A Review of the State of Science and Technology in Minnesota

Autumn 2016

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November 2016

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About The Minnesota High Tech Association

The Minnesota High Tech Association (MHTA) is a non-profit association of more than 300 science and technology companies and organizations. Together, we fuel Minnesota's prosperity through innovation and technology. Our members include some of the world's leading corporations, mid-sized companies and startups. We are united behind a common vision to make Minnesota one of the country's top five technology states. Minnesota High Tech Association members represent IT, bio-sciences, advanced manufacturing, clean, green and edtech. Once a company or organization joins MHTA, all of its employees become members.

mhta
Driving Innovation & Technology

Introduction

Minnesota's innovation economy is shaped by a diverse array of industries, from software to medical devices and biotechnology, to retail and financial services. In a number of ways, these industries are related to one another, with changes in one affecting changes in others. While measuring innovation is a difficult task, there are likely a number of factors that drive innovation across the country and within individual states.

While not meant to be exhaustive, factors that drive innovation likely include having a highly educated, talented workforce, particularly within the disciplines of science, technology, engineering, and mathematics (STEM). Investments by industry and government at federal and state levels in research and development (R&D) activities is also an important indicator of a region's innovation capacity, as are investments by venture capitalists and angel investors.

Investments in STEM workforce, research and development, and businesses at the startup or growing stage are inputs into a state's innovation ecosystem. Without these inputs (human and risk capital), innovation, as measured by patent output, would likely flounder, as would other indicators such company valuations.

In what follows we aim to review the state of technology in Minnesota. In addition to providing an overview of STEM workforce issues facing Minnesota companies, we review patents issued in 2015 as well as financing of Minnesota startups, and comment on policy issues that impact science and technology businesses in Minnesota. As with any review, the following is not exhaustive, but should shed some light on science and technology in Minnesota.

Innovation: How Minnesota Compares

Since the publication of the 2015 state of technology report, the Milken Institute released its 2016 State Technology and Science Index.[1] The index scores states on 107 indicators across five categories: Research and Development Inputs; Risk Capital and Entrepreneurial Infrastructure; Human Capital Investment; Technology and Science Workforce; and Technology Concentration and Dynamism. Overall, the Milken Institute ranks Minnesota seventh among the nation's 50 states. This year is the first year since 2004 that Minnesota has cracked the top 10 of the Milken Institute's State Technology and Science Index, and is a five-place improvement from 2014.

2016 Milken Institute's State Technology and Science Index Rankings

Category	MN Ranking	Top State
Overall	7	Massachusetts
Research and Development Inputs	19	Massachusetts
Risk Capital and Entrepreneurial Infrastructure	16	California
Human Capital Investment	5	Colorado
Technology and Science Workforce	4	Maryland
Technology Concentration and Dynamism	15	Maryland

Massachusetts continues to hold the top spot according to State Technology and Science Index, followed by Colorado, Maryland, California, and Washington.

Minnesota's composite scores highlight Minnesota's strengths with respect to Human Capital Investment (ranked fifth) and the state's Technology and Science Workforce (ranked fourth). The report notes that Minnesota ranks third with respect to concentration of computer and mathematical operations occupations, and has a growing health technology sector, which helps attract high-skilled workers.

Although Minnesota's Research and Development Inputs score climbed five places from the 2014 rankings, much work remains to catch the top state, Massachusetts. Massachusetts outscored the second-place state by 14 points, and is ranked in the top 10 for 15 of the 18 indicators that make up the Research and Development Inputs composite. The Milken Institute cites Massachusetts as the top state in terms of average dollars awarded under the small business technology transfer (STTR) program and with respect to private industry R&D expenditures.

[1] http://statetechandscience.org/State-Technology-and-Science-Index-2016.pdf, accessed November 3, 2016.

Minnesota also faces challenges with respect to its Risk Capital and Entrepreneurial Infrastructure (ranked 16th) and Technology Concentration and Dynamism (ranked 15th). The Risk Capital and Entrepreneurial Infrastructure composite index measures the structures and environment, including access to capital, patent activity, and business incubators and accelerators, which shape successful entrepreneurial endeavors. The top states of California and Massachusetts have relatively high levels of venture capital investment as a percentage of gross state product (GSP) and patent activity.

The Technology Concentration and Dynamism composite index measures "each state's entrepreneurial, government, and policymaking success (or failure) based on high-tech employment, payroll activity, net business formations, and growth".[2] This index measures, to some degree, the outcomes associated with public and private financing of research and development, risk capital, investments in human capital, and a skilled workforce. States that receive high scores in this composite index tend to have growing or established tech hubs or clusters with a diverse group of industries. While there is room for improvement here, the Milken Institute notes that "a focus on technology transfer from the University of Minnesota Venture Center has helped add to the creation of companies and contributed to the state's rise [from 20th to 15th] in Technology Concentration and Dynamism".[3]

As Minnesota looks to enhance its innovation competitiveness, more can be done to invest public and private financial resources in research and development activities. These investments, particularly those in basic research, might not have immediate payoff, but will help form the foundation of the industries of the future. Creating an environment that fosters growth in high-tech industries will help to improve the state's rankings, particularly the Risk Capital and Entrepreneurial Infrastructure and Technology Concentration and Dynamism composite indexes.

2. http://statetechandscience.org/State-Technology-and-Science-Index-2016.pdf, page 42, accessed November 3, 2016.
3. http://statetechandscience.org/State-Technology-and-Science-Index-2016.pdf, page 12, accessed November 3, 2016.

Minnesota's STEM Workforce

As of 2015, Minnesota was home to 9,418 technology business, employing nearly 142,000 people with a payroll of $13.3 billion, resulting in a 7.5 percent estimated direct impact on Minnesota's economy.[4] Between 2014 and 2015, Minnesota added nearly 5,500 jobs in the state's technology industry (4.0 percent increase year-over-year). In 2015, the average wage in Minnesota's technology industry was $93,500, compared to an average private sector wage of $52,500.

Minnesota's leading technology industry sectors (by employment) include: computer systems design; measuring and control instruments manufacturing; telecommunications; engineering services; and research and development (R&D) and testing labs.

Leading Minnesota Tech Industry Sectors by Employment (2014 vs 2015)

Tech Sector	2015 Employment	2014 Employment	Pct. Change
Computer Systems Design	38,400	33,800	13.6%
Measuring and Control Instruments Manufacturing	25,600	25,200	1.6%
Telecommunications	13,300	13,400	-0.7%
Engineering Services	12,700	12,400	2.4%
R&D and Testing Labs	10,200	10,900	-6.4%

The above table shows employment by technology industry sector, comparing 2015 to 2014. The sector with the largest in year-over-year increase is computer systems design, with a 13.6 percent increase compared to 2015. This sector of the technology industry also employed the greatest number of people in 2015, with 38,400 workers. The measuring and control instruments manufacturing sector employed 25,600 in 2015, for an increase of 1.6 percent compared in 2014, and the engineering services sector employed 12,700 people in 2015, compared to 12,400 in 2014 (2.4 percent increase).

While employment gains were observed in three of the top five sectors of the technology industry, two of the sectors experienced declines. These include the telecommunications sector, which lost 100 jobs between 2014 and 2015 (0.7 percent decline), and R&D and testing labs, which experienced a 6.4 percent decline from 2014 to 2015. Despite the job loss in these two sectors, Minnesota had 20,300 posting for technology occupations job openings in the fourth quarter of 2015–that is a 45.3 percent increase from the fourth quarter of 2014.

[4] https://www.comptia.org/docs/default-source/advocacydocs/cyberstates/comptia-cyberstates-2016-vfinal-minnesota.pdf?sfvrsn=2, accessed August 10, 2016.

Similar trends hold for the Minneapolis Metropolitan Statistical Area (MSA). In 2015, the Minneapolis MSA was home to 4,811 technology industry businesses, employing 113,086 people (or 7 percent of the private sector workforce).[5] In 2015, average technology industry wages within the Minneapolis MSA were $96,400 compared with an average private sector wage of $57,100.

The Minneapolis MSA shares the same leading technology industry sectors by employment with Minnesota as a whole.

Leading Minneapolis MSA Tech Industry Sectors by Employment (2014 vs 2015)

Tech Sector	2015 Employment	2014 Employment	Pct. Change
Computer Systems Design	30,600	27,400	11.7%
Measuring and Control Instruments Manufacturing	24,100	23,700	1.7%
Engineering Services	10,000	9,800	2.0%
Telecommunications	9,400	9,600	-2.1%
R&D and Testing Labs	8,600	8,900	-3.4%

As with Minnesota, the computer systems design sector experienced the larges employment gains in the technology industry within the Minneapolis MSA. The computer systems design sector employed 30,600 people in 2015, compared to 27,400 in 2014 (11.7 percent change). The measuring and control instruments manufacturing sector employed 24,100 people in 2015, compared to 23,700 in 2014 (1.7 percent increase), with the engineering services sector also experiencing employment gains of 2.0 percent year-over-year.

The telecommunications and R&D and testing sectors experienced employment losses in 2015, compared to 2014. In the Minneapolis MSA, the telecommunications sector experienced a decline of 2.1 percent in 2015 compared to 2014, while the R&D and testing sector witnessed a 3.4 percent decline year-over-year. The Minneapolis MSA decline in the R&D testing and labs sector was not as severe as the 6.4 percent decline experienced across the state Minnesota. The 2015 metro area decline (2.1 percent) in the telecommunications sector, however, was more pronounced than that experienced by the state (0.7 percent).

[5] https://www.comptia.org/docs/default-source/advocacydocs/cyberstates/msa-reports/comptia-cyberstates-2016---minneapolis-vfinal.pdf?sfvrsn=2, accessed August 10, 2016.

Patent Activity

Minnesota is home to some of the world's most innovative companies. Indeed, this is reflected in the number of patents issued to Minnesota companies.

Top 10 Minnesota Entities to Receive Utility Patents (2015)

First-Named Assignee	Patents	Share of all MN Patents
IBM	503	13%
3M Innovative Properties Company	313	8.1%
~Individually Owned Patent	291	7.5%
Medtronic Inc.	279	7.2%
Seagate Technology, LLC	256	6.6%
Cardiac Pacemakers, Inc.	156	4.0%
Honeywell International Inc.	156	4.0%
ADC Telecommunications, Inc.	73	1.9%
Ecolab USA Inc.	73	1.9%
Boston Scientific Scimed, Inc.	66	1.7%

The above table displays the top 10 Minnesota-based companies or individuals to receive utility patents in 2015.[6] In 2015, IBM was award 503 utility patents, followed by 3M with 313 patents. Individuals received 291 patents, Medtronic received 279 patents and Seagate Technologies received 256 patents. Rounding out the top 10 are Cardiac Pacemakers, Honeywell (each with 156 patents), ADC Telecommunications, Ecolab (each with 73 patents), and Boston Scientific (with 66 patents).

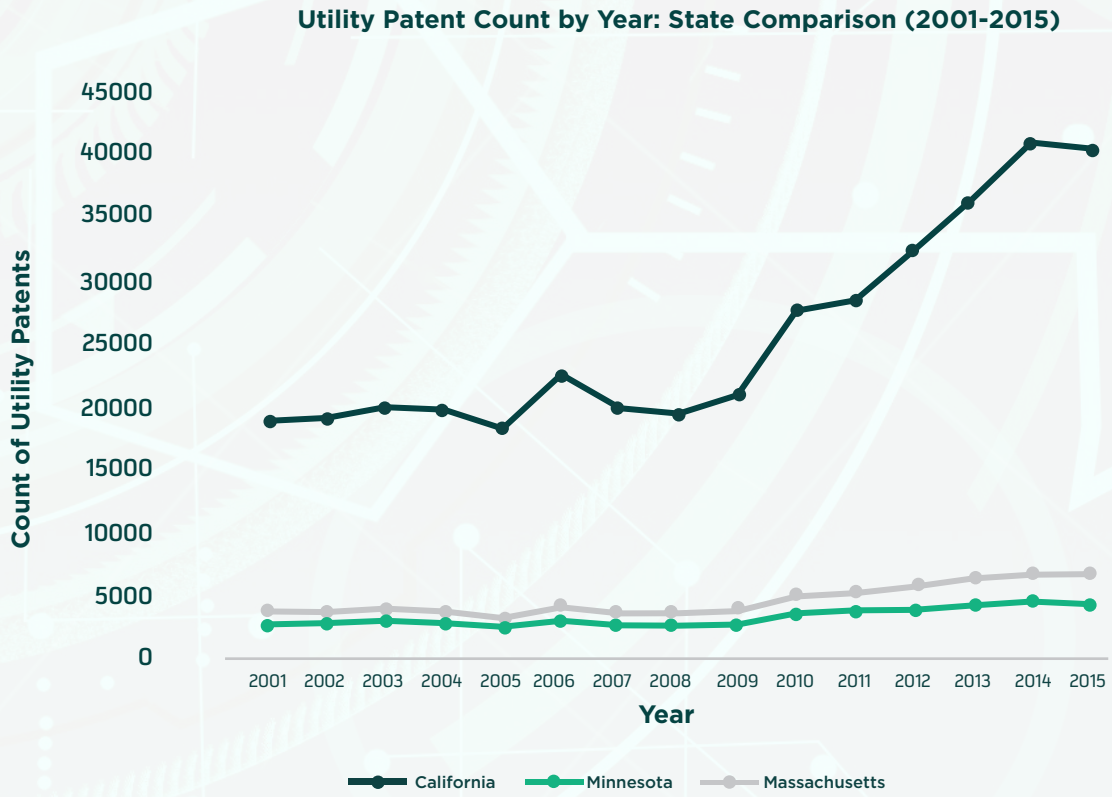
The top 10 Minnesota-based entities to receive patents account for more than 54 percent of all patents issued to Minnesota-based companies or individuals. IBM accounted for 13.0 percent of all patents issued in 2015, with 3M accounting for 8.1 percent of all patents.

6. http://www.uspto.gov/web/offices/ac/ido/oeip/taf/stcasg/mn_stcorg.htm, accessed August 10, 2016.

Top Ten Minnesota Patents Issued by Technology Class (2015)

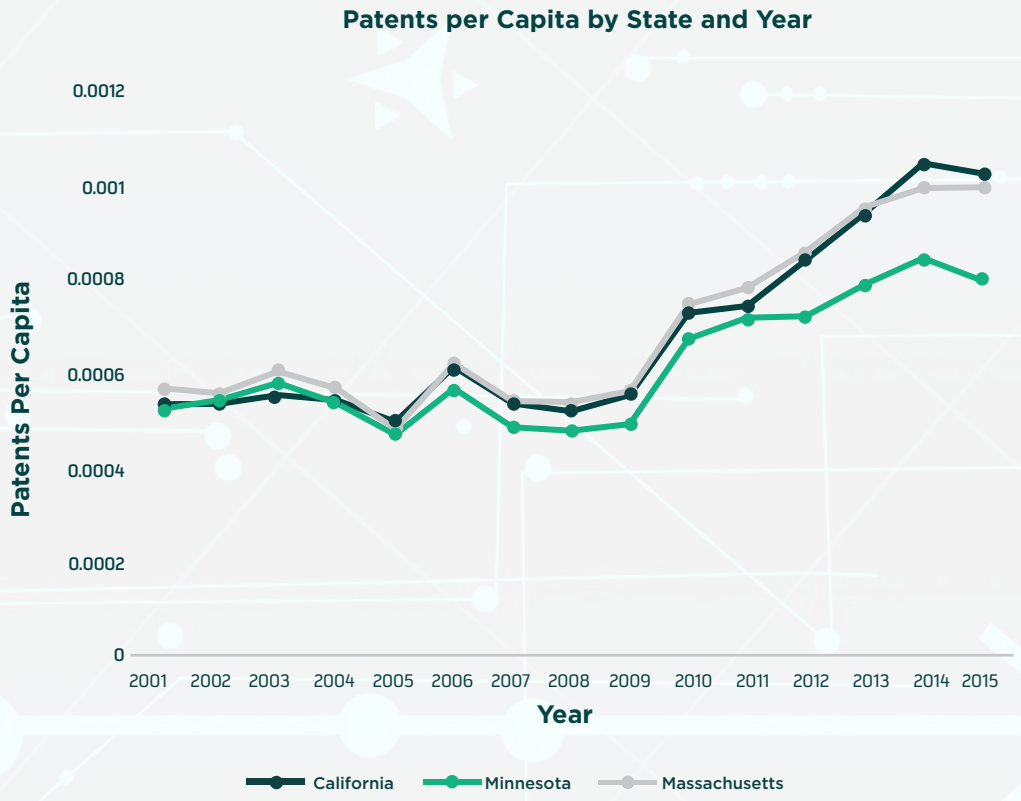
Rank	Class Title	Patents
1	Surgery: Light, Thermal, and Electrical Application	302
2	Surgery (includes Class 600)	206
3	Surgery (instruments)	188
4	Dynamic Magnetic Information Storage or Retrieval	136
5	Surgery (Medicators and Receptors)	135
6	Drug, Bio-Affecting and Body Treating Compositions (includes Class 514)	120
7	DP: Database and File Management or Data Structures (Data Processing)	106
8	Multicellular Living Organisms and Unmodified Parts Thereof and Related Processes	103
9	Multiplex Communications	101
10	Prosthesis (i.e., Artificial Body Members), Parts Thereof, or Aids and Accessories Therefor	85

Many of the patents issued in 2015 were for technologies related to medical devices, biotechnology, data processing, or telecommunications. Of the patents issued in 2015, those related to surgery were most prevalent, accounting for four of the top 10 classes. Patents classified as Surgery: Light, Thermal, and Electrical Application accounted for 302 patents issued to Minnesota-based companies or individuals.



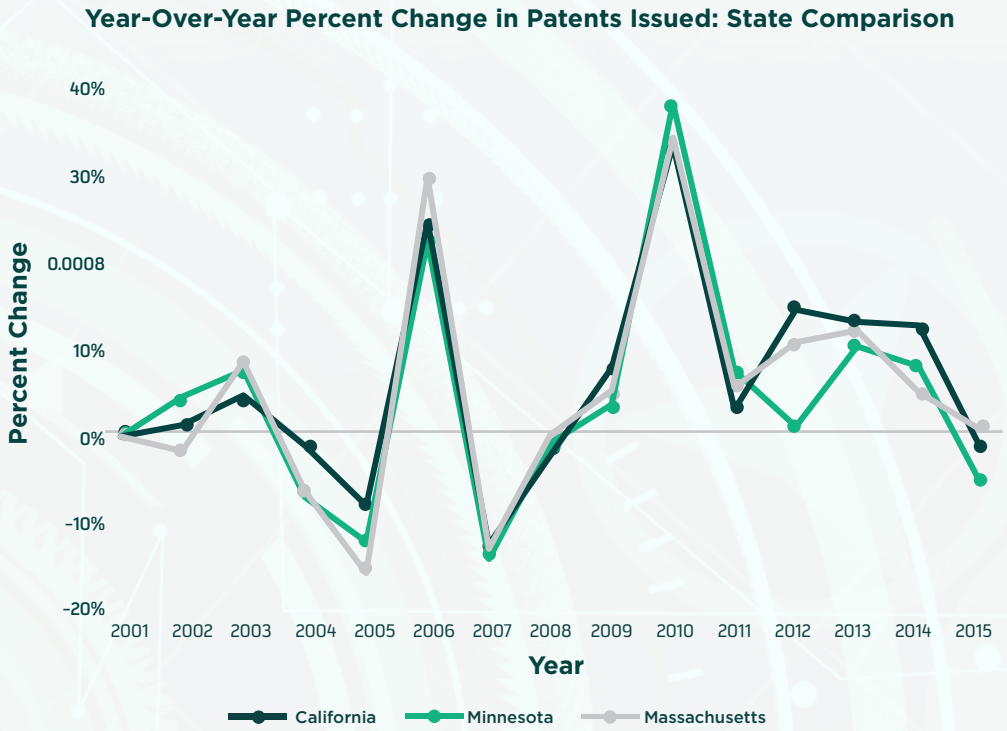
Patent activity within a state can indicate that state's innovation output. States such as Massachusetts and California routinely rank as two of the most innovative states in the country. Indeed, Bloomberg released its 2015 State Innovation Index in January 2016, with Massachusetts and California ranked first and second most innovative states, respectively.[7] Minnesota was the 10th most innovative state in 2015.

Among various categories, Bloomberg considers patent activity in its ranking, which it defines as the percentage of total U.S. patents and per million of a state's population. According to Bloomberg's metric, California and Massachusetts rank first and second, respectively, with respect to patent activity. Minnesota ranks fourth nationally with respect to patent activity.



Although Minnesota's patent activity ranks fourth nationally, Minnesota trails California and Massachusetts with respect to patents per capita. This gap has become more pronounced following the year 2011. In 2015, Minnesota produced 0.0008 patents per capita, while California produced 0.001027 per capita and Massachusetts produced 0.000997 patents per capita. Between 2001 and 2005, Minnesota, California, and Massachusetts were on par with each other with respect to patents per capita. Following 2005, however, Minnesota's patent activity has remained suppressed compared to that of California and Massachusetts, with this gulf widening after 2011.

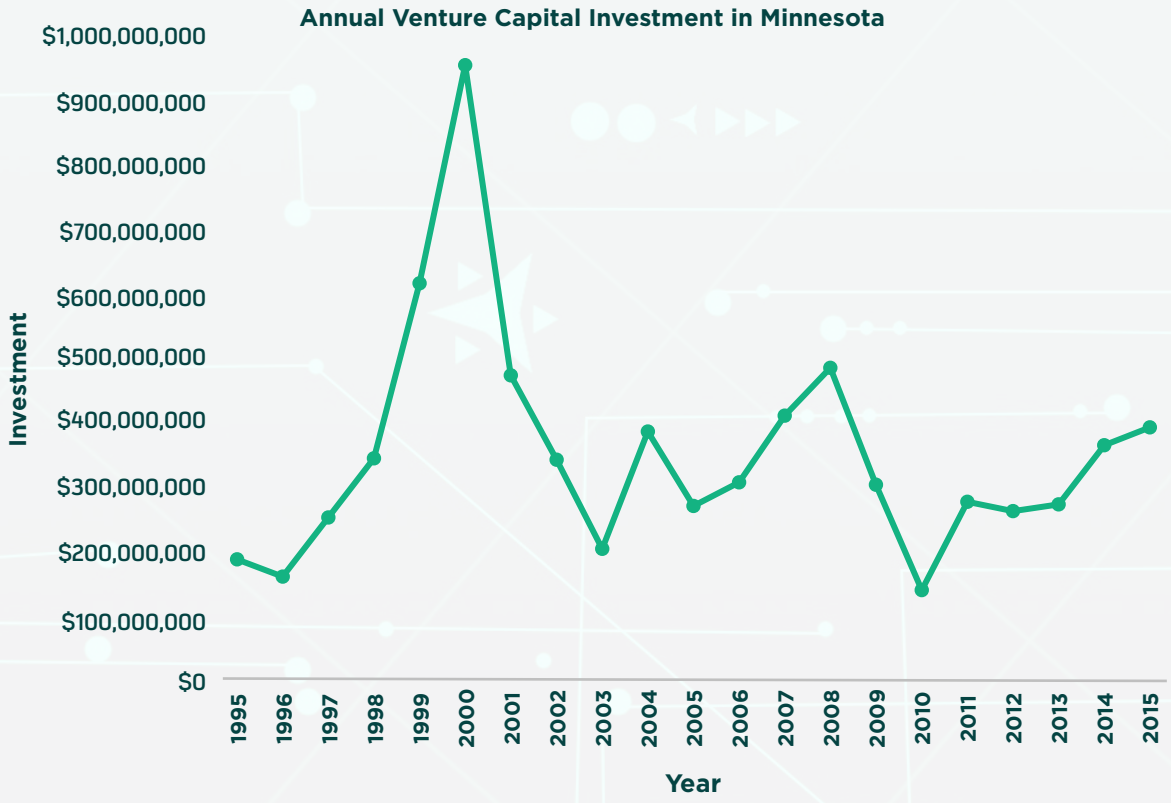
[7] http://www.bloomberg.com/news/articles/2016-01-07/here-are-the-most-innovative-states-in-america, accessed August 10, 2016.



If we consider year-over-year changes in patents issued by state, Minnesota appears to follow the general trend exhibited by Massachusetts and California. Years 2006 and 2010 experienced the greatest annual percent change in patents issued. The issuance of patents declined in 2015 compared to 2014 for California and Minnesota, with a slight increase for Massachusetts. The declines in 2015 follow years of positive growth in the issuance of patents.

Financing Tech Startups

Financing of Minnesota's startups in 2015 continued to climb out of its low point from 2010. In 2015, Minnesota startups raised more than $395 million in venture capital, which is up from nearly $368 million in 2014.[8]



The above chart shows venture capital investment in Minnesota companies from 1995 through 2015. Although these trends have been discussed elsewhere,[9] a couple of comments are appropriate here. PricewaterhouseCoopers and MoneyTree revised its data upward for years 2013, 2014, and 2015; this change is reflected here, and is an update to our previous report on venture capital investments in Minnesota. The revisions in investment figures for these years accentuates the recovery from the recession following the 2008-2009 financial crisis.

In 2015, venture capital investments in Minnesota startups targeted seven industries, with software and medical devices and equipment taking home the majority of the total investment.

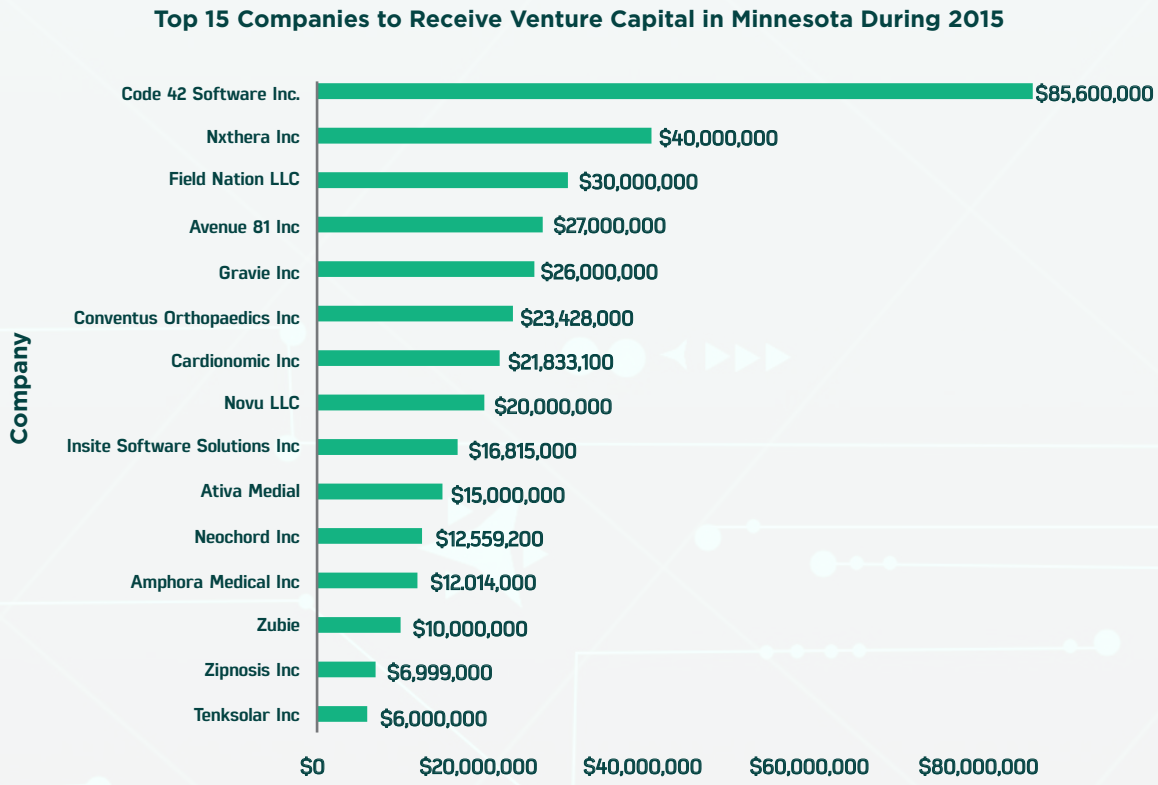
[8] https://www.pwcmoneytree.com/HistoricTrends/CustomQueryHistoricTrend, accessed August 11, 2016.
[9] http://www.mhta.org/wp-content/uploads/delightful-downloads/2016/04/MHTA-Venture-Capital-2016-FINAL-single-page.pdf, Minnesota High Tech Association.

Venture Capital Investment in Minnesota (2015)

Industry	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Industry Total
Software	$41,278,000	$37,000,000	$40,000,000	$86,800,000	**$205,078,000**
Medical Devices and Equipment		$12,559,200	$27,014,000	$90,262,100	**$129,835,300**
Media and Entertainment		$12,500,000	$2,800,000	$23,499,000	**$38,799,000**
Industrial/Energy	$3,224,000	$6,000,000			**$9,224,000**
Biotechnology		$3,377,100		$1,975,000	**$5,352,100**
IT Services			$5,000,000		**$5,000,000**
Business Products and Services				$1,900,000	**$1,900,000**
Quarter Total	**$44,502,000**	**$71,436,300**	**$74,814,000**	**$204,436,100**	**$395,188,400**

The table above breaks down venture investment in Minnesota by industry and quarter of 2015. The fourth quarter of 2015 experienced the most investment of any quarter of 2015, with nearly $191 million in venture capital investment. In the fourth quarter alone, nearly $87 million was directed to the software industry and more than $90 million was directed to the medical device and equipment industry.

Over the course of 2015, the software industry accumulated more than $205 million in venture capital investment, followed by the medical device and equipment industry with nearly $130 million in venture capital. Together these two industries accounted for nearly 85 percent of the total venture capital invested in Minnesota in 2015.



Thirty Minnesota companies received venture financing in 2015, though three of the companies did not disclose the amount of the investment. Of the venture-backed companies in 2015, Code 42 Software received the largest investment, totaling $85.6 million, followed by Nxthera with $40 million. Field Nation, Avenue 81 (Lead Pages), and Gravie round out the top five companies to receive venture capital in Minnesota during 2015.

2015 Venture Capital Investment by Stage

Company Stage	Investment Total	Pct. Total Investment
Seed	$3,875,000	0.98%
Early	$109,257,100	27.65%
Expansion	$159,118,000	40.26%
Later	$122,938,300	31.11%

Companies receiving venture capital investments in 2015 are comprised primarily of those in the expansion stage of growth, accounting for 40 percent of venture capital investments. Later stage companies received more than 31 percent of all venture capital investments flowing into Minnesota during 2015, while early stage companies received nearly 28 percent of such investments. Seed stage companies accounted for less than one percent of venture capital investments in Minnesota during 2015.

Through the third quarter of 2016, Minnesota companies have attracted more than $252 million of venture capital investment. The medical device and equipment industry accounted for nearly 51 percent of venture funding through the third quarter of 2016, followed by the

financial service industry with nearly 18 percent of the total. Thus far in 2016, venture capital investments have been led by CVRx ($93 million), Bright Health ($40.5 million), Tenksolar ($25.2 million), Torax Medical ($25 million), and When I Work ($15 million).

Another indicator of startup success is funding from angel investors. In 2010, Minnesota the Minnesota State Legislature passed and the governor signed into the law an angel investment tax credit. Minnesota's angel investment tax credit provides a 25 percent tax credit to qualified investors that make qualified investment in qualified companies; the credit is distributed on a first-come, first-receive basis. Prior to the creation of the tax credit, there was not a convenient way to track angel investment; since its creation, the Department of Employment and Economic Development (DEED) has kept track of angel investment activity.

In 2015, more than $70 million tied to the angel investment tax credit was invested in Minnesota startups.[10]

Angel Investment in Minnesota by Industry (2015)

Business Type	Total Investment	Deals	Average Investment
Software	$20,154,085	21	$959,718
Medical Devices	$13,959,807	17	$821,165
Biotechnology	$12,023,798	15	$801,587
Other	$7,789,001	21	$370,905
Clean Technology	$4,402,017	8	$550,252
Consumer Products	$2,734,890	5	$546,978
IT Services	$2,594,485	6	$432,414
Internet/Web	$2,380,000	9	$264,444
Electronics/Instrumentation	$1,763,750	3	$587,917
Healthcare	$1,467,500	5	$293,500
Food & Drink	$1,092,500	3	$364,167
Marketing	$50,000	1	$50,000

In 2015, angel investors most heavily invested in the software industry at more than $20 million across 21 deals, for an average investment of nearly $960,000 per deal. The medical device industry secured nearly $14 million in angel investment in 2015, with the biotechnology industry not far behind at more than $12 million.

[10] https://mn.gov/deed/assets/atc-credits-issued-list-2015_tcm1045-131747.docx, accessed August 11, 2016.

University Research – University of Minnesota

An important piece of Minnesota's innovation picture is the work done at the state's only research university, the University of Minnesota. Indeed, the University of Minnesota spends $800 million annually on research and development, which is the eighth highest level of R&D spending in the country among universities.[11] Like other leading universities across the country, some of the research conducted at the University of Minnesota is patented and licensed for use by commercial companies, while other research is patented and spun off to form new companies. The university's Office for Technology Commercialization helps with this process, and has had increasing success. 2015 was a successful year for the University of Minnesota. In 2015, the University of Minnesota submitted 146 applications for new patents and spun out 16 startup companies, including Vidku and UpTern. Thus far in 2016, the University of Minnesota has spun out a record 17 startups, reaching a milestone of 100 total spinouts. In 2015, the University of Minnesota generated more than $20 million in gross revenue and had 268 new license agreements.[12]

The quality of the University of Minnesota's research strengths and research initiatives determine, in part, the quality of the talent each attracts. By focusing on the University of Minnesota's research strengths, there are opportunities to build on and enhance various research initiatives within the university as it focuses its research efforts and partners with industry.

University of Minnesota Graduate Programs

As the University of Minnesota and the State of Minnesota look to attract top talent, both in terms of researchers and professionals, it is instructive to note some of the university's research strengths. Although this was discussed in a previous report, some of it bears repeating, such as the University of Minnesota's graduate programs are a key driver in attracting top research. Of particular note are the university's graduate programs in chemical engineering, applied mathematics, and combinatorics/discrete mathematics.

The University of Minnesota's chemical engineering graduate program is ranked fifth by U.S. News & World Reports.[13] While the University of Minnesota's mathematics graduate program is ranked 17th overall,[14] the sub-disciplines of applied mathematics and combinatorics/discrete mathematics are ranked fifth and eighth, respectively.[15,16] These disciplines and sub-disciplines represent some of the highest quality graduate programs in the country.

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[11] http://www.research.umn.edu/news/stats.html, accessed September 15, 2016.
[12] http://www.research.umn.edu/documents/stats/2015/rankings/Rankings%20-%20NSF,%20ARWU,%20CMUP.xlsx, accessed September 15, 2016.
[13] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/chemical-engineering-rankings?int=9d0e08&int=a06908, accessed September 15, 2016.
[14] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/mathematics-rankings?int=abc409, accessed September 15, 2016.
[15] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/applied-mathematics-rankings, accessed May 29, 2015.
[16] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/discrete-mathematics-rankings, accessed May 29, 2015.

The chemical engineering graduate program is located in the College of Science and Engineering's Department of Chemical Engineering and Material Science. The 14 research areas within the department range from biological engineering to nanomaterials and nanotechnology to electrochemical materials and devices. The department is particularly strong in applied and computational mathematics, and catalysis, separations and reaction engineering.[17] Work within the applied and computational mathematics division focuses on:

> developing and applying ever more powerful tools applied toward mathematical analysis and computational simulation in fields ranging from solid-state materials to chemical reactions to biological systems to fluid dynamics. Ongoing efforts in applied and computational mathematics range from analytical and numerical models to describe physical phenomena, from atomistic to continuum, to systems-level analysis, control, and optimization.[18]

The department's work in the area of catalysis, separations and reaction engineering has focused on "experiments and simulations to identify reaction mechanisms, to the synthesis of new enzymes, microbes, nanoporous catalysts, separation membranes and adsorbents and their use in novel sustainable processes for the production of fuels, pharmaceuticals, specialty and commodity chemicals, and other products."[19]

The university's strengths in chemical engineering, applied mathematics, and combinatorics/discrete mathematics are potentially fruitful areas for continued collaboration with industry, and might present opportunities for the creation of innovative technologies, resulting in commercial products. The University of Minnesota, in partnership with the State of Minnesota, also recently formed Minnesota's Discovery, Research, and InnoVation Economy (MnDRIVE), which we explore next.

MnDRIVE

MnDRIVE is a university-led initiative, funded with $36 million from the State of Minnesota, which "aligns areas of university strength with the state's key and emerging industries to advance new discoveries that address grand challenges".[20] MnDRIVE focuses on four key areas: (1) robotics; (2) global food; (3) environment; and (4) brain conditions. The missions of the various research areas are provided in the table on the following page.

[17] http://www.cems.umn.edu/research-areas, accessed May 29, 2015.
[18] http://www.cems.umn.edu/research-areas/applied-and-computational-mathematics, accessed May 29, 2015.
[19] http://www.cems.umn.edu/research-areas/catalysis-separations-and-reaction-engineering, accessed May 29, 2015.
[20] https://mndrive.umn.edu/about, accessed May 29, 2015.

MnDRIVE Research Visions
Robotics
The initiative will provide critical innovations, education, and training in relevant disciplines in engineering, materials science, computer science, and mathematics, and application domains. In addition, partnerships in the areas of the initiative with industries in technology, healthcare, food, and agriculture will be strengthened to the economic benefit of the State of Minnesota and its citizens. Immediate examples of application areas include precision agriculture, environmental monitoring, surgical robotics, and 3D printing.
Global Food
This core MnDRIVE area aims to advance industry practices and public policy to promote global food protection and grow consumers' confidence in the food they buy, develop new markets for sustainable development to address resource constraints on water and energy and train the next generation of food scientists.
Environment
This core MnDRIVE area will perform research with the goal of developing technologies around bioremediation to solve environmental challenges in the state while collaborating with industry leaders to target the most critical environmental challenges. In the long-term, targeted efforts will lead to both improved water quality across the Iron Range and the Mississippi and Minnesota River watersheds, and greater employment and commerce.
Brain Conditions
This core MnDRIVE area will strengthen the university's brain and neuromodulation research infrastructure and capacity and pioneer new technology and applications that decrease the incidence of neurological disease and transform how we prevent, treat and cure diseases. The university will leverage its investments in medicine and engineering and partnerships with the state's medical device industry, ranked second largest in the nation, and national and global efforts.

Two of the MnDRIVE research areas, robotics and brain conditions, seem to be particularly well-suited for the university's research strengths. Neuromodulation, and the development of new technologies to treat brain ailments, is closely related to the research conducted by the Department of Chemical Engineering and Material Sciences, with research areas in electrochemical material and devices, biological engineering, and applied and computational mathematics. Robotics, with its emphasis on a number of disciplines, including mathematics and material sciences, and potential impact on health sciences and surgical robotics, is also well-suited to the university's research strengths.

Public Policy

State legislative activity also contributes to the advancement of science and technology in Minnesota. During the recent 2016 Legislative Session, the state Legislature considered a number of issues that impact Minnesota's science and technology community. These issues included: strengthening Minnesota's research and development (R&D) and angel investment tax credits, investing in broadband deployment in areas of the state that need it most, and modernizing Minnesota's telecommunications regulatory framework.

In 2016, the Legislature approved $35 million in funding for the Border-to-Border Broadband Development Grant program and updated the state's broadband speed goals to reflect the recommendations of the Governor's Broadband Task Force: by no later than 2022 all Minnesota businesses and homes have access to high-speed broadband that provides minimum download speeds of at least 25 megabits per second and minimum upload speeds of at least 3 megabits per second. Also by 2026, it is a state goal that all Minnesota businesses and homes have access to at least one provider of broadband with download speeds of at least 100 megabits per second and upload speeds of at least 20 megabits per second.

Through 2015, the state's Border-to-Border Broadband Development Grant Program had received $30 million in funding, which leveraged $41 million in private investments, and helped connect 9,322 households and 936 businesses to broadband. Ensuring the state has a robust broadband network will help Minnesota businesses across the state as they look to connect to the global marketplace and attract talented workers.

As noted above, Minnesota's angel investment tax credit provides a 25 percent tax credit to qualified investors that make qualified investment in qualified companies, and is distributed on a first-come, first-receive basis. Every two years the angel investment tax credit must be extended by the Legislature. In 2016, the angel investment tax credit was extended through fiscal year 2017, and funded at $10 million. The angel investment tax credit is an important mechanism for encouraging investment in startups across Minnesota, and has helped to spur nearly $70 million in investment in 2015 alone. Extending the credit's expiration date and allocating additional funds to the credit will help to spur additional investments in Minnesota's small, growing technology companies.

Minnesota's R&D tax credit is structured in a two-tiered system, where qualified research investments below a certain threshold ($2 million) are eligible for one credit rate (10 percent), while investments above that threshold are eligible for another rate (2.5 percent). Although there was discussion about strengthening the second tier of the credit, from 2.5 percent to 4.0 percent, and making the first tier of the credit refundable, in the end the Legislature decided not to alter the existing credit. In fact, although the Legislature passed an omnibus tax bill in 2016, it was vetoed by the governor after the discovery of an error that would have reportedly cost the state more than $100 million.

As Minnesota competes with other states around the country, such as Massachusetts and California, which have two of the strongest R&D tax credits, there is an opportunity for Minnesota to enhance its R&D tax credit. Massachusetts's R&D tax credit is 10 percent on any qualified research expense and 15 percent for basic research expenses.[8] California's R&D tax credit is 15 percent for qualified research expenses and 24 percent of basic research expense.[9] Enhancing Minnesota's R&D tax credit, to be more competitive with those of California and Massachusetts, will better help Minnesota to compete these states and others across the country.

Regulatory modernization of the telecommunications industry was also considered and passed, with mixed success, during the 2016 Legislative Session. A bill to provide telecommunications regulatory parity between competitive local exchanges and incumbent local exchanges was signed into law. This legislation levels the playing field for telecommunications providers, ensuring a competitive marketplace for all providers.

The Minnesota State Legislature also considered legislation to modernize Minnesota's voice-over-Internet-Protocol (VoIP) regulations. The legislation would exempt VoIP providers from a regulatory framework that has been applied to legacy phone carriers. Although more than 30 states have enacted similar legislation, the Legislature did not active favorably on it in 2016.

Finally, a bill was introduced during the 2016 Legislative Session that would establish and fund at $500 million over 10 years a state research and development authority aimed at strengthening Minnesota's research, development, and commercialization capacity. Although the bill did not receive a legislative hearing during the session, it is unique in its scope of support for science and technology in Minnesota.

The state research and development authority would support innovation in Minnesota in a number of ways, including funding for accelerating the commercialization process, funding for research at colleges, universities, and non-profit research institutions; funding for early-stage and startup companies, as well as matching grants for companies that receive SBIR/STTR funding; and career exploration and internships in science, technology, engineering, mathematics, and manufacturing (STEMM).

Conclusion

In many respects, 2015 and 2016 were strong years for Minnesota's science and technology community. Utility patents are near record highs and venture capital investments continue their upward trend from the depths of the financial crisis. Investments in Minnesota's software and medical device and equipment industries show particular promise, accounting for 85 percent of the state's venture capital haul in 2015.

Venture capital investments in 2015 were led by Code 42 Software with $85.6 million, followed by Nxthera with $40 million. Field Nation received $30 million in venture capital, Avenue 81 (Lead Pages) landed $27 million, and Gravie secured $26 million in venture capital investments during 2015.

Angel investors also invested heavily in the software industry, which secured more than $20 million in funding, across 21 deals, during 2015. The medical device industry secured nearly $14 million of investment from angel investors, followed by the biotechnology industry with more than $12 million. Together, these three industries accounted for 65.5 percent of all angel investment tied to the angel investment tax credit.

While investment in Minnesota companies continues to grow, the 2016 Legislative Session resulted in some progress for Minnesota's science and technology community and some slow down. The Legislature did not strengthen Minnesota's R&D tax credit, but it did extend the angel investment tax credit for one more year with $10 million allocate to the credit. Although the Legislature did not exempt VoIP providers from a regulatory framework that has been applied to legacy phone carriers, it did level the playing field for telecommunications providers. Additionally, the Legislature did appropriate $35 million in funding for the Border-to-Border Broadband Development Grant program and updated the state's broadband speed goals to reflect the recommendations of the Governor's Broadband Task Force.

As we look to the future, Minnesota's science and technology community is poised for continued progress. State initiatives, like a potential R&D authority, and enhancement of the state's R&D tax credit would help to more firmly place Minnesota on competitive ground with respect to some of the nation's most innovative states.

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