a hub of major agbioscience-based industry for innovations. The resources of this area include ten of the top 25 U.S. food manufacturer’s headquarter in this area: Kraft, Anheuser-Busch, General Mills, ConAgra, Kellogg, Sara Lee, Hormel, Cargill, SABMiller, and Chiquita Brands. In addition, two of the top five seed companies from around the globe locate their businesses in the North Central U.S. region: Monsanto and Land O’Lakes. With more than 400 plant and life science firms in the St. Louis region, the area also maintains the largest cluster of plant science Ph.D.’s in the world.\textsuperscript{141}

Two of the world’s preeminent agricultural equipment manufacturers are also based in the Midwest region, which are the world’s largest agricultural equipment manufacturer Deere & Company (located in Illinois) and the world’s second largest agricultural equipment manufacturer Case New Holland’s North American Headquarter (located in Illinois). Outside of plant-based agriculture, the Midwest is also the center to many of the leading animal science corporations in the world including: Fort Dodge Animal Health (located in Kansas), Abbott Animal Health (located in Illinois), Boehringer Ingelheim Vetmedica (located in Missouri), Novartis Animal Health (located in Iowa), and also Pfizer Animal Genetics (located in Michigan).\textsuperscript{142} The Kansas City region boasts “the single largest concentration of animal health interests in the world.”\textsuperscript{143}

\textsuperscript{140} Battelle(2011).Power & Promise: Agroscience in the North Central United States.[online] Retrieved from: https://mail.google.com/mail/u/0/?pli=1#search/battelle/144e7eea88b5aa?compose=1451c4e7acfdab8b&projector=1
\textsuperscript{142} Battelle (2011)
Finally, the land-grant universities constitute much of the current strength of the Midwest because of the testing, piloting, other scale-up infrastructure and expertise to provide innovative opportunities in the Midwest. “Land-grant universities” are public universities in each state that were founded as institutions requiring an agriculture school pursuant to the Morrill Act in 1862. Today, these universities are among the world’s premier research institutions such as the University of Illinois at Urbana-Champaign. In 2009, these colleges in the Midwest conducted $3.6 billion of academic research in ag-biosciences studies. In addition to research, these universities also provide skilled human capital needed by the Midwest ag-biosciences sector for basic and applied knowledge base to advocate the advancement of ag-bioscience. With skilled human capital, a pipeline of developed student talent was created that has sustained science and technology development to keep the U.S. agricultural industry, agribusiness and associated business sectors at the peak of its innovational competitiveness.\footnote{Ibid}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Ranking} & \textbf{University Name} & \textbf{States} \\
\hline
4 & University of Wisconsin-Madison & Wisconsin \\
6 & Purdue University & Indiana \\
10 & Iowa State University & Iowa \\
11 & Ohio State University & Ohio \\
16 & Michigan State University & Michigan \\
17 & University of Illinois at Urbana-Champaign & Illinois \\
26 & University of Minnesota & Minnesota \\
\hline
\end{tabular}
\end{table}
Illinois and Chicago

In the heart of the U.S. Corn Belt, Illinois has significantly contributed to the production of corn, soybean, and swine in the world. According to the Illinois Department of Agriculture, more than 76,000 Illinois farms cover nearly 80 percent of the state’s total land area, producing a wide variety of agricultural commodities. Though most of Illinois’s farmland produces corn and soybeans, roughly 1 in 4 farms raise beef cows, and about 1 in 10 farms raise hogs. With more than 9 billion dollars revenue generated from sheer marketing for sales, agriculture drives prosperity to both rural and urban Illinois.

Chicago, the global city of the Midwest, has been both a hub of financial exchanges among industries and a place where young talent finds their career paths. Many of the global leaders of agriculture are located either within a short radius of the city or in a bordering state, as the city acts as a commerce hub for agriculture with the Chicago Mercantile Exchange operating in the heart of the city. The city performs as the center for international business, its resources include:

- Major U.S. research centers: Argonne, Fermi, USDA’s National Center for Agriculture Utilization Research
- The largest diagnostic & imaging concentration: Abbott, Roche, Siemens, GE, Philips
- The largest agricultural and industrial biotechnology concentrations: ADM, Tate& Lyle, Monsanto, BP, DowAgro, Cargill, Dupont
- 35 agriculture companies, each with revenue over $2 billion, are headquartered in Midwest

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149 Ibid
150 Ibid
Entrepreneurs and Chicago alike will benefit from the concentration of large institutions, research facilities, and funding available to grow new innovations in the agriculture industry across the Midwest.

The Next Innovations: Combining Engineering and Agriculture

The next innovation for the industry lies in the application of emerging technologies to promote agricultural functions. Precision agriculture and biotechnology have the ability of being two of such emerging technologies that could create a paradigm shift in the industry. Research on these topics and applications of the technology have already begun assisting farmers on not only farming smart, but also planting the right seeds.

Precision Agriculture

Smart technology has already touched lives of millions, and now, it is coming to large farms. USDA (NRCS) in its report on precision agriculture: NRCS Support for Emerging Technologies, published in 2007 defined the term as “a management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture, or yield, for optimum profitability, sustainability, and protection of the environment.”152 In effect, precision agriculture utilizes much of the ‘big data’ and data analytics trends usually associated with the high-tech world and applies these capabilities to farming.

The four major focuses in precision agriculture today include: automation, data analytics and decision-making, resource management, and information communication.

Automation

Examples of two of the more promising technologies within automation are real time kinematic (RTK) and light bar guidance systems that enable a piece of agricultural equipment to drive itself. The RTK technology is essentially a very accurate GPS guidance system. It allows auto-steer, an add-on component, to drive agricultural equipment with sub-inch accuracy. It is the integration of GPS and software. It uses GPS system to receive and process signals, and the hardware, driven by the software inside, steers the equipment. RTK technology is accurate and expensive, but its best use is for production processes that require pin-point accuracy, such as planting. Light bar guidance systems are an inexpensive solution for purposes that involve less accuracy, such as spreading and spraying applications. It is a GPS guidance system mounted in the cab of agricultural equipment that provides direction to the driver by means of a horizontal display of lights. A series of lights enables the operator to align the tractor with the next set of rows requiring treatment to prevent over application of nutrients or pesticides. Newer models can provide some auto-steer functions. These two products display some of the advancements and possibilities enabled by applying technologies from more traditional high-tech areas to the agriculture industry as to improve farming operations.153

Big Data and Decision-Making

As IBM indicated in their white paper, “Analytics in agriculture: Driving efficiencies and insight to create ‘Smarter Agribusiness’”: “As science took the lead in the last Green Revolution, information technology, including advanced analytics and big data’ solutions, will drive the required efficiencies and insight for improved decision making in this new era of “Smarter Agribusiness.”¹⁵⁴

Big data in agriculture focuses on gaining a better understanding of the farm and factors that influence the yield of it. Within this area, big data has a wide array of applications in the agricultural production process, ranging from pre-planting decision making to assisting farmers in identify optimal treatment and threats to yield. Generally, a large field is broken into finer "grids", much like pixels on a LCD display. Environmental attributes that pertain only to that certain grid are gathered by various traditional and emerging technologies, such as soil survey, aerial imagery, high-resolution satellite images. Then, properties of the field, such as pH, moisture, yield and management history, etc. are stored to either local or cloud storage. The data gathering process is strongly influenced by advancement in industries other than agriculture, such as design and manufacturing of sensors, which may be placed in the next generation of drones, whose commercial use is subject to future regulation approval.

At the early planning stage, field specific data can help farmers decide the optimal seed hybrid and planting date for best yield. At the early planning stage, field specific data can help farmers decide the optimal seed hybrids and planting date for best yield. As new as big data analytics is, Climate Corp, a firm recently acquired by Monsanto for $930 million, provides a line of consulting services to farmers regarding decisions from planting to harvest in order to help its clients to improve per acre profitability.

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The driver behind its power is the capability of tracking, keeping, organizing, and interpreting detailed information pertaining to small areas of land. Because the amount of data generated far exceeds the conventional methods of data organization and interpretation and the data contains details that can influence a farm’s entire year’s results, big data business will be valuable to farmers in ways of increased profitability and assurance.

Basic economic principles suggest that competition will increase quality of goods and services, as well as driving down prices. With the lack of competition existing in agricultural big data, a window of opportunity exists for start-ups with data analytical expertise to get involved in agricultural big data, and gain from magnet companies that seized the Midwest talents within the Midwest area. Even companies like IBM have turned their attention towards data analytics in the agriculture industry. With entries of competitors in the future, big data and various informational technology programs should drastically change operational norms in the industry.

Resource Management

Resource management is where technology and data analytics join forces, and precision farming becomes ‘precise.’ Once the farmer has planted the right seeds, mapped out his farm, and has the right equipment, he can then employ variable-rate application, not only as a cost containment mechanism but also as a yield optimization method.\(^{159}\) With variable-rate application, computer-controlled equipment continually readjusts the application of nutrients, water, and pesticides. By applying exact amounts needed by each area of the field, farm profitability increases as resources can be more efficiently utilized. Sampling data from various sensors can provide the prescription for the particular fertilizers or pesticides to be applied to each area.\(^{160}\) Next, a GPS receiver in the spreader truck enables the computer to recognize where it is in the field. Finally, computer controlled nozzles vary the types and amounts of inputs according to the variable rate application plan.\(^ {161}\)

Information Communication

Information is only useful when timely communicated to decision makers. Today, people consume increasingly large amounts of information digitally since personal computers, mobile phones and tablets allow users to quickly draw information while they work in the field. For precision agriculture consulting services to be valuable for producers, information must be updated in real time and delivered in multiple channels. Monsanto has achieved this with its Climate Corp website, which updates weather information, forecast, impacts on yield tailored to specific field grids, and other analysis features such as optimal planting time interval, all in real time. Its \textit{AgIndex} app for mobile systems, provides information such as weather forecast, news release, insect risk forecast, etc., and presents it in a way that users could learn it with a quick glance. With advancement in precision agriculture, we can see the increasing need for development of easy and practical information distribution channels.


Figure: Climate Corporation application images

Example Startups in Agriculture

In addition to resources, several identified Midwest startups have had exceptional results raising capital and continuing their businesses.

Solum

Solum, an Iowa based 25 people company, made significant strides since it was founded in 2009. Its line of research involves the applications of software and soil measurement on precision agriculture. The company is backed by Khosla Ventures, Andreessen Horowitz and Google Ventures. In 2012, the company was able to raise $17 million from venture firms. The company is now part of Climate Corp, which in turn is part of Monsanto.

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163 A screenshot of Monsanto’s AgIndex app for iPad.
NewLeaf Symbiotics

NewLeaf Symbiotics is a biotech company located in the Bio-Research & Development Growth Park (BRDG) in Missouri. It was formed in 2012, and is researching a family of bacteria that will allow crops grow faster, healthier, and produce higher yields. It has filed its own patents, and plan on commercialize its products in 2014. In January 2013, the company was able to raise $7 million from venture investors.

Farmeron

Farmeron is a cloud based farm management system developer that specifically target dairy management. Farmeron hopes to replace overwhelming spreadsheets used by most farmers to track farm operations data. On May 8, 2012, the company was able to raise $1.4 million from venture capitalists.

Biotech & Genetic Materials

Precision agriculture helps farmers achieve the maximum yield potential of their seeds through data analysis and external technology. Genetic seed engineering technologies, on the other hand, help farmers raise the yield potentials by adding advantageous traits. Seed companies now produce seed varieties that are resistant to herbicides and worm, as well as other adverse factors that would harm yields. Already existing technology clusters in this area include the BRDG Research Park and University of Illinois Research Park. These existing technology parks provide infrastructure and function as incubators for startups.

St. Louis Case Study: A Global Plant Sciences Cluster

Monsanto Corporation

Monsanto, a leading global agriculture firm based in Saint Louis, MO, produces and markets various seeds, in addition to a variety of other products that help increase yields. According to Morningstar, “about 90% of the soybeans and 80% of the corn grown in the U.S. contain a Monsanto trait.”\(^{164}\) Besides genetically modified organism (GMO) products, Monsanto behaves as a magnet company in the Saint Louis community. Because of their global nature, advanced research, and involvement within the community, Monsanto has been able to draw and retain talent within Saint Louis and the Midwest.

In the past three years, Monsanto has made several significant investments and acquisitions that have impacted the agriculture and startup community. On October 2, 2013, Monsanto acquired leading machine-learning and weather startup Climate Corporation for around $1.1 billion.\(^{165}\) Climate Corporation aims to help farmers to predict climate changes by examining weather data and providing insurance in order to help farmers remain profitable in extreme weather conditions. Through Climate Corporation’s data collection and analysis technology, Monsanto has increased optimization of agricultural yields around the globe.\(^{166}\)

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\(^{166}\) Ibid
In May 2012, Monsanto also acquired Precision Planting Inc., from Tremont, IL, to become a part of Monsanto’s Integrated Farming system business unit that aims to maximize production yield. The $250MM acquisition will allow Monsanto to help farmers to control the growing process of their crops.167

Further investments into the community include an investment of $400 million to acquire a research facility in Chesterfield, MO and created 675 job opportunities in April 2013. With the investment, Monsanto has expanded its research center by adding laboratories, greenhouse and plant growth chambers and hire more scientists with well-paid salaries for future agricultural research and technology development.168

<table>
<thead>
<tr>
<th>Monsanto's 2014 Research &amp; Development Pipeline</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartStaxPRO</td>
<td>This product could increase farmer's ability to fight agriculture's &quot;billion dollar bug&quot; - the corn rootworm - with the potential of more corn and less insecticide costs.</td>
</tr>
<tr>
<td>Higher Yielding Corn (Biotech-Phase 3)</td>
<td>The higher-yielding corn trait, when stacked on top of Genuity corn products and other corn pipeline traits, could help farmers grow more corn on their land.</td>
</tr>
<tr>
<td>Third Generation Above Ground Insect Protection (Biotech-Phase 3)</td>
<td>This next-generation product is designed to give growers broader control in managing the corn earworm and fall armyworm insects.</td>
</tr>
<tr>
<td>Fourth Generation Below-Ground Insect Protection (Biotech-Phase 1)</td>
<td>This product could provide farmers with multiple modes of action for increased root protection and crop durability against corn rootworm.</td>
</tr>
<tr>
<td>Anthracnose Stalk Rot (Breeding-Phase 4)</td>
<td>This product could help protect crops against this fungus. Stalk rot diseases are found around the world and anthracnose specifically affects 65% of all U.S. corn grown.</td>
</tr>
<tr>
<td>Gross's Wilt Resistance (Breeding-Phase 3)</td>
<td>Gross's Wilt Resistance corn could help protect crops against this devastating bacterium that affects close to 30% of all U.S. corn acres.</td>
</tr>
<tr>
<td>Corn Yield &amp; Stress II (Biotech-Phase 2)</td>
<td>This second-generation corn Yield and Stress trait will use multiple genes to protect the corn pant from stress, helping farmers grow more corn on their land.</td>
</tr>
<tr>
<td>Second-Generation Stalk Rot Resistance (Breeding-Phase 1)</td>
<td>Stalk rot affects nearly all corn-growing regions globally. This corn would have more resistance to these stalk rot diseases.</td>
</tr>
<tr>
<td>Next Generation Herbicide Tolerant Corn (Biotech-Phase 3)</td>
<td>This product, with both glufosinate and dicamba tolerance, could help farmers manage weeks like waterhemp, kochia, and marestail.</td>
</tr>
<tr>
<td>Gray Leaf Spot Resistance (Breeding-Phase 3)</td>
<td>Gray leaf Spot resistance could improve protection against a fungal disease which, as one of the widest spread corn diseases in the U.S., impacts more than half of all acres planted each year.</td>
</tr>
<tr>
<td>Fourth Generation Weed Control (Biotech-Phase 1)</td>
<td>This product contains multiple herbicide tolerances that could help farmers protect fields from broadleaf and grass weeds.</td>
</tr>
</tbody>
</table>

Danforth Plant Science Center

Most prominent of Monsanto’s acquisitions and developments within the Midwest is the donation of $50MM and 40 acres of land to aid in the creation of the Danforth Plant Science Center and create a location for plant science innovation in the Midwest.\(^ {169}\) The Danforth Plant Science Center is a not-for-profit research institute aimed at improving the human condition through plant science innovations. Researchers at the Danforth Center are mainly focused on feeding the hungry, improving human health, and renewing the environment through converting noncommercial research.\(^ {170}\) The center exists due to funding generated from endowments, contributions, and grants provided by the state of Missouri, Monsanto, the Danforth Foundation, and many others. The Danforth Plant Science Center further enhances Saint Louis’s position as a regional leader in the field of plant sciences.

The Danforth Center partnered with Wexford Science and Technology, a BioMed Realty company, to develop the LEED Silver research part that has currently 18 enterprises employing 270 people\(^ {171}\). This community has developed into the Bio Research & Development Growth (BRDG) Park. BRDG Park’s first campus opened in June 2009 featuring world-class wet laboratories, office space, and an on-site workforce development and training program. BRDG Park helps emerging life science and clean-tech start-ups by providing the tools and facilities they need to succeed. These tools include interactions between top scientists and access to state-of-the-art facilities such as research grade greenhouses, growth rooms and chambers, a proteomic facility, a tissue transformation complex, and a microscopy suite. The main two research centers are Enterprise Rent-A-Car Institute for Renewable Fuels\(^ {172}\) and Institute for international crop improvement\(^ {173}\). For Enterprise Rent-A-Car Institute, its research covers subject such as increasing the yield productivity and quality of oils from algae based oils, building next-generation tools using bio energy grasses, understanding how oilseed crops handle drought stress, decoding the genomes of bioenergy crops and bio energy grasses, and using metabolic engineering to improve oilseed content and quality. For the Institute for International Crop Improvement research includes projects to improve disease resistance, drought tolerance, and vitamin content.

\(^ {172}\) Donald Danforth Plant Science Center.(2014). Enterprise Rent A Car Institute for Renewable Fuels, Retrieved from: http://www.danforthcenter.org/about/brdg-park
\(^ {173}\) Donald Danforth Plant Science Center.(2014). Institute for International Crop Improvement, Retrieved from: http://www.danforthcenter.org/scientists-research/research-institutes/institute-for-international-crop-improvement
Enterprise Rent A Car Institute for Renewable Fuels
Challenges

Sustaining innovation and technological advances is important for any industry. For agriculture specifically, these advancements will come in the form of greater efficiency and productivity within farming. Precision farming along with Triad sensors, intelligent networks, and robots provide avenues for these advancements to occur. As for innovation, big companies in the agricultural field, such as Deere & Company, ADM, and Cargill, also play important roles. E Premium Tractor 7430, which is a new product of Deere & Company, provides the chance for tractors to gather huge data. These new tractors report data via cloud services to gather big data. However, with these advancements, challenges also arise. In data, successful farmers may be reluctant to share information on their growth strategies due to secrecy in their competitive advantage. Consequently, it will be important to determine who owns the data as sharing data may not be appealing to farmers seeking to optimize their output relative to competitors.

The three major public funding resources in agricultural industry are federal funding, state funding, and general public funding. The majority federal funding comes from NIH, NSF, DOD, DOE, NASA, USDA. When analyzing the funding for the agricultural industry from 1990 to 2009, there is a growing trend of NIH funding. USDA generates stable but lower funding when compared with other funding sources. Generating more funds from all the public resources is the biggest challenge for the U.S. agriculture industry.

When analyzing the funding trends from 1980 to 2009, private funding outpaces public funding. Private funding contributes to the Midwest agriculture in specific areas. Large corporations such as ADM and Monsanto generate more funding for agricultural technology research. One downside of private funding is it limits agricultural innovations from non-agricultural industry background studies.

Finally, as identified by industry interviews, agriculture as two more entrepreneurial ecosystem challenges in the raising of venture capital and large firm interactions. The reduced number of venture capital firms as compared to other industries such as digital technology indicates the lower number of investors in the Midwest specializing in the agriculture industry. Industry interviews echoed this claim and a number of large West Coast venture firms are beginning to fill in the capital gap left in the industry as indicated by recent deals such as Climate Corporation. However, part of the cause lies in the geographic spread between many of the large agriculture companies, cities, and startups in the Midwest. For an investor or corporate executive, several flights and multi-hour car rides are needed to progress to each of the spread out cities. Consequently, a common centrally located meeting place is needed to connect startups to large companies for industry advice and connect startups and investors for fund raising.

Conclusion

Moving forward, the Midwest is a region with significant potential for innovation in agriculture. Between the historical role as a “breadbasket of the United States,” coupled with the presence of large, established food and agriculture firms and research centers, the role of the Midwest has never been stronger. We view this momentum as only accelerating in the coming decade, especially given the convergence of food and agriculture with disciplines such as engineering and computer science. The presence of land grant universities and other Tier One research institutions can accelerate the process of innovation and commercialization of research. Although geographic disparities across the region must be remedied, the Midwest has the potential for a holistic effort capable of encouraging growth and investment in food and agriculture in the coming decade. Solutions emerging from this ecosystem would not only benefit agricultural production in the Midwest, but would be realized on a global scale.
# Appendix

## List of Agriculture and Food Industry Firms with >$300MM in Annual Sales

<table>
<thead>
<tr>
<th>Company</th>
<th>City</th>
<th>State</th>
<th>Sales USD (MM)</th>
<th>Employees</th>
<th>Assets USD (mil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargill Inc</td>
<td>Minneapolis</td>
<td>Minnesota</td>
<td>136,700.0</td>
<td>140,000</td>
<td>59.9</td>
</tr>
<tr>
<td>The Kroger Co.</td>
<td>Cincinnati</td>
<td>Ohio</td>
<td>98,375.0</td>
<td>343,000</td>
<td>29,314.0</td>
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<tr>
<td>Archer Daniels Midland Company</td>
<td>Decatur</td>
<td>Illinois</td>
<td>89,804.0</td>
<td>30,600</td>
<td>43,752.0</td>
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<tr>
<td>CHS Inc</td>
<td>Inver Grove Heights</td>
<td>Minnesota</td>
<td>44,479.9</td>
<td>10,716</td>
<td>13,504.3</td>
</tr>
<tr>
<td>Deere &amp; Company</td>
<td>Moline</td>
<td>Illinois</td>
<td>37,795.4</td>
<td>67,000</td>
<td>59,521.3</td>
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<tr>
<td>Mondelez International Inc</td>
<td>Deerfield</td>
<td>Illinois</td>
<td>35,299.0</td>
<td>107,000</td>
<td>72,557.0</td>
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<td>McDonald's Corporation</td>
<td>Oak Brook</td>
<td>Illinois</td>
<td>28,105.7</td>
<td>440,000</td>
<td>36,626.3</td>
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<td>Carlson Companies Inc</td>
<td>Minnetonka</td>
<td>Minnesota</td>
<td>19,800.0</td>
<td>57,000</td>
<td></td>
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<tr>
<td>Kraft Foods Group Inc</td>
<td>Northfield</td>
<td>Illinois</td>
<td>18,218.0</td>
<td>23,000</td>
<td>23,148.0</td>
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<td>General Mills, Inc.</td>
<td>Minneapolis</td>
<td>Minnesota</td>
<td>17,774.1</td>
<td>41,000</td>
<td>22,658.0</td>
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<td>SUPERVALU INC.</td>
<td>Eden Prairie</td>
<td>Minnesota</td>
<td>17,097.0</td>
<td>35,000</td>
<td>11,034.0</td>
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<tr>
<td>ConAgra Foods Inc</td>
<td>Omaha</td>
<td>Nebraska</td>
<td>15,491.4</td>
<td>34,840</td>
<td>20,405.3</td>
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<td>Monsanto Company</td>
<td>St. Louis</td>
<td>Missouri</td>
<td>14,861.0</td>
<td>21,900</td>
<td>14,392.0</td>
</tr>
<tr>
<td>Kellogg Company</td>
<td>Battle Creek</td>
<td>Michigan</td>
<td>14,792.0</td>
<td>30,277</td>
<td>15,474.0</td>
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<td>Land ’O Lakes, Inc.</td>
<td>Arden Hills</td>
<td>Minnesota</td>
<td>14,116.2</td>
<td>9,100</td>
<td>6,356.7</td>
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<td>Meijer, Inc.</td>
<td>Grand Rapids</td>
<td>Michigan</td>
<td>13,900.0</td>
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<td>65,000</td>
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<tr>
<td>Yum! Brands, Inc.</td>
<td>Louisville</td>
<td>Kentucky</td>
<td>13,084.0</td>
<td></td>
<td>8,695.0</td>
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<tr>
<td>GROWMARK Inc</td>
<td>Bloomington</td>
<td>Illinois</td>
<td>10,171.2</td>
<td>745</td>
<td>2,365.8</td>
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<tr>
<td>Hormel Foods Corp</td>
<td>Austin</td>
<td>Minnesota</td>
<td>8,751.7</td>
<td>19,700</td>
<td>4,915.9</td>
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<td>Reyes Holding Ingredion Inc</td>
<td>Rosemont</td>
<td>Illinois</td>
<td>7,400.0</td>
<td>14,000</td>
<td></td>
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<tr>
<td>The J.M. Smucker Company</td>
<td>Westchester</td>
<td>Illinois</td>
<td>6,328.0</td>
<td>11,300</td>
<td>5,360.0</td>
</tr>
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<td>The Andersons, Inc.</td>
<td>Orrville</td>
<td>Ohio</td>
<td>5,897.7</td>
<td>4,875</td>
<td>9,031.8</td>
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<td>Associated Wholesale Grocers, Inc.</td>
<td>Kansas City</td>
<td>Kansas</td>
<td>5,100.0</td>
<td>2,000</td>
<td></td>
</tr>
<tr>
<td>Mosaic Co</td>
<td>Plymouth</td>
<td>Minnesota</td>
<td>4,765.9</td>
<td>8,200</td>
<td>19,554.0</td>
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<tr>
<td>Mead Johnson Nutrition CO</td>
<td>Glenview</td>
<td>Illinois</td>
<td>4,200.7</td>
<td>7,200</td>
<td>3,474.1</td>
</tr>
<tr>
<td>Eby-Brown Co LLC</td>
<td>Naperville</td>
<td>Illinois</td>
<td>4,100.0</td>
<td>2,000</td>
<td></td>
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<tr>
<td>Osi Group LLC</td>
<td>Aurora</td>
<td>Illinois</td>
<td>4,000.0</td>
<td>19,000</td>
<td></td>
</tr>
<tr>
<td>Schreiber Foods, Inc.</td>
<td>Green Bay</td>
<td>Wisconsin</td>
<td>4,000.0</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>Hillshire Brands Co</td>
<td>Chicago</td>
<td>Illinois</td>
<td>3,920.0</td>
<td>9,500</td>
<td>2,434.0</td>
</tr>
<tr>
<td>The Scoudar Company</td>
<td>Omaha</td>
<td>Nebraska</td>
<td>3,500.0</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Schwan Food Company</td>
<td>Marshall</td>
<td>Minnesota</td>
<td>3,380.0</td>
<td>22,000</td>
<td></td>
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<tr>
<td>Valmont Industries, Inc.</td>
<td>Valley</td>
<td>Nebraska</td>
<td>3,304.2</td>
<td>10,769</td>
<td>2,776.5</td>
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<tr>
<td>Scotts Miracle-Gro Co</td>
<td>Marysville</td>
<td>Ohio</td>
<td>2,816.5</td>
<td>6,200</td>
<td>1,937.2</td>
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<td>Spartan Stores, Inc.</td>
<td>East Grand Rapids</td>
<td>Michigan</td>
<td>2,608.2</td>
<td>4,225</td>
<td>789.7</td>
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<tr>
<td>The Wendy's Co</td>
<td>Dublin</td>
<td>Ohio</td>
<td>2,487.4</td>
<td>37,000</td>
<td>4,363.0</td>
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<td>Panera Bread Co</td>
<td>St. Louis</td>
<td>Missouri</td>
<td>2,385.0</td>
<td>22,700</td>
<td>1,180.9</td>
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<td>Houchens Industries Inc</td>
<td>Bowling Green</td>
<td>Kentucky</td>
<td>2,360.0</td>
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<td>Schnuck Markets Inc</td>
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<td>Missouri</td>
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<td>TreeHouse Foods Inc.</td>
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<td>Illinois</td>
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<td>Ag Processing Inc.</td>
<td>Omaha</td>
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<td>2,126.7</td>
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<td>The Toro Company</td>
<td>Bloomington</td>
<td>Minnesota</td>
<td>2,041.4</td>
<td>5,057</td>
<td>1,002.7</td>
</tr>
<tr>
<td>Briggs &amp; Stratton Corporation</td>
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Source: OneSource
Manufacturing

Photography: Courtesy of Erich Schrempp and Winzeler Gear, Harwood Heights, IL
Executive Summary

As Chicago and the Midwest seek to build regional industry tech clusters to spawn and develop entrepreneurship within the region, advanced manufacturing possess many of the attributes needed in the region to aid in the development of an entrepreneurial ecosystem. In gathering data for the report, our team conducted numerous interviews with professionals ranging from startups to leaders of public-private industry initiatives to experts within the advanced manufacturing industry. This primary research, paired with extensive secondary research, has aided us in mapping out the resources of the region along with the challenges and opportunities the industry can capitalize upon.

Manufacturing in Chicago and the Midwest acts as a key industry driver accounting for 17% of the region’s total GDP and an employment multiplier of 3.2 jobs created due to every 1 manufacturing job. With these industry strengths come key challenges such as dispelling the industry stigma, the perception of off-shoring benefits, machine and infrastructure costs, investment models, and fragmentation among the numerous small and medium-sized enterprises in the industry. Though these challenges may hinder growth in the industry, the opportunities available in the region, such as UI Labs and brand transformation, can overcome prior challenges. Strong support through information sharing among industries and universities, increased high school programs, and university opportunities can provide the vehicles for which to expand the industry in the Midwest. A series of regional programs attempting to develop manufacturing in the region include: UI Labs, Chicago Robotics Lab, Center for Technology Development and Ventures at University of Chicago, Chicago Technology Park, National Opinion Research Center at the University of Chicago, Chicago Research Center, and the Innovation Factory.

Manufacturing in the Midwest is posed not only for an industrial renaissance but also to grow the middle class across Chicago and the Midwest.

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Industry Overview

Introduction

“Manufacturing isn’t dying – it’s changing.”

Advanced Manufacturing is different from traditional manufacturing because of its use of innovative technology to improve products or processes. A concise definition of advanced manufacturing offered by some is “manufacturing that entails rapid transfer of science and technology (S&T) into manufacturing products and processes.” The manufacturing sector has been experiencing an era of change for the last 50 years. From 1957 to 2007, manufacturing’s share of U.S. GDP declined from 27% to less than 12%, though much of this trend reflects declining prices for manufactured goods. In 1969, manufacturing accounted for 26% of national employment but accounts for only about 9% today. However, despite these relative declines, manufacturing remains a sizeable contributor to our economy and directly employs over 11.5 million people. Paradoxically, even as manufacturing’s relative share of employment and GDP has decreased in recent decades, manufacturing has actually become even more important to sustaining American prosperity.

According to “Manufacturing Growth,” written by Devon Swezey and Ryan McConaghy, manufacturing is the most capital-intensive and productive sector of the economy, and it is key to developing and commercializing new technologies. A healthy manufacturing sector can act as a vehicle to boost the local and national economy.

Opportunity

Company

Digital technology is transforming manufacturing, making it leaner and smarter—and raising the prospect of an American industrial revival. For large firms, this means a swath of new tools to build smarter, leaner factories and explore innovative new products, materials and techniques that weren’t possible before. And thanks to plummeting prices, small companies have access to better, cheaper manufacturing equipment and design tools—giving even one-person startups the chance to create market-moving innovations.

US Economy

Manufacturing already has had a major impact on American employment and prosperity. In March 2009, manufacturing companies paid $32 per hour in wages and benefits, while all employers paid an average of $29.39 per hour—a 9% wage premium.

Beyond direct job creation, manufacturing generates high levels of output and employment throughout the economy. The sector has the largest “employment multiplier,” according to economist Josh Bivens, who finds that each job created in manufacturing leads to the creation of 2.91 additional jobs, compared to

179 Swezey, loc. cit.
1.54 jobs in business services and 0.88 jobs in retail trade. For the Chicago region, estimates are even higher, with each manufacturing job supporting 3.2 other jobs. Every dollar in final sales of manufacturing products supports $1.40 in output from other economic sectors. Most industries, including professional and business services have multipliers of less than $0.70, and no other industry has a multiplier above $1.10. As the demand for manufacturing grows, investment, job creation, and innovation grows throughout the economy.

**Advanced Manufacturing in Chicago**

According to industry experts, the biggest challenge the industry faces is the lack of talent. As an industry expert stated in an interview, “there is a clear lack of vocational workers, which is problematic. If a company is not able to find a qualified workforce at a competitive price, it will most likely not want to open a manufacturing facility in the area.” The same issues are seen at higher levels of the industry. Instead of manufacturing, young workers with STEM degrees are choosing to go into ‘more attractive’ industries, most notably software – including companies such as Google, Facebook, etc. Another issue is the lack of capital at the early stage. Many manufacturing startups are extremely capital-intensive and, as noted by one of the interviewed industry experts, “they usually are not garage startups”. It is not uncommon for a startup to need $500k-1MM to develop a proof of concept.

As an interviewed executive put it, “there are 100 pieces that go into creating a battery.” Instead of competing directly with the battery manufacturer, it would make more sense for a small or medium-sized enterprise (SME) to specialize in one of the 100 pieces. By following this theory, the more large manufacturers in a region or area, the more work and opportunity there would be for SME's. Chicago needs to find a way to entice prospective manufacturers, and the recent Digital Manufacturing Institute is an example showing Chicago’s commitment to the industry.

**Challenges**

Chicago and the Midwest face a number of obstacles within the manufacturing realm. The two most commonly stated challenges were funding, as well as the industry stigma that has plagued manufacturing over the last several decades. Because of the longevity required for a return on investment, combined with what can be a low-margin business model, the opportunities to start a large-scale manufacturing operation are limited. Improvement and growth in advanced manufacturing requires heavy capital expenditures, demanding time and patience. According to an interviewee, new investment is not being made in the manufacturing sector, but rather in industries that are less capital-intensive with faster returns on investment. It is difficult for a manufacturing company to find a suitable process venture capital, and in many cases, manufacturing startups may be more likely to receive funding from a dedicated venture capital group of a large manufacturing company, such as a Dow or DuPont. Fragmentation also plays a major role, with most manufacturing firms falling into the category of “small businesses” that do not have the same resources for information sharing, business development, or capital investments as larger original equipment manufacturers (OEMs).

Additionally, the numbers of funds have gone down and diversity reduced as a result of consolidation and investor wariness for large costs associated with manufacturing startups. As another interview stated, the large infrastructure costs associated with local production of advanced materials may make investors wary to invest the necessary capital into facilities and equipment. As a result, early-stage firms operating

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in this space have become increasingly reliant on government grants such as SBIR funding, or are looking to state-wide incentive programs geared at incentivizing manufacturing firms with subsidized access to resources and facilities.

Additionally, the industry continues to face a stigma that manufacturing is no longer relevant in the United States. In this new digital world, investments in manufacturing have decreased and manufacturing is no longer perceived as a “hot” area. However, numerous evidence now points to the benefits of “Made in the USA,” as “re-shoring,” or bringing back manufacturing that had been outsourced, is taking hold across the country. This is due to rising labor costs abroad, along with increases in the price of fuel and time for goods to reach the customer. The convergence of manufacturing with industries such as medical device production provides for opportunities to grow the manufacturing base in the Midwest while simultaneously decreasing the total cost of ownership.

The acquisition of venture funding by manufacturing firms may be difficult, but Chicago has other great complementary resources for manufacturing startups. For example, Chicago has many universities in its vicinity that startups can partner with and make use of their equipment, which is critical for capital-intensive advanced manufacturing. There is also a great talent pool from the surrounding universities, such as the University of Illinois, Northwestern, University of Michigan, University of Chicago, and many more. Additionally, opportunities to partner with community colleges and local-area high schools to change the manufacturing stigma at an earlier age can create the potential for a generational shift in the stigma of manufacturing, while at the same time providing a secure avenue for employment. Looking into the future, Chicago is in an excellent position to grow its industrial industry.

**Chicago Advantages**

Chicago is home to many universities and research facilities providing an advantage over many other cities. By being home to research centers in various fields such as robotics, nanotechnology, medicine, engineering, and even market and social sciences, Chicago proves that it is already competing globally in advanced manufacturing. However, there is opportunity for improvement among different markets. Metropolitan Chicago specializes in 8 different major manufacturing industries:

- Pharma/Medical Supply
- Computer/Electronics
- Chemicals, Plastics, Rubber
- Fabricated Metal
- Paper, Printing
- Primary
- Furniture, Apparel, Other
- Food, Beverage

According to the Chicago Metropolitan Agency for Planning (CMAP), Chicago has opportunity to grow by spurring research and development, increasing workforce development, and improving upon the city’s transportation and cluster investment. The strength of Chicago lies in its cluster diversity, which gives it an advantage as compared to other cities with only one heavy specialty. Being the nation’s second largest manufacturing cluster and the third largest metropolitan area, Chicago is guaranteed an impact in

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today’s world market\textsuperscript{186}. To truly categorize and address such a complex issue as advanced manufacturing, CMAP utilizes the three “P’s” (product, process, and people) to determine a sector’s strengths as well as weaknesses. Product, process, and people are all indicators of the best examples of advanced manufacturing. Any sector that ranks high in these attributes already performs to the standard needed from Chicago. The region’s sectors that rate high according to the press release by the CMAP include pharmaceuticals and medical supply; chemicals, plastics, and rubber; and fabricated metal products\textsuperscript{187}.

Another area of strength, and the most poised to lead in today’s world, is in the machinery sector, which still excels in electrical and industrial equipment despite decreased activity in aerospace and automotive industries\textsuperscript{188}. Chicago is in the spotlight to lead in a variety of fields. According to the Geography of Production in Metropolitan Chicago findings, the Chicago metropolitan area is one of the nation’s major manufacturing areas\textsuperscript{189}. Though Chicago has gained many new jobs in moderate tech industries (electrical equipment and appliances, machinery, petroleum and coal), the most promising route still lies in the new and high tech industries (biotech, healthcare, pharmaceuticals). What Chicago can do now is to still strengthen these existing industries with new technologies and promote high-skill production all across its cluster.

In fact, the growth of manufacturing jobs in Chicago has been higher when compared to cities across the United States. “Since the beginning of 2010, the number of manufacturing jobs in metropolitan Chicago and the entire United States has begun to rise after a decade of unprecedented decline.” In total, Chicago’s job market in the manufacturing industry rose 5\% compared to the 4\% growth in the United States. In the United States as a whole, growth in manufacturing mainly took place in the durable goods industry, especially machinery and transportation equipment; whereas non-durable goods continued to decline with the exception of leather\textsuperscript{190}. Chicago has experienced almost double-digit increases in industries focused on Transportation Equipment, Motor Vehicles and Parts, and even in the non-durable industries such as Leather production. In fact, according to the UIC Center for Urban Economic Development, Chicago’s specialties lie in its wide array of manufacturing industries, which have remained a key area of emphasis over the years\textsuperscript{191}. Chicago is a unique example among many cities mainly due to the unprecedented potential it possesses. Chicago will always continue to be successful whether in one industry or another by competing in the world market through capitalizing on its own regional strengths. These include the eight core industries primed through years of growth.

However, Chicago also has another advantage above other metropolitan cities. Freight and transportation costs greatly affect manufacturing competitiveness according to the second report issued by CMAP\textsuperscript{192}. Research has shown that rising transportation costs and simply the stress induced by freight changes, impact a manufacturer’s time to market, reliability, and flexibility in response to market demands\textsuperscript{193}. There is a heavy interdependence needed between manufacturing operations and complex freight logistics. Yet, unlike other regions, metropolitan Chicago already has a well-developed and interwoven

\textsuperscript{186} CMAP. \textit{Manufacturing Cluster Drill Down}. Chicago Metropolitan Agency for Planning, 2013.
\textsuperscript{187} Wial, loc. cit.
\textsuperscript{190} CMAP, loc. cit.
\textsuperscript{191} Wial (Locating Chicago Manufacturing: The Geography of Productino in Metropolitan Chicago)
\textsuperscript{193} Ibid.
freight-manufacturing cooperation. There are a number of transportation mediums already in place for manufacturers. These assets include:

- **Rail**: Metropolitan Chicago is the only region served by six of the seven Class I railroads
- **Truck**: Seven major interstate highways converge in the region, the most in the nation
- **Air**: O’Hare is the nation’s second busiest international air cargo gateway by value
- **Water**: The region’s water system serves as the only connection between the Mississippi River waterway and the Great Lake and Saint Lawrence Seaway system.

The Chicago region is unique in the fact that no other region can compete with its multifaceted and well-organized freight infrastructure. No other region is capable of emulating the kind of capabilities that exist across Chicago’s freight modes. Additionally, Chicago’s already-existing and capable freight infrastructure allows for timesaving in goods movement. Due to the wide variety of modes available, Chicago’s manufacturing cluster will allow manufacturers to export to nearly every market around the world. In 2010 alone, Chicago’s manufacturing cluster managed to export abroad over $34 billion in manufactured goods, trumping any other domestic region with the exception of Los Angeles. Chicago’s regional production systems play an integral role in the global economy.

Yet, in order to integrate this success into advanced manufacturing, there must be a combination of fields to improve upon technologies or create new technologies. This in turn will attract manufacturers and innovation to Chicago. Chicago possesses the framework for advanced manufacturing, being home to a multitude of companies currently involved in integration.

**Bridging the Gap Between University and Industry**

Chicago needs a bridge to gap new and upcoming technology with larger and interested companies. In order to show Chicago is capable or already present in advanced manufacturing, correlation between the upcoming technologies must be made. Therefore, startup incubators or simply companies involved in the development of new technologies must be present or growing. The world is developing and moving ahead to the next generation of advanced products and technologies. These include nanotechnology and biotech industries that Chicago needs to address and capitalize on. It’s here that Illinois, as a whole, excels. There are plenty of examples of startup accelerators and incubators currently in the process of churning out ideas and new technologies that will have the desired impact in today’s world. In total, there are more than 82 facilities dedicated to research and the advancement of technologies ranging from hair products and market design to nano-robots combating disease in the human body. Chicago-based Inventables has been pioneering new techniques to bring the design process for manufactured goods directly to the end-consumer. The resources are present, but it is only the attention that is lacking.

Industry-university relationships are also paramount to achieving growth for the broad manufacturing community. Harwood Heights-based Winzeler Gear has had an extensive relationship with Bradley University in Peoria, where mechanical engineering faculty and students work on applied research in conjunction with the firm, enabling both parties to find mutual benefit through collaboration. Although the relationship began organically, it has fostered into opportunities for recruiting students, as well as a way for companies like Winzeler to be actively involved in shaping the curriculum for future engineering

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194 Ibid.
195 Ibid.
196 Ibid.
students. Because of the traditional academic focus on metals, Winzeler helped pioneer the introduction of plastics engineering into the curriculum.

Similar efforts at the high school level include communities such as East Leyden High School, where a former World War II era machining lab was transformed into a modern facility, “including lathes, vertical mills, CNCs, grinders and band saws.” Year-long classes range from Machine Tool Technology, Advanced Machine Tool Technology, and CNC Machine Tool Technology. By partnering with local manufacturing associations and firms, high schools and community colleges can become equally involved in training the next generation of the manufacturing workforce, while at the same time providing firms with the opportunity to showcase the industry to students at an early age. Providing students in high school and at community colleges the opportunity to participate in job shadows, summer internships, and other experiential learning offers the industry an avenue to regain prestige, but also serves as a valuable educational tool to students. One recommendation from executives is to increase the connections between the manufacturing associations and the local-area secondary schools and community colleges.

Another area for expansion was the role of liaisons between the manufacturing industry and university offices of research and technology transfer. As one executive stated, “There needs to be a better sense of what is needed from industry, as well as what is available from academia and universities. This will require multiple sources of feedback from manufacturing firms, as well as more information sharing from universities.” By fostering greater engagement between universities and SMEs, greater linkages can enable the commercialization of research while also providing firms with a way of better identifying best practices and recruiting talent. The emphasis should remain on creating simple and efficient ways for smaller manufacturers to become involved and engaged in the discussion with universities and schools.

Recommendations based on the Chicago Metropolitan Agency for Planning take place in areas of growth including manufacturing R&D, transportation and infrastructure, and the already advanced manufacturing workforce. Improvements are to enhance the already present competitive edge in Chicago. These include increasing technology commercialization to bridge the gap between private investments and research conducted at universities and centers mentioned.

Facilities Dedicated to the Integration of Technology

UI Labs

One of the most recent research centers in Chicago is UI Labs, which won a $70MM deal recently and has cumulative financial commitments of $320MM. As part of the government’s recently announced Digital Manufacturing and Design Innovation Initiative (DMDII), the goal is to revitalize and enhance manufacturing through concepts such as “data analytics, intelligent machines and sensing technology to quickly take products from concept to production.”

The vision of UI Labs is to “strive to define the important problems of our day, design ways to align the right resources and connect the right people, and deliver brilliant solutions to market.” It is connected with a multitude of industries and government sectors, as well as research facilities and universities. It creates partnership with leading industries and universities, with the support of government, to provide solutions for major business problems and simulate the growth of the economy. Given the growth of reshoring, manufacturers are quickly seeing the need to increase efficiency and automation, while at the

same time working to create better partnerships with academia to train the next generation of skilled laborers\textsuperscript{203}. UI Labs has the opportunity to become the venue to serve all the necessary stakeholders.

**Chicago Robotics Lab\textsuperscript{204}**

Also known as the Rehabilitation Institute of Chicago, the Chicago Robotics Lab research is aimed at sensory motor systems through integration with robotics and artificial systems. They are interested in how the brain processes, executes, and compartmentalizes motor behaviors and reactions as well as the human body’s response to prosthetics and other biotech solutions. Robotic technologies are used in conjunction with our understanding of biology to address everything from simple medical issues to complex ones.

**University of Chicago Center for Technology Development and Ventures\textsuperscript{205}**

Heavily qualified in science, business, and intellectual property, the Center for Technology Development and Ventures provides guidance and resources through the invention development process. The CTDV is instrumental in building bridges from simple research into actual practical application. The Center for Technology Development and Ventures contain strong industry partnerships and have the resources needed for new and upcoming technologies to make an impact on the market.

**Chicago Technology Park\textsuperscript{206}**

The CTP serves as vital growing ground for technology companies in either early development or already expanded companies looking for help. The mission of CTP is to assist in growth of startups and specifically generate market exposure, as well as to help in providing fully equipped infrastructure, university resources, internship programs and custom-designed business development services. More than 150 people work for companies in the incubator. Such companies include those in drug discovery, medical devices and testing, genomics, and others who collaborate with premier medical facilities for research and design.

**Chicago Research Center\textsuperscript{207}**

CRC is a privately-owned research facility specializing in “phase II, III and IV clinical trials for the pharmaceutical and biotechnology industries.” It operates as an independent research center solely dedicated to conducting clinical trials in a broad array of specialties; including psychiatric, general medicine and sleep. The Chicago Research Center is famous for their uncompromising approach to research and is staffed with a highly-trained team of dedicated professionals. The Research Center consists of seasoned personnel with a combined total of more than 30 years of clinical research experience. They are affiliated with some of the biggest pharmaceutical companies in the United States including Abbott and AbbVie.

**Innovation Factory\textsuperscript{208}**

The Innovation Factory is a design studio excelling in transforming ideas into products. They excel in consulting services, provide business models and marketing plans, and provide hands-on help for clients.

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\textsuperscript{201} Ibid.
\textsuperscript{202} "Robotics Lab." - Rehabilitation Institute of Chicago. N.p., v.qβ. 05 Apr. 2014.
\textsuperscript{205} Chicago Research Center, Inc. Chicago Research Center, Inc., n.d. Web.
looking to build a startup. They have worked with shoe designer Emanuel Nwabuisi and hosted a “3D fashion show” on April 24, 2013.

Conclusion

Manufacturing is an industry poised for growth in Chicago and the Midwest region. In combination with the recent efforts for creating an industrial renaissance, the Midwest in particular is well suited to address the convergence of manufacturing with industries such as biomedical devices, clean energy, and advanced materials. Moving forward, universities and manufacturing associations should look to developing closer partnerships as a way of educating college students about careers in manufacturing, in addition to creating a positive feedback loop for combining industry needs with engineering research.

Additionally, community colleges and high schools can play a role by focusing on creating curriculum for students looking to pursue a vocational career. Finally, the role of incubators and venture capital cannot be overstated, especially when combined with grants and government funding for improved manufacturing infrastructure. Together, public and private stakeholders have the opportunity to create improved linkages while also growing an industry that has long been a backbone of Chicago and the Midwest.
Key Findings

Our analysis focuses on several key areas noted by interviewees and stakeholders from both the Midwest and other regions of the country. These insights include:

Resource Dispersion

A consistent theme from our interviews and survey responses was the fragmentation of resources around the Midwest. Partially due to geography and a priority on local initiatives, there is room for expansion of funding, mentorship, and other services for emerging growth firms across the entire Midwest. Expansion of capital beyond traditional Midwest metropolitan hubs can serve to scale nascent firms in supporting metropolitan areas. The presence of tier-1 research institutions across the Midwest creates potential for encouraging spin-outs to stay.

Linkages between Stakeholders

There is potential for greater collaboration / information sharing between established firms, start-ups, and universities. The facilitation of technology transfer and applied research has largely been unpublicized to small and emerging-growth enterprises and offers significant promise through efforts such as the Digital Manufacturing Institute in Chicago and the Lightweight and Modern Metals Manufacturing Innovation Institute in Detroit.

Regional Initiatives

Individual states and cities have certain industry specializations, but few efforts on innovation and entrepreneurship have pushed collaboration beyond traditional boundaries to include multi-state and multi-city partnerships. Going forward, cities must view relationships and the sharing of resources as being mutually beneficial and grow together.

Investment and Venture Capital:

There is a demonstrated need for more sophisticated investors in industries dealing with advanced technologies, enhancing early seed and Series A funding. This is coupled with a need for a better understanding of business and investment models accompanying capital-intensive industries and advanced technologies. One theme heard from entrepreneurs was the difficulty in finding venture funding within industries such as advanced manufacturing, agriculture, and life sciences, particularly due to capital requirements as well as the timeline for return on investments and advanced knowledge needed to understand sophisticated technologies.

There is an opportunity for greater deal syndication across the Midwest, not only to promote the distribution of capital, but also to serve as a catalyst for the addition of venture funding into promising industries that have traditionally lacked large sums of funding.

Additionally, there was discontent expressed by entrepreneurs and investors outside of the Midwest over discontinuity in term sheet structure. In particular, both groups viewed term sheets from investors outside of the Midwest as being more equitable, whereas term sheets within Chicago and the Midwest tended to be more favorable to the investors, thus encouraging firms to seek investment and opportunities outside of the region. Many entrepreneurs and investors noticed investment conservatism in Midwest...
venture deals through an increased emphasis on developed commercialization plans or existing revenue among Midwest VCs. In contrast, outside VCs were more willing to invest in firms with little to no revenue but large growth potential.

Finally, despite an increasing amount of angel investment and established community for private equity / mezzanine levels of funding, there is a significant opportunity to bridge the funding gap at the mid-tier (Series A) levels. The consequence of this gap has been an increased need for developing startups to look towards coastal capital and the larger fund sizes on each coast to provide Series A funding rounds instead of focusing on the Midwest.

Publicity

A major opportunity for Chicago and the region is to increase awareness of the resources and infrastructure available for entrepreneurs across the entire Midwest. Although each individual metropolitan area supports any number of opportunities for entrepreneurs, they are routinely recognized as separate and distinct entities, as opposed to being part of a broad Midwest ecosystem. Through a carefully coordinated effort to attract more regional publicity, Chicago and the Midwest can garner national attention for the resources currently in existence.

In closing, our findings support the following conclusion:

*Increasingly, Chicago and the Midwest have shown an increase in the volume and velocity of connections necessary for an entrepreneurial environment. The opportunity lies in creating greater density and linkages on a regional level, with geographic hubs taking a leadership role. Going forward, the collaboration between universities, industries, and government must focus on ways to better allocate formerly disparate resources to aid in tech transfer, commercialization, and the scalable growth of emerging firms.*

Similar sentiments were felt by the survey distributed to 20,000 University of Illinois students.
Student Entrepreneurship Survey

Methodology

The survey originated from a desire to determine the reasons being for the exodus of Midwestern educated student talent to other regions of the country or world along with the entrepreneurial leanings of this party. Previously, many individuals and organizations have conducted similar research through either personal inferences, student interviews, or small-scale surveys for niche subsets. However, our goal for the survey sought to directly capture student sentiment on a much larger scale with an emphasis on STEM students but with a population that consisted of the other student bodies across universities.

Our vehicle for data collection consisted of a 33 question survey requesting a series of responses to identify student backgrounds, employment preferences, and thoughts on entrepreneurship in the Midwest. Subjects of the survey, students, were asked to respond to these questions through the selection of multiple-choice responses, sliding-scale values, and limited free response. Survey questions included a single filter on question 22 [“How likely are you to start a new company in the future?”] which skipped questions for subjects who responded with a 2.5 or lower out of 5 and ended the survey instead of proceeding into the entrepreneurial section. The intent of this filter was to only provide the final entrepreneurial questions to subjects who had interest or expertise in the area. To encourage responses from University of Illinois at Urbana-Champaign students to answer roughly 10 minutes of questions, a randomized offering of 10 $75 Amazon gift cards sponsored by The Academy of Entrepreneurial Leadership at the University of Illinois was provided.

Before distribution, the created survey was reviewed by multiple independent individuals including Leigh Estabrook of the University of Illinois who has expertise on survey creation and distribution due to past experience in the conducting of large-scale campus surveys. Once finalized, the University of Illinois Institutional Review Board certified the survey. This certification entails the protection of student identities through anonymity as analyzed by an IRB official investigating the phrasing and content of the survey. Anonymity for students occurred through a lack of identification questions that could harm students and a separation of emails provided for the random drawing from the responses provided. Next, the Dean of Students and Division of Management Information (DMI) granted access for the survey to be distributed to the student body. DMI provided an email population consisting of 15% business, 35% engineering, and 50% other. On March 10th, the survey via Qualtrics software was distributed to students in the email population with a reminder sent out on March 17th. Survey collection ended on March 21st with 1,809 completed surveys and all uncompleted surveys recorded as partial responses in the data.

Limitations

This survey has inherit limitations in due part because of the population and sample demographics. At the time of this report, the survey has only been distributed to University of Illinois at Urbana-Champaign students. In addition, students at this school, as shown through the sample demographics, predominantly have strong connections with Chicago because of their hometowns around the Chicago metro area. Consequently, many of the statistics referring to knowledge of Chicago may be enhanced because of the high proportion students from Illinois. As a result, this preliminary version of survey results cannot be inferred to act as a representation for Midwest university students as a whole.

Additionally, due to the nature of Institutional Review Board certification, students were never forced to answer any previous questions before proceeding forward. Consequently, total responses per question may vary which will interfere with comparing responses across two different questions unless the data is filtered for only students who answered both compared questions.
Selected Key Findings

10% of students are in transition to employment at startups. However, in 3-5 years, the proportion of students seeking smaller firms shrink.

When asked what size of a company students would be interning or employed at this summer versus their goal employer size after 3-5 years, the proportion of students working in startups to small companies shrank from 32% to 23%. Though smaller employers shrank as goal employers after 3-5 years, medium-sized businesses absorbed much of the decrease among smaller firms. The change in preference could result from a range of differing reasons including: a decrease in risk appetite as age increases and students may be starting their families, students may desire a more stable than dynamic environment later in their career, or students previously in startups plan on their companies breaking into the medium-sized business range in 3-5 years. Though, at first glance, these results may seem concerning to the startup community, the migration to medium-sized businesses (100-999) could signal the employment of students in previous startups such as Groupon that have surpassed their initial ‘startup’ phase. The students may not be in the most risky ventures after 3-5 years but they still could be in developing young companies of the community.
Illinois attracts 2% more students for internship/fulltime employment relative to those who call Illinois home

Of the students who responded to both Q8 and Q10, Washington leads the locations in terms of students changing locations for employment with a 9x return and California ranks second with a 2x return. Of all locations, the two highest international populations, China and India, face the greatest deficit in talent returning home as each has a return rate of 35% and 27% respectively. When filtering results further into engineering and computer/information science students (549 total), Illinois still gains 1.02x of students working in Illinois relative to those from Illinois. However, Washington, New York, California, and Texas have much stronger returns at 13x+ (0 students from WA and 13 working in WA), 3.25x, 2.94x, and 1.56x respectively.

After filtering even further to include on those students with a reported GPA from 3.5-4.0, California develops an even greater multiple of 7.2x students working California for every student from California and Washington remains positive at 0 students from Washington but 9 students working there. However, Illinois still remains positive at 1.03x in this filter, signaling that the state is able to retain more high GPA engineering and computer/information science talent than they lose at UIUC according to the survey sample.

Finally, after removing the GPA filter and filtering to graduation years of 2014, Illinois has a deficit of students leaving of .91x (80 students from Illinois and 73 students working in Illinois) while other states gain students (Texas at 3.0x, California at 3.5x, and Washington at a 0:6 ratio). Following prior trends, other countries lose all of their engineering and computer/information science students to the United States. Because of the drop in retention for Illinois after filtering for 2014 graduation years, a conclusion can be made that, in our survey population, many students intern for companies in Illinois while students but leave Illinois when accepting fulltime positions. An opportunity for the state and university is to improve upon the internship to fulltime conversion in order to retain more talent in the state.
Many students have goals to, in 3-5 years, work in the key industries Chicago is seeking to grow in the near future.

As many new entrepreneurial and industry initiatives have embarked in Chicago such as 1871, MATTER, and UI Labs, a key factor in their success will be the recruitment of university talent into these growth industries. When asked to state their current employer along with their goal employer industry, students provided a variety responses across over 27 industries. Key within these findings is the amount of students in Chicago’s key growth industries (computer, software, and telecommunication; healthcare; agriculture; manufacturing; and biotechnology) as their current employer industry and more importantly, the desire of students to enter these industries in the next 3-5 years. The amount of students seeking to enter these industries ranges from a growth multiple of 1.06x (1.06 times more students want to enter the industry than are in it now) in agriculture to 1.96x for biotechnology. These results are promising for the growth of these initiatives as students at University of Illinois at Urbana-Champaign want to enter the industries Chicago wants to develop into clusters.
91% of students viewed Chicago as having an entrepreneurial culture

When asked whether a series of cities were entrepreneurial or not, 91% viewed Chicago as possessing an entrepreneurial culture. This percentage equates to roughly the same ratio as Los Angeles, which 91% of responders also viewed as entrepreneurial. Relative to other cities, Chicago trails San Francisco, CA which leads the list at 97% and Austin, TX at 95%. However, a higher ratio of students viewed Chicago as more entrepreneurial than other start-up hot spots such as Boulder, CO at 88% and New York at 89%. Chicago has succeeded in becoming known more and more as being an entrepreneurial city even when compared in context to other large cities prominent in the start-up scene.
Only San Francisco / Silicon Valley exceeds Chicago in terms of student familiarity with entrepreneurial programs

On a scale of 1 to 7 (1 being no knowledge and 7 being very knowledgeable), students were asked to rate their familiarity with the startups and entrepreneurial programs in a variety of cities across the nation. Chicago at 3.55 trailed San Francisco at 3.78 by .23 points followed by a large gap to New York at third with 2.96 and another large gap to Austin in fourth at 2.34. Chicago’s high finish represents shows signs of positive standing in terms of awareness though Chicago has a strong advantage due to its proximity to UIUC. However, a concerning statistic is the relative uncertainty of most respondents in awareness to entrepreneurial programs in all cities and the lack of knowledge of other Midwestern cities could hinder development of a Midwest-wide technology cluster. Chicago has strong footing in terms of student knowledge at UIUC but has the opportunity to develop this knowledge much further to become the most well-known among their state’s students.

Students focus on access to capital, talent pools, and entrepreneurial support networks as their top three factors in deciding the location of their startup

With 72%, 63%, and 58% of students selecting access to capital, talent pools, and entrepreneurial support networks, respectively, the desire for these conditions to be met or exceeded in their cities of choice resonates highly with future entrepreneurs. For Chicago or other Midwestern cities to assume a competitive position with more established entrepreneurial sites such as Silicon Valley, the achievement of these factors must be reached and communicated to future entrepreneurs. Compounding on these points, weather was the lowest factor, which may bode well for the Midwest after the recent cold winter. Finally, students viewed the location of friends as the second-lowest factor but consideration must be given to this point as friends can also equate to future talent pool, which is highly related, as many entrepreneurs start companies with friends who have the needed expertise for business success.
The Midwest has a perceived disadvantage in regards to entrepreneurial support networks and access to capital, two of the biggest factors in determining where to locate startups.

According to student respondents, the Midwest needs to enhance their access to capital, entrepreneurial support networks, and culture in order to entice more entrepreneurs to start companies in the region. A lack of the top two factors could result in increased diaspora of Midwestern entrepreneurs to outside locations as they fear for the success of their enterprises. However, these lacking resources could be merely a perception issue among students than an accurate portrayal of the resources available. Another survey question of knowledge of the region (Q29), noted that most students felt unknowledgeable about the entrepreneurial programs and networks available for entrepreneurs in the Midwest. The Midwest as a region may be missing many of these resources but the more likely answer, as supported by question 29, indicates a lack of knowledge of what is available, which will be much easier to fix than building new entrepreneurial infrastructure.
Relative to the Midwest as a whole, Chicago is perceived to have more entrepreneurial resources though crime concerned students the most.

69% of respondents viewed crime as a factor that Chicago needs to improve upon with connecting programs and support networks trailing at 57% and 39% respectively. When comparing the subset, Chicago, to the Midwest as a whole, students viewed the Midwest as having more pressing entrepreneurial infrastructure issues than Chicago. However, many of the social and university issues in Chicago concern students greatly in viewing Chicago as a viable location to build a company. Chicago, like many large cities, has large amounts of crime numerically but the distinguishing factor, as one respondent commented, may be that students are more likely to hear about the crime or corruption in Chicago over any positive news about entrepreneurship. The publicity issue further extends into university programs where knowledge of partnerships with Chicago can be unheard among students. Students echoed this issue in the comments section where many were confused as to where they should even start in terms of gaining mentors or learning about the legal aspects of starting a company. Though Chicago may have higher than average crime, a big consideration must be taken as to what information reaches the students and any noise which may be attached to the signal.

Prominent Comments

Due to student passion on the topic and their will to see progress happen in the Midwest, over 100 students took time to type out paragraph or more long responses to an optional question asking for any additional comments. The following excerpts for respondents provide differing viewpoints and key points that the survey questions could not capture directly.
Conclusions

The survey, through responses from student at the University of Illinois at Urbana-Champaign, has found great strides have been made by the city of Chicago and Midwest region in terms of entrepreneurial appeal to students, however, opportunity still exists for these regions to develop further to become a technology cluster. In terms of success, Chicago and the Midwest has strengths in:

- Chicago becoming recognized as having an entrepreneurial culture
• Familiarity with Chicago entrepreneurial programs rivals San Francisco / Silicon Valley
• Students are excited about entrepreneurship and are looking forward in the Midwest growing
• UIUC students have knowledge of an array of different Midwest and Chicago based entrepreneurial companies, programs, and startups

From these key points, students have become aware of Chicago and the Midwest from of a high-level or ‘30,000 ft.’ viewpoint. Furthermore, students eagerly anticipate the next moves coming from the Midwest as the student base of UIUC wants to see more entrepreneurship in their hometown. For the Midwest and Chicago, opportunity for great expansion has arrived as their entrepreneurial brand by students is increasing and the student body is eager to see success happen.

However, many of these strengths have been coupled with opportunities for the region to expand upon or eradicate existing weakness such as:

• Though Chicago may be well known among UIUC students as entrepreneurial, other Midwest cities fall far below cities outside of the region
• The same trend of lacking knowledge persists as most students are unaware of programs in other Midwestern cities
• Perception of a lack of capital and entrepreneurial networks in the Midwest may cause persisting struggles as these two factors are among the most important for students looking to start companies
• Though Chicago fares better in consideration of key entrepreneurial infrastructure, students have concerns over crime in the city and desire more programs connecting the city and campus

At face value, these weaknesses may seem large or overcoming as these issues will need to be confronted for the success of a networked Midwestern technology cluster. However, from our series of interview with stakeholders throughout the Midwest from a variety of viewpoints along the entrepreneurial value chain, many of these weaknesses are resulting more from perception rather than lacking infrastructure. Due to location, students in Champaign-Urbana experience isolation from events occurring throughout the rest of the Midwest or even within their state. A key step in building upon the Midwest’s successes will me to make sure the news of successful exits or opportunities is communicated to everyone.

The goal of our research is to not stop where we are now and base changes in the region on one school’s report. Rather, our plan is to use the results from UIUC as a beta test for the viability of this information and to encourage schools throughout the Big Ten and Midwest to provide the survey to their own students so as to create a true sentiment of students and future entrepreneurs of the Midwest. The survey has already been loaded into Qualtrics as our medium for spreading the survey easily across multiple universities and certification as to the validity of the survey has been granted by the Institutional Review Board. Consequently, the only remaining step is the access to sample pools of students as per granted by each university. Once achieved, an extensive representation of the viewpoints of students can be achieved and programs can be tailored to best suit the student needs.
Recommendations
Recently, Chicago and the Midwest have made great strides in creating the essential infrastructure needed to develop a globally competitive entrepreneurial cluster. An exemplary initiative is ThinkChicago, which works to inspire the surrounding community along with the founding of influential networking programs. Models of collaboration include 1871 for digital, MATTER for biosciences, and UI Labs for university-corporate connections within their newly created manufacturing center. These programs within the city have succeeded in cultivating much excitement as well as the aggregation of resources needed to support growth in these industries. However, one industry, arguably the Midwest’s greatest asset, is missing from the current list of key entrepreneurial focus points in Chicago: agriculture.

The Midwest, also known as the “breadbasket of the U.S.,” contains many of the global leaders of the agriculture and food industries including:

- Kraft
- Archer Daniels Midland
- Anheuser-Busch
- General Mills
- ConAgra
- Kellogg
- Hillshire Brands
- Kroger
- Hormel
- Cargill
- SABMiller
- Chiquita Brands
- Monsanto
- Dow AgroSciences
- Land O’Lakes
- Deere & Company
- Caterpillar
- Case New Holland
- Fort Dodge Animal Health
- Abbott Animal Health
- Boehringer Ingelheim Vetmedica
- Novartis Animal Health
- Pfizer Animal Health
Accounted among these firms in the Midwest is over $600 million in annual revenue from operations spanning every continent of the world, according to CapIQ. Much of the talent and research along with arable farmland spurring the growth of these companies lies in the heartland of the United States. In addition, the land-grant universities and their agriculture colleges provide the expertise and renewing talent to sustain growth in the region. Within the Midwest, numerous top agriculture colleges exist including:

- #4 University of Wisconsin at Madison
- #6 Purdue University
- #10 Iowa State University
- #11 Ohio State University
- #16 Michigan State University
- #17 University of Illinois at Urbana-Champaign
- #26 University of Minnesota

Building off of the success and technologies of these institutions and corporations is the Chicago Mercantile Exchange Group, which acts as the pricing standard for the agriculture market. In summation, the Midwest, as a connected network of parties, possesses the greatest potential due to their numerous global corporations, top-tier universities, and ideal locations to become the world’s agriculture center for new innovations.

Recently, the agriculture industry has gained publicity with successful exits at large valuations along with local Midwest Series A raisings. The Climate Corporation, founded by early Google employees in California, made recent headlines with their acquisition by Monsanto for $930MM in October 2013. These exits, previously only generating significant publicity when in the digital startup sphere, exist in agriculture due to the necessity of companies to provide farmers with the means to produce double the amount of food currently harvested to meet the demands of the world in 2050. Another case study of agriculture startup success with local ties is FarmLogs, a Y-Combinator alumni startup based in Ann Arbor, MI focusing on the infusion of web and mobile technology into farming. In early January 2014, FarmLogs raised $4MM in their Series A round lead by Drive Capital of Columbus, OH, along with additional investments from Chicago-based Hyde Park Angels and Hyde Park Ventures. As entrepreneurs begin to infuse the abilities from high-tech ventures in software and data analytics to solve agriculture challenges, great opportunities have risen in terms of both social service and investment opportunities.

Creating an agriculture and food sciences innovation hub in the Midwest will provide the venue and resources for entrepreneurs interested in solving the world’s next greatest growth challenge. AGRI is designed to complement the existing Midwest initiatives such as 1871, MATTER, the Danforth Plant Science Center, and UI Labs by creating critical density in resources and act as an aid in connecting disparate corporate and institutional resources. To accomplish this goal, AGRI will provide space for future entrepreneurs to meet along with teams to work on their transforming their ideas into companies. In addition, co-working and dedicated work spaces will be available for startups either in the suburbs or outside of the city, especially if these companies

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need to be located next to experimental fields, in order for these entrepreneurs to interact with visiting industry experts and venture capitalists.

One of the key features enticing companies and individuals to locate or visit AGRI will be dedicated programs either on a monthly or quarterly basis focused upon different segments of the agriculture and food science industries. Examples of program cycles will be data analytics and big data in farming, drone and advance electronics technology in agriculture, plant science development, health and wellness, innovations in food processing, and efficient allocation of resources in the food industry.

For each of these segments, industry professionals from large companies and investors skilled in the segment will provide open lectures at AGRI to educated the in-house entrepreneurs and interested community members. To further entice corporate officials and investors to visit with business interests in mind, startups relevant to the current segment will do demonstrations of products to the visiting experts and interested community. This action will inspire hype among the AGRI community and illustrate the successes of participants to the Midwest agriculture community to garner national attention to the region.
The Practicum Institute

What:
The Practicum Institute represents the first opportunity for tier one research universities to connect their top students in a collaborative environment focused on solving the prominent challenges within a multitude of industries. Drawing on the successes of the MIT-Harvard Health Sciences and Technology program and Stanford Design School, Practicum Institute will consist of select undergraduate students from Tier One research universities from an array of complementing backgrounds. An ideal scenario consists of 3-4 institutions within a 200-mile radius of Chicago, with each school’s representatives from subsections of their colleges with emphasis on strengths of each university. One Friday a month, a panel of speakers (corporate executives or leading researchers) will present on the background and new challenges arising in each of their industries. The areas of focus may include manufacturing, biotechnology, healthcare, agriculture, technology, creativity/design, business plans, finance (venture valuations), and various other possibilities. The goal is for these students, from varying schools, countries, and disciplines, to learn about a variety of upcoming industry challenges to solve from leading authorities and apply their perspectives from each of their unique backgrounds in a collaborative environment as a beginning to school partnerships.

Why:
Currently, the Midwest has failed to capitalize upon a growing trend of partnership among many leading universities on each coast. A leading example is the cross listing of classes between MIT and Harvard along with their joint Health Sciences and Technology program that pairs the brightest medical students and PhDs from both campus to take advantage of each other’s greatest assets. This same model, with a unique twist, has great potential in the Midwest as the undergraduate students from Northwestern, UChicago, and UIUC remain among the most sought after in world. By combining the best students of each school’s specialties, a similar environment of combining complementary students initiates the first act of bridging gaps between these Illinois schools and encourages cross university communications at the campus level. The goal of the program is to start the sharing of resources between universities and providing a platform for each university’s talent to work on business ventures with each other. In addition, hosting the event in Chicago will allow for students to become acquainted with the varying resources and organizations that Chicago can provide to these students in accomplishing their venture goals.

From the corporate or speaker perspective, the event fills philanthropic and educational leanings of experienced executives but, more importantly, makes business sense to the speakers as many of their firms would incur costs of near or exceeding $100,000 per recruit to capture these same talents. In combination with the extensive and prestigious alumni of each school, a compelling educational and business proposition can be made for executives to participate. Furthermore, the arrival of these executives into Chicago presents great opportunities for local organizations to interact with these out of town thought leaders who otherwise may never have come.

When:
The program will ideally commence within 1-2 years’ time, with classes starting in late September or October, depending upon recruitment and class scheduling. Classes would continue throughout the year and into May. However, scheduling will be a concern if there is a mix of semester and quarter based schools with different timed breaks. Consequently, administrators...
the program will need to conduct much of the marketing and scheduling during the prior summer in order to secure speakers and class dates.

Where:

The Practicum Institute will be held in downtown Chicago at a variety of locations as deemed appropriate according to the class module. Examples would include holding technology seminars at 1871, biotech/healthcare seminars at Matter, and manufacturing seminars at UI Labs. These locations are ideal in that students will have the greatest access to the resources available at each of these locations in accordance with the module but also the speakers will be brought to these locations where Chicago and the Midwest can centrally showcase their proud developments. As a result, the symbiotic relationship between students and venture development centers should encourage success for both parties.

Conclusion:

Practicum Institute has the ability to not only increase the potential success for top students from tier one universities but also provide the first action towards aggregating the resources of many of the Midwest’s best universities into a stronger connected network. As a beneficial side-effect, support through the program towards gathering top thought leaders could provide exposure to Chicago’s newly formed entrepreneurial centers. Components of the program remain open for improvement and all continued ideation is welcome.
Midwest Startup Showcase

Through one hundred interviews of professionals in the entrepreneurship community ranging from venture capitalists to entrepreneurs in university research parks, a common theme expressed by both ends of the startup spectrum was a disconnect between advanced technologies and funding sources in many key industries including biotechnology, healthcare, and agriculture. As a result of this gap in connection, many of the best entrepreneurs relocate to the coast so they can gain access to a supporting entrepreneurship network. Consequently, the $8.4 billion[^212] worth of funded research in the Big Ten, which excludes many top Midwest universities outside of the Big Ten, along with the researchers associated with this funding represent an untapped resource for the Midwest. The key to unlocking this entrepreneurship potential in the Midwest is to provide many of these advanced researchers with the resources needed to develop companies based upon their technologies in the Midwest. Due to the fragmentation and spread of Midwest universities, each school has currently taken it upon themselves to solve this resource deficiency. However, a singular school cannot compare to developed cities in terms of resources needed for rapidly growing companies. The Midwest Startup Showcase aims to solve the resource deficiency by concentrating the Midwest’s resources and attention towards these promising startups at a singular, central event in Chicago, the global city of the Midwest.

Over a single or multi-day period, venture capitalists, angel investors, incubator representatives, and corporate research arms from across the Midwest will be gathered to the event in Chicago with the enticement of experiencing the best in technology from the Midwest and new investment opportunities for their firms. This event will differ from the recent surge in other startup competitions and networking events, as the audience is not solely the investor and startup, but rather companies, students (college and high school), and the Chicago community as a whole. Instead of designing a networking event, the showcase focuses more on creating an experience for the Midwest community to see, interact, and become inspired by the entrepreneurship occurring in their states and cities. As a result, a strong emphasis will be placed on prototypes or demonstrations that can allow the audience to see the technology in action or interact with the innovations after the presentations. Casting away the business models assumed by common networking events of a bland PowerPoint presentation followed by professional questioning and instead adopting a style used by South by Southwest and TechWeek of focusing on entertainment should still facilitate business transactions but also build excitement about entrepreneurship in the community. This technique should make attending the event more desirable to investors and startups while inspiring the general audience to innovate the next round startups.

The important emphasis from the attendee perspective is the anticipation of these firms seeing the next investment opportunities to redefine their portfolios or companies. Consequently, startups will be presenting in front of their potential next rounds of funding, industry connections, and/or future acquirers as well as customers. To filter these startups for the quality needed to build excitement in the investor community, the showcase will partner with universities who will nominate their own best candidates for the event in the following industry categories: digital/electronics, biotech/healthcare, and agriculture/manufacturing, among others. The goal is to work with universities instead of acting as an outside unit seeking to relocate their best talent. Success for the universities and startups would be a strong pitch at the event, which attracts further funding and mentoring support that they can utilize back at their company spaces. A benefit to this method of recruiting will be the utilization of a school’s knowledge of their best startups through their entrepreneurship programs and each school adding their own stake in the showcase. An optimal subset of participating universities would include the Big Ten’s largest

[^212]: Committee on Institutional Cooperation Annual Report 2011-2012
research universities along with other prominent research or technology-driven schools. The ideal characteristics of a nominated startup would include many of the following:

- Disruptive product
- Incorporation or commitment as a startup
- Relatively new company (0-3 years old) in a research park or university incubator
- Plans on commercialization, even if relatively broad
- Patentable technology
- Prototypes/Product designs
- Limit of prior funding up to and including angel or series A rounds

Contrary to many business plan or startup competitions, these ideal characteristics intend to narrow down potential candidates to those startups needing incubator space, venture funding, or advanced industry mentoring.

A sample timeline of events would entail:

As a whole, the Midwest Startup Showcase seeks to act as a connector or meeting place for the Midwest to display its innovations and potential to a national audience. The Midwest will benefit through aggregating resources instead of all attempting to independently rival large clusters in power. In addition, strong startups and successful exits from this event can draw attention and investors from the coasts to set up offices in Chicago. Universities will benefit from the exposure to their research park or general startups that need the next level of resources not found in a campus town to grow and develop. Finally, the event acts as a vehicle to build hype, publicize what the cities of Midwest can offer to each other, and most importantly, create the initial connections between universities and cities to create a strong technology cluster and entrepreneurial community.
Conclusion

We believe that these recommendations, when complemented with efforts on a regional level, offer the opportunity to enhance the image and entrepreneurial culture of the Midwest, while at the same time providing mechanisms to encourage domestic job growth.

Next Steps

We envision the next steps to our recommendations to be the refinement of ideas and strategies along with support from stakeholders in both the private and public sectors on a local and regional level. Given the opportunity for individuals from varying backgrounds to come together around a common cause of long-term economic growth and regional prosperity, we encourage discussion that will lead to tangible and measurable accomplishments for Chicago and the Midwest in the coming 3-5 years. The opportunity to capitalize on our collective interests has never been greater.
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Jude Conway       Chris Magnuson   Khan Siddiqi
Patrick Cunningham    Joey Mak    Anne Sissel
George Deeb       Chris Mallet    Lucas Smith
Virgil DeLay     Jeff Margolis    Steve Sonka
Tim Deppen        Galen Mason    Patrick Spain
Sarah Doherty     Rick Mattoon    Nancy Sullivan
Jim Durham        Kip McCoy    Howard Tullman
Raj Echambadi    Vern McGinnis    Kapila Viges
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James Gillespie    John Murray    Troy Vosseller
Scott Glickson   Phil Nevels    Nicole Walker
Barbara Goodman    Caralynn Nowinski   David Weinstein
Steven Gould      Anthony Palcheck    Scott Whitaker
Keith Graff       Jasmin Phua    Michael Willard
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Disclaimer: The viewpoints in this paper gathered from the above individuals do not reflect the opinions of their employers or institutions.

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Appendix
Appendix I: Research Staff Profiles

Co-Chairs Steve Sprieser (left) and Brian Lickenbrock (right)

Front row (left to right): Annie Xiang, Chong (Flora) Gu, Guangrong (Rachel) Fu, Zimo Yan, Dandi Wang;
Second row: Lei Duan, Joe Stempel, Jacob Hanselman, Josh Alfaro;
Third row: Brian Lickenbrock, Steve Sprieser, Zijun (Moby) Xu, Patrick J. Schultz, Shoham Das
Steve Sprieser  
Co-Chair  
Steve is a graduate student in Library and Information Science at the University of Illinois, where he focuses on healthcare informatics and data analytics. He holds a B.S. in Information Systems, also from Illinois. He has worked with a variety of healthcare firms for the last three years. In his free time, Steve is an endurance athlete and marathon runner. Upon graduation in May 2014, Steve plans on being part of the growing healthcare startup and venture ecosystem in Chicago.

Brian Lickenbrock  
Co-Chair  
Brian is a graduate student in Accountancy with a concentration in venture development at the University of Illinois, where he also holds a B.S. in Accountancy and a minor from the Hoeft Technology Management Program. In school, he has consulted for high-tech startups and Fortune 500 firms and has interned at MasterCard and Boeing. In his free time, Brian enjoys mountaineering and other outdoor activities. Upon graduation, Brian plans on being an active member in the Chicago venture and entrepreneurship community.

Annie Xiang  
Team Lead - Biotechnology  
Annie is an undergraduate student in Accountancy with a minor in Communication at the University of Illinois at Urbana-Champaign. She has worked on various consulting projects for non-profit organizations. Upon graduation in May 2015, Annie will work for the International Tax Division in a public accounting firm. Annie is a passionate world traveler. She has so far visited 20 different countries. Her goal is to visit all seven continents by age 30.
Jingfeng (Jeffrey) Li
Analyst - Biotechnology
Jeffrey is an undergraduate student at University of Illinois at Urbana-Champaign where he is majoring in Accounting and Finance with a minor in computer science. He obtained his private pilot license during college and enjoys flying. Upon graduation, Jeffrey will continue his education at University of Illinois for a Master of Accountancy. In the future, Jeffrey is interested in working in the banking industry.

Jacob Hanselman
Analyst - Biotechnology
Jacob is an undergraduate student at University of Illinois at Urbana-Champaign where he is majoring in Bioengineering and is a part of the Hoeft Technology and Management Program. In his free time, Jacob is an avid soccer player. Upon graduation, Jacob aspires to pursue a career in the growing biotechnology industry of medical devices, pharmaceuticals, and diagnostics.

Alexander Johansson
Analyst - Biotechnology
Alex is an undergraduate student at the University of Illinois at Urbana-Champaign, majoring in Finance. Alex’s plan upon graduation are to work at Abercrombie & Fitch’s Finance Division in Columbus, Ohio. Alex is also the former president of Capital Markets Group and a proud member of Psi Upsilon Fraternity. During his free time, he enjoys working out, Crossfit, playing golf and spending time with family and friends.
Patrick J Schultz
Team Lead - Healthcare
Patrick is an undergraduate student studying Community Health with a concentration in Health Planning & Administration at the University of Illinois at Urbana-Champaign. He has worked with a healthcare informatics firm, and has secured future internships with an EMR Vendor as well as the Operations Department of a leading hospital. Upon graduation in May 2015, Patrick aspires to implement meaningful change throughout the healthcare continuum through the utilization of technologies.

Josh Alfaro
Analyst - Healthcare
Josh is an undergraduate student studying Community Health with a concentration in Health Planning & Administration at the University of Illinois at Urbana-Champaign. For the summer and fall of 2014, he will be an intern for a leading hospital. Upon graduation in May 2015, Josh is interested in working in the field of healthcare consulting or healthcare administration.

Alex Schwartz
Analyst - Biotechnology
Alex is an undergraduate student majoring in Accountancy at the University of Illinois. After completing his undergraduate degree, he plans on enrolling in the Master of Accounting Science program at the University of Illinois. In his free time, Alex enjoys playing basketball and following capital markets.
Zijun (Moby) Xu  
Analyst - Healthcare  
Moby is an undergraduate student majoring in Finance and Accounting in the University of Illinois at Urbana-Champaign. He has interned at Prudential-Rubloff, a real estate company in Chicago in 2013, functioning as an internal business consultant to the firm for the improvements. In the future, Moby hopes to work in the banking industry.

Chong (Flora) Gu  
Team Lead - Agriculture  
Flora is an undergraduate student in Agricultural Accounting. She has worked with KPMG as a winter intern and she is currently working as a research assistant for Foreign Corrupt Act research. In her free time, she enjoys swimming and watching movies.

Lei Duan  
Analyst - Agriculture  
Lei is an undergraduate student in Agriculture and Consumer Economics with an Agricultural Accounting concentration at the University of Illinois. After being admitted into the Master in Accounting Science program at University of Illinois, Lei plans on becoming a Certified Public Accountant after graduation.
Zimo Yan  
**Analyst - Agriculture**  
Zimo is an undergraduate student studying financial planning at University of Illinois Urbana-Champaign. For the summer of 2013, Zimo interned at a leading company concentrated in securities and trading. For the summer of 2014, she will be an intern for a leading bank in New York. In her free time, she loves to run and do yoga. Upon graduation in May 2015, Zimo is interested working in the field of wealth management or finance.

Dandi Wang  
**Analyst - Agriculture**  
Dandi is an undergraduate student in Agriculture and Consumer Economics at the University of Illinois at Urbana-Champaign, where she concentrates on the agricultural finance and financial planning. She worked with a commercial bank last summer and learned how the banking system works. In her free time, Dandi likes to travel and explore the different aspects of the world. For this summer, Dandi plans to intern with an accounting firm.

Guanrong(Rachel) Fu  
**Analyst - Manufacturing**  
Rachel, is an undergraduate student in accounting and finance at the University of Illinois. Upon graduation in May 2014, she will pursue a Master degree in Accounting with an IT concentration. Rachel has worked in a public accounting firm and financial service broker before. She has actively been involved with various startup companies. In her free time, Rachel prefers to play tennis and workout. Upon graduation in May 2015, Rachel plans to join a startup company or financial service company.
Joe Stempel
Analyst - Advanced Manufacturing
Joe is an undergraduate sophomore student majoring in economics with a minor in business at the University of Illinois at Urbana-Champaign. In the future, Joe hopes to work as an analyst in the private equity or investment banking industry.

Shoham Das
Analyst - Manufacturing
Shoham is an undergraduate student in aerospace engineering at the University of Illinois. Shoham has worked with a number of startups and is actively involved in consulting organizations around campus. Over the summer, he plans on dedicating time to his own personal startup. Upon graduation in May of 2017, Shoham plans to join a private independent space agency.
Appendix II: Other Summary Statistics from Student Survey

Q2. At your university, which of these disciplines best describes your major? Check more than one box if applicable.

<table>
<thead>
<tr>
<th>Major</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>677</td>
</tr>
<tr>
<td>Business</td>
<td>500</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>193</td>
</tr>
<tr>
<td>Computer and Physical Sciences</td>
<td>133</td>
</tr>
<tr>
<td>Agriculture</td>
<td>113</td>
</tr>
<tr>
<td>Health-related Fields</td>
<td>106</td>
</tr>
<tr>
<td>Opt Out</td>
<td>98</td>
</tr>
</tbody>
</table>

Q3. In which range does your cumulative GPA fit within?

<table>
<thead>
<tr>
<th>GPA Range</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5-4.0</td>
<td>1277</td>
</tr>
<tr>
<td>3.0-3.49</td>
<td>664</td>
</tr>
<tr>
<td>2.5-2.99</td>
<td>212</td>
</tr>
<tr>
<td>2.0-2.49</td>
<td>39</td>
</tr>
<tr>
<td>0.0-1.99</td>
<td>6</td>
</tr>
<tr>
<td>Opt Out</td>
<td>15</td>
</tr>
</tbody>
</table>
Q4. Which level in school relates most to your current educational status?

EDUCATION LEVEL

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Undergraduate</th>
<th>Masters</th>
<th>PhD</th>
<th>Professional Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education Level</td>
<td>1679</td>
<td>298</td>
<td>196</td>
<td>42</td>
</tr>
</tbody>
</table>

Q5. What is your estimated graduation year?

GRADUATION YEAR

<table>
<thead>
<tr>
<th>Graduation Year</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduation Year</td>
<td>609</td>
<td>701</td>
<td>482</td>
<td>365</td>
<td>53</td>
</tr>
</tbody>
</table>
Q6. Which gender do you identify with?

**IDENTIFIED GENDER**

<table>
<thead>
<tr>
<th>Identified Gender</th>
<th>Male</th>
<th>Femal</th>
<th>Other</th>
<th>Opt out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1160</td>
<td>1028</td>
<td>3</td>
<td>16</td>
</tr>
</tbody>
</table>

Q7. What is your race?

**RACE**

<table>
<thead>
<tr>
<th>Race</th>
<th>Asian or Pacific Islander</th>
<th>Black / African American</th>
<th>Hispanic / Latino</th>
<th>Native American</th>
<th>White (Non-Hispanic)</th>
<th>Other</th>
<th>Opt Out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>615</td>
<td>90</td>
<td>148</td>
<td>7</td>
<td>1239</td>
<td>40</td>
<td>72</td>
</tr>
</tbody>
</table>

Q8. In which region does your hometown reside?
Q9. Which description best fits your current or future (summer) work status? Check all that apply.

Q10. Where will you be located for your internship or fulltime position in Summer 2014?
Q11. Your summer or fulltime 2014 employer most accurately operates in which of the following industries?

Q12. Your employer most appropriately fits which size category?
Q13. In 3-5 years, your goal employer most accurately operates in which of the following industries?

Q14. Your goal employer would most appropriately fit which size category?
Q15. When considering different employment options, how much does each attribute factor in?

**IMPORTANCE OF EMPLOYMENT FACTORS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Importance Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Security/Stability</td>
<td>4.13</td>
</tr>
<tr>
<td>Role/Exciting Challenges</td>
<td>4.09</td>
</tr>
<tr>
<td>Salary</td>
<td>4.08</td>
</tr>
<tr>
<td>Work/Life balance</td>
<td>4.04</td>
</tr>
<tr>
<td>Benefits</td>
<td>3.93</td>
</tr>
<tr>
<td>Autonomy</td>
<td>3.52</td>
</tr>
<tr>
<td>Exit Options (New Career Opportunities)</td>
<td>3.44</td>
</tr>
<tr>
<td>Stock Options</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Q16. Which factors would attract or detract you towards living in the region you attended college?
Q17. How well do you feel that your education has prepared you for starting a company? 4.51 out of 7

Q18. How often does your university challenge students to find and present solutions to existing business and industry problems? 3.89 out of 7, *Medium: Occasionally taught each semester*

Q19. Do you feel that your university provides ample opportunities to learn about starting a company and connecting with entrepreneurial (entrepreneurs, venture capitalists, incubators… etc.) resources?
Q20. Which methods of teaching best help you learn about starting companies and handling business situations?

**Best Methods to Teach Company Creation and Business Situations**

- Projects with Sponsor Companies: 3.96
- Speakers with Business Experience: 3.8
- Case Studies: 3.44
- Traditional Lectures: 2.85

Q21. Have you or any of your immediate family members started a company?
Q22. How likely are you to start a new company in the future? 2.96 out of 5, Undecided

Q23. If you want to become an entrepreneur, what timeframe do you think this goal will be realized?

Q24. If you want to become an entrepreneur, where will you seek assistance? Check all that apply.
Q25. In your opinion, which of the cities have an entrepreneurial culture?

Q26. Which factors weigh heavily if you were to start a company? Check all that apply.
Q27. Which of the past factors need to be enhanced the most in the Midwest? Check all that apply.

**ENTREPRENEURIAL FACTORS TO BE ENHANCED IN THE MIDWEST**

- **Entrepreneurial support networks**: 50%
- **Access to capital**: 48%
- **Culture**: 40%
- **Past startup success in the region**: 34%
- **Talent pool**: 32%
- **Mentors**: 29%
- **Related companies nearby**: 27%

Q28. In which areas does Chicago need to improve upon? Check all that apply.
Q29. How familiar are you with different entrepreneurial programs and startups in the following cities:

**ENTREPRENEURIAL FACTORS TO BE ENHANCED IN CHICAGO**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crime</td>
<td>69%</td>
</tr>
<tr>
<td>Programs connecting college to the cities companies and related companies nearby</td>
<td>57%</td>
</tr>
<tr>
<td>Entrepreneurial support networks</td>
<td>39%</td>
</tr>
<tr>
<td>Not familiar enough with the city</td>
<td>32%</td>
</tr>
<tr>
<td>Culture</td>
<td>30%</td>
</tr>
<tr>
<td>Past startup success in the region</td>
<td>29%</td>
</tr>
<tr>
<td>Access to capital</td>
<td>29%</td>
</tr>
<tr>
<td>Mentors</td>
<td>25%</td>
</tr>
<tr>
<td>Related companies nearby</td>
<td>20%</td>
</tr>
<tr>
<td>Talent pool</td>
<td>18%</td>
</tr>
</tbody>
</table>

**FAMILIARITY WITH ENTREPRENEURIAL PROGRAMS IN DIFFERENT CITIES**

<table>
<thead>
<tr>
<th>City</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco / Silicon</td>
<td>3.78</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>3.55</td>
</tr>
<tr>
<td>New York, NY</td>
<td>2.96</td>
</tr>
<tr>
<td>Austin, TX</td>
<td>2.34</td>
</tr>
<tr>
<td>Boulder, CO</td>
<td>2.17</td>
</tr>
<tr>
<td>Madison, WI</td>
<td>2.14</td>
</tr>
<tr>
<td>Saint Louis, MO</td>
<td>2.14</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>2.03</td>
</tr>
<tr>
<td>Indianapolis, IN</td>
<td>1.93</td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>1.89</td>
</tr>
<tr>
<td>Nashville, TN</td>
<td>1.87</td>
</tr>
<tr>
<td>Columbus, OH</td>
<td>1.71</td>
</tr>
<tr>
<td>Ames, IA</td>
<td>1.47</td>
</tr>
</tbody>
</table>
Appendix III: Copy of Survey
Default Question Block

Informed Consent Form

You are invited to participate in a research study on student perceptions of entrepreneurship, startup firms, and innovation. This study is conducted by Dr. Paul Magelli and sponsored by the Academy for Entrepreneurial Leadership from the University of Illinois Urbana Champaign.

This study will take approximately 8-10 minutes of your time. You will be asked to complete an online survey about your perspectives on entrepreneurship, innovation, and start-ups in Chicago and the Great Lakes region. Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. You may skip any questions you do not wish to answer. If you want do not wish to complete this survey just close your browser.

Your participation in this research will be anonymous and data will be averaged and reported in aggregate. Possible outlets of dissemination may be local newspapers, as well as a report for the City of Chicago. Although your participation in this research may not benefit you personally, it will help us understand student interest in start-ups and entrepreneurship in an effort to provide better resources and opportunities for students in the Midwest.

There are no risks to individuals participating in this survey beyond those that exist in daily life. Your decision to participate, decline, or withdraw from participation will have no effect on your current status or future relations with your university.

You will be eligible for a raffle to win one of ten Amazon gift cards worth $75 by entering your email address at the end of the survey (email addresses will be stored separately from your response).

If you have questions about this project, you may contact Dr. Paul Magelli at (217) 244-3407 or via email at pmagelli@illinois.edu

If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Institutional Review Board at 217-333-2670 (collect calls will be accepted if you identify yourself as a research participant) or via email at irb@illinois.edu.

Please print a copy of this consent form for your records, if you so desire.

I have read and understand the above consent form, I certify that I am 18 years old or older and, by clicking the submit button to enter the survey, I indicate my willingness voluntarily take part in the study.

Which University do you currently attend?

At your university, which of these disciplines best describes your major? Check more than one box if applicable.
In which range does your cumulative GPA fit within?

Which level in school relates most to your current educational status?

What is your estimated graduation year?

Which gender do you identify with?

What is your race?
In which region does your hometown reside?

[Dropdown]

Which description best fits your current or future (summer) work status? Check all that apply.

- Fulltime
- Internship
- Co-opt
- Summer job
- Continued education
- Studying abroad
- Currently searching

Where will you be located for your internship or fulltime position in Summer 2014?

[Dropdown]

Your summer or fulltime 2014 employer most accurately operates in which of the following industries?

- Agriculture
- Accounting
- Aerospace and Defense
- Airline
- Apparel & Accessories
- Automotive and Transportation
- Biotechnology
- Computer, Software, and Telecommunications
- Consulting
- Consumer Products
- Department, Retail, and Grocery Stores
- Education
- Energy, Chemical, and Petroleum
- Finance (commercial banking)
- Finance (investment banking, private equity, hedge fund)
- Food, Beverage & Tobacco
- Health Care
- Publishing, Advertising, and Journalism
- Legal
- Manufacturing
- Music and Video Media
- Pharmaceuticals
- Real Estate
- Securities & Commodity Exchanges, Brokerage
- Service
- Sports, Entertainment & Leisure
- None of the above

Your employer most appropriately fits which size category?

[Dropdown]
Startup (0-20 employees and <5 years old)
- Small Business (0-99 employees)
- Medium-sized Business (100-999 employees)
- Large-sized Business (1,000+ employees)

In 3-5 years, your goal employer most accurately operates in which of the following industries?
- Agriculture
- Accounting
- Aerospace and Defense
- Airline
- Apparel & Accessories
- Automotive and Transportation
- Biotechnology
- Computer, Software, and Telecommunications
- Consulting
- Consumer Products
- Department, Retail, and Grocery Stores
- Education
- Energy, Chemical, and Petroleum
- Finance (commercial banking)
- Finance (investment banking, private equity, hedge fund)
- Food, Beverage & Tobacco
- Health Care
- Publishing, Advertising, and Journalism
- Legal
- Manufacturing
- Music and Video Media
- Pharmaceuticals
- Real Estate
- Securities & Commodity Exchanges, Brokerage
- Service
- Sports, Entertainment & Leisure
- None of the above

Your goal employer would most appropriately fit which size category?
- Startup (0-20 employees and <5 years old)
- Small Business (0-99 employees)
- Medium-sized Business (100-999 employees)
- Large-sized Business (1,000+ employees)

When considering different employment options, how much does each attribute factor in?

<table>
<thead>
<tr>
<th>Does Not Matter</th>
<th>Indifferent</th>
<th>Crucial Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Job Security/Stability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worklife balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role/Exciting Challenges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock Options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exit Options (new career opportunities)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which factors would attract or detract you towards living in the region you attended college?

<table>
<thead>
<tr>
<th>Detract Significantly</th>
<th>No Effect</th>
<th>Attract Significantly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Weather</td>
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<tr>
<td>Cost of living</td>
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<td>Job openings</td>
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<td>Wages</td>
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<td>Amenities</td>
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<td></td>
</tr>
<tr>
<td>Forced to leave because of visa (4 if no, 7 if yes)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How well do you feel that your education has prepared you for starting a company?

High: Extensive Preparation (at least one class per semester emphasizes this)  Medium: Occasional Preparation (One class every year at most)  Low: No Preparation (One class or less all through school)

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td></td>
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<td></td>
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</tbody>
</table>

How often does your university challenge students to find and present solutions to existing business and industry problems?

High: Most if not all classes and projects  Medium: Occasionally taught each semester  Low: Rarely, if ever focused on

<table>
<thead>
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<th>4</th>
<th>5</th>
<th>6</th>
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<td>Response</td>
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</tr>
</tbody>
</table>

Do you feel that your university provides ample opportunities to learn about starting a company and connecting with entrepreneurial (entrepreneurs, venture capitalists, incubators... etc.) resources?

Yes  No  Somewhat  I don’t know

Which methods of teaching best help you learn about starting companies and handling business situations?

<table>
<thead>
<tr>
<th>Not Informational</th>
<th>Somewhat Helpful</th>
<th>Extremely Educational</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Speakers with business experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case studies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Traditional lectures</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects with sponsor companies</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Have you or any of your immediate family members started a company?

- [ ] I have started a company
- [ ] At least one of my family members has
- [ ] Both
- [ ] Neither I nor any of my family have started a company

How likely are you to start a new company in the future?

<table>
<thead>
<tr>
<th>Unlikely</th>
<th>Undecided</th>
<th>Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Response

If you want to become an entrepreneur, what timeframe do you think this goal will be realized?

- [ ] During college
- [ ] Upon graduation
- [ ] 3-5 years after graduation
- [ ] 10 or more years after graduation

If you want to become an entrepreneur, where will you seek assistance? Check all that apply.

- [ ] Chamber of Commerce
- [ ] University career office
- [ ] Local small business assistance office
- [ ] Mentor/Alumni
- [ ] Venture capital firm
- [ ] Startup Groups
- [ ] Incubator
- [ ] Other (fill in)
In your opinion, which of the cities have an entrepreneurial culture?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Don't Know</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ames, IA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austin, TX</td>
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<td></td>
<td></td>
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<tr>
<td>Boulder, CO</td>
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<td></td>
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<tr>
<td>Detroit, MI</td>
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<td></td>
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<tr>
<td>Indianapolis, IN</td>
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<td></td>
<td></td>
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<tr>
<td>Los Angeles, CA</td>
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<tr>
<td>Miami, FL</td>
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<tr>
<td>Nashville, TN</td>
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<tr>
<td>New York, NY</td>
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<tr>
<td>Omaha, NE</td>
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<td></td>
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<tr>
<td>Raleigh-Durham, NC</td>
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<tr>
<td>Saint Louis, MO</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco / Silicon Valley, CA</td>
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</tr>
</tbody>
</table>

Which factors weigh heavily if you were to start a company? Check all that apply.

- Proximity to family
- Access to capital
- Talent pool
- Weather
- Culture
- Related companies nearby
- Mentors
- Entrepreneurial support networks
- Past startup success in the city
- Location of friends

Which of the past factors need to be enhanced the most in the Midwest? Check all that apply.

- Access to capital
- Mentors
- Talent pool
- Entrepreneurial support networks
- Past startup success in the region
- Related companies nearby

In which areas does Chicago need to improve upon? Check all that apply.

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How familiar are you with different entrepreneurial programs and startups in the following cities:

<table>
<thead>
<tr>
<th></th>
<th>No Knowledge</th>
<th>Somewhat Knowledgeable</th>
<th>Very Knowledgeable</th>
</tr>
</thead>
<tbody>
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</table>
Please list the first three startups, incubators, entrepreneurial networks, mentors, venture capital firms, or companies with entrepreneurial programs from Chicago or the Midwest that you can recall from memory.

Organization 1

Organization 2

Organization 3

Enter N/A for no recollection

Any additional comments on your perspectives of entrepreneurship and innovation in the Midwest?

Do you wish to be entered into a drawing to receive a gift certificate?

- Yes
- No

Please answer the following questions so that you can be included in a drawing for a gift-certificate. This information will not be associated with your data

First Name

Last Name

University Email