Appendix 3: 2015 Battelle Report (Review of Nebraska's Innovation Drivers)

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Review of Nebraska's Innovation Drivers

The 2010 Battelle report addressed the question of how well Nebraska performs in measures of innovation and entrepreneurial development. Over time, an economy must remain competitive to be successful. Innovation is the "means—perhaps the only means—by which a high skill, high wage economy can successfully compete with high skill, lower wage economies without reducing its standard of living" [NGA, Innovate America: Final Report, 2007, p.1].

A set of measures was developed by Battelle to determine if Nebraska has the presence of innovation activities needed to support overall innovation and entrepreneurial development. These included measures of talent, entrepreneurial activity, risk capital, research and development, and intellectual property generation and technology transfer.

The Nebraska Department of Economic Development's (NDED) Research Division reviewed and updated Battelle's 2010 report using its own data. NDED is not able to reproduce and extend all of Battelle's innovation measures primarily due to Battelle's use of proprietary data; however, many of these measures exist in other formats. Where it is possible, this report uses Battelle's methods and measures, if not the same data sources.

Measuring Innovation in Nebraska

In this report, the Research Division reviews and updates, where possible, Battelle's assessment of Nebraska's preparedness for an innovation-driven economy. Battelle identified a broad set of measures to determine a state's readiness to develop a successful, innovation-based economy that can remain competitive. These measures involve talent, as measured by academic performance in science and engineering; entrepreneurial activity, measured by business establishment, employment and revenue growth; the availability of risk capital, measured by venture capital and Small Business Innovation Grant awards; research and development, measured by R&D expenditures in academic and industry settings; and intellectual property generation and technology transfer, measured by the number of patents granted and university technology transfers. Where possible, the Research Division reviewed and updated Battelle's innovation-related measures, and when this was not possible, alternative measures were identified.

The 2010 Battelle report identified a group of benchmark states selected to provide geographic balance, peer states, and states identified by NDED to be more advanced in developing an innovation-based economy. Battelle avoided states with large populations and major cities. Battelle identified seven benchmark states: Iowa, Kansas (neighboring states), Oklahoma and Tennessee (identified as peer states in moving toward an innovation-driven economy), Virginia, Utah, and Wisconsin (states viewed as more advanced in innovation).

To these states, one additional state, Minnesota, was added based on Minnesota's proximity to Nebraska in a number of state rankings. The original seven benchmark states are compared to Nebraska using updated data.

This allows for comparison to the previous benchmark states. A new set of five benchmark states is proposed, along much the same lines: Iowa, Utah, Wisconsin, Minnesota, and Wisconsin. The body of the report contains comparison data for both the original Battelle benchmark states, and the proposed five benchmark states, for a total of eight potential benchmark states.

Innovation Potential Measured as Skilled Talent

Battelle's first measure of Nebraska's preparedness to develop an innovation-driven economy is based on the educational achievements of Nebraska residents. Educational achievement was measured in terms of science and engineering degrees and college graduation rates. The 2010 Battelle report concluded that Nebraska's performance in this measure was mixed, and described it as "generally slightly below the national average—in the type of high-skilled talent needed to fuel innovation in today's knowledge-based economy" [Battelle, 2010, p. 20].

The first measure, science and engineering degrees as a share of all higher education degrees, is presented in Table 6a. Nebraska's percentage of these degrees as a share of all higher education degrees, increased from 22.8% in 2001 to 24.1% in 2011, the last year data is available. Nebraska's score on this measure is below the national percentage; however, the measurement was taken at a time when the national share of science and engineering degrees was falling. Nebraska's ranking among the 50 states improved over this time period from 48th to 42nd. Compared to the benchmark states, Nebraska was lagging behind all in 2001, but had caught Kansas and Tennessee by 2011.

Table 6a. Key Indicators: Talent/Science and Engineering Education, Percent of Higher Education Degrees

State	Science & Engineering Degrees as Percentage of Higher Education Degrees				State Rank of Science & Engineering Degrees as Percentage of Higher Education Degrees			
	2001	2007	2008	2011	2001	2007	2008	2011
United States	**29.6%**	**28.9%**	**28.9%**	**29.3%**				
Nebraska	**22.8%**	**23.6%**	**24.0%**	**24.1%**	**48**	**44**	**43**	**42**
Iowa	28.1%	27.4%	27.0%	28.3%	28	29	31	27
Kansas	27.4%	25.1%	24.8%	23.2%	30	41	39	46
Minnesota	28.7%	26.1%	26.5%	27.6%	25	33	32	30
Oklahoma	27.3%	25.2%	24.3%	24.7%	31	40	40	41
Tennessee	24.6%	23.8%	24.3%	23.6%	43	43	40	43
Utah	29.2%	32.3%	30.9%	29.4%	23	12	18	22
Virginia	35.3%	33.9%	34.0%	32.8%	6	6	6	12
Wisconsin	28.7%	30.2%	29.6%	29.9%	25	19	20	19

Source: National Science Foundation, National Center for Education Statistics, Integrated Postsecondary Education Data System database, various years.
Note: Higher education degrees include bachelor's, master's, and doctorate levels. Science degrees include physical, computer, agricultural, biological, earth, atmospheric, ocean, and social sciences; psychology; and mathematics.

Comparing 2001 and 2011 data, only three of the other benchmark states—Iowa, Utah, and Wisconsin—joined Nebraska in moving against the national trend of a shrinking percentage of science and engineering degrees as a percentage of all higher education degrees.

The second measure of educational achievement is science and engineering doctorate degrees as a share of science and engineering degrees. This data, summarized in Table 6b, is similar to the percentage of science and engineering degrees as a share of all higher education degrees discussed above. The national trend between 2001 and 2011 is slightly downward, while Nebraska, ranking below the national figures, increased its share during this time. In 2001 4.9% of science and engineering degrees conferred nationally were doctorate degrees, and it was

4.0% in Nebraska. By 2011, the national rate had dropped to 4.4%, and Nebraska's had risen to 4.4%. Nebraska's ranking among the 50 states in this measure of educational achievement rose from 31st to 19th during the 2001 to 2011 time period.

In terms of benchmark states, Nebraska was ahead of only Oklahoma and Utah in terms of the percentage of doctorate degrees awarded in science and engineering compared to all science and engineering degrees. By 2011, Nebraska scored better than four benchmark states—Iowa, Oklahoma, Utah, and Virginia—in this measure.

Nebraska and four other benchmark states improved the percentage of science and engineering doctorate degrees as a percentage of all science and engineering degrees conferred between 2001 and 2011. These included Kansas, Oklahoma, Tennessee, and Utah.

In 2001, Nebraska colleges and universities conferred 3,261 science and engineering degrees. This ranked Nebraska 34th in the nation in terms of the number of degrees conferred in these fields, but a measure of the number of degree completions per capita, better accounts for population differences in the comparison.

Table 6b. Key Indicators: Talent/Science and Engineering Education Doctorate Degrees

State	Science & Engineering Doctorate Degrees as Percentage of Science & Engineering Degrees				State Rank Science & Engineering Doctorate Degrees as Percentage of Science & Engineering Degrees			
	2001	2007	2008	2011	2001	2007	2008	2011
United States	**4.9%**	**5.1%**	**5.1%**	**4.6%**	**N/A**	**N/A**	**N/A**	**N/A**
Nebraska	**4.0%**	**4.2%**	**3.9%**	**4.4%**	**31**	**32**	**39**	**26**
Iowa	5.0%	5.3%	5.1%	3.3%	14	13	15	42
Kansas	4.2%	4.1%	4.1%	5.0%	28	36	33	11
Minnesota	5.7%	6.1%	5.5%	5.3%	8	3	11	4
Oklahoma	3.3%	4.0%	3.4%	3.7%	40	37	44	34
Tennessee	4.5%	4.8%	4.9%	4.7%	24	22	19	17
Utah	3.2%	3.3%	3.5%	3.7%	42	42	43	34
Virginia	4.2%	4.3%	4.4%	4.2%	28	29	28	29
Wisconsin	4.7%	4.8%	5.3%	4.5%	18	22	12	24

Source: National Science Foundation, National Center for Education Statistics, Integrated Postsecondary Education Data System database, various years.
Note: Higher education degrees include bachelor's, master's, and doctorate levels. Science degrees include physical, computer, agricultural, biological, earth, atmospheric, ocean, and social sciences; psychology; and mathematics.

Table 6c presents the number of science and engineering degrees awarded by state per 100,000 persons living in the state. According to this measure, Nebraska was producing more science and engineering graduates per 100,000 population than the nation as a whole, in each of the years presented. Nebraska's rank among the 50 states remained relatively constant in the years presented, increasing from 20th to 19th between 2001 and 2011. Iowa, Kansas, Utah, Virginia, and Wisconsin, among the benchmark states, produced more science and engineering degrees per capita than Nebraska in 2001. By 2011, Nebraska surpassed Wisconsin on the list.

Table 6c. Key Indicators: Talent/Science and Engineering Degrees Conferred Annually per Capita

State	Science & Engineering Degrees Conferred Annually per 100,000 Population				State Rank Science & Engineering Degrees Conferred Annually per 100,000 Population			
	2001	2007	2008	2011	2001	2007	2008	2011
United States	**182.6**	**210.3**	**214.0**	**235.3**	**N/A**	**N/A**	**N/A**	**N/A**
Nebraska	**192.8**	**216.0**	**225.2**	**243.1**	**20**	**23**	**21**	**19**
Iowa	217.9	253.7	272.5	433.8	14	11	9	3
Kansas	206.4	211.1	210.7	209.5	16	26	26	30
Minnesota	187.0	240.7	255.0	296.4	21	16	11	10
Oklahoma	170.6	171.6	166.2	171.7	30	38	37	40
Tennessee	135.4	143.8	146.4	160.1	41	46	46	45
Utah	269.3	322.1	308.8	333.9	4	4	4	5
Virginia	219.8	241.2	251.1	291.9	12	15	15	12
Wisconsin	195.1	228.4	225.7	241.1	19	18	20	22

Source: National Science Foundation, National Center for Education Statistics, Integrated Postsecondary Education Data System database, various years.
Note: Higher education degrees include bachelor's, master's, and doctorate levels. Science degrees include physical, computer, agricultural, biological, earth, atmospheric, ocean, and social sciences; psychology; and mathematics.

In terms of science and engineering doctorates awarded in Nebraska per 100,000 population, Nebraska's share rose from 7.6 per 100,000 in 2001 to 10.6 in 2011, the last year data is available. This compares to 8.9 science and engineering doctorates awarded per 100,000 in the US as a whole in 2001, and 10.9 in 2011. This measure is another where Nebraska lags the nation throughout the 2001 to 2011 time period, but has made progress in the national rankings. In terms of state ranking, Nebraska moved from ranking 26th among the 30 states in 2001, to 18th in 2011.

Table 6d. Key Indicators: Talent/Science and Engineering Doctorate Degrees per Capita

State	Science & Engineering Doctorate Degrees Conferred Annually per 100,000 Population				State Rank Science & Engineering Doctorate Degrees Conferred Annually per 100,000 Population			
	2001	2007	2008	2011	2001	2007	2008	2011
United States	8.9	10.8	10.9	10.9	**N/A**	**N/A**	**N/A**	**N/A**
Nebraska	**7.6**	**9.1**	**8.9**	**10.6**	**26**	**25**	**25**	**18**
Iowa	11.0	13.4	14.0	14.4	9	7	7	5
Kansas	8.7	8.7	8.5	10.5	19	29	30	19
Minnesota	10.7	14.8	14.1	15.8	11	4	5	4
Oklahoma	5.7	6.9	5.7	6.3	38	38	43	43
Tennessee	6.1	6.9	7.2	7.6	36	38	38	35
Utah	8.6	10.5	10.8	12.4	21	18	20	13
Virginia	9.3	10.4	11.1	12.1	14	19	18	14
Wisconsin	9.1	11.0	11.9	10.8	16	16	13	17

Source: National Science Foundation, National Center for Education Statistics, Integrated Postsecondary Education Data System database, various years.
Note: Higher education degrees include bachelor's, master's, and doctorate levels. Science degrees include physical, computer, agricultural, biological, earth, atmospheric, ocean, and social sciences; psychology; and mathematics.

In terms of science and engineering doctorate degrees per capita, all benchmark states improved in the number of these degree awards per capita between 2001 and 2011. In 2001, Nebraska lagged all benchmark states but Oklahoma and Tennessee in this measure, and by 2011 Nebraska had passed Kansas and remained higher than Oklahoma and Tennessee in terms of doctorate degrees awarded in science and engineering fields.

A final measure of educational achievement used by Battelle is the percentage of a state's population with a bachelor's degree or higher. Table 6e presents 5-year data from the US Census' American Community Survey (ACS), and shows both the percentage of the population with at least a bachelor's degree and the state rank, where 1 is the state with the highest percent and 50 is the state with the lowest. The 5-year data were selected because relatively small annual sample sizes in the ACS could cause inconsistent results. In addition, because the starting year for ACS data is 2005 and not 2001, we would not have been able to present data consistent with the time periods chosen for the other measures. Given this, the Research Division chose to present the data with the smallest sampling error.

Once again, Nebraska appears to be behind the national figures, but is closer to the national level at the end of the study period. The percentage of Nebraska residents with at least a bachelor's degree was 27.1% for the period ending in 2009, compared with 27.5% of the US population during the same period. By 2013, that percentage had risen to 28.5% for Nebraska and 28.8% nationally. In terms of 50-state rankings, Nebraska's rank fell from 20th to 21st during this time period.

Table 6e. Key Indicators: Talent/Science and Engineering Education, Population with a Bachelors' Degree or Higher.

State	Population Ages 25 and over with a Bachelor's Degree or Higher		State Rank, Population Ages 25 and over with a Bachelor's Degree or Higher	
	2009	2013	2009	2013
United States	**27.5%**	**28.8%**	**N/A**	**N/A**
Nebraska	**27.1%**	**28.5%**	**20**	**21**
Iowa	24.2%	25.7%	36	36
Kansas	28.8%	30.3%	16	15
Minnesota	31.2%	32.6%	10	10
Oklahoma	22.4%	23.5%	41	42
Tennessee	22.4%	23.8%	41	41
Utah	28.7%	30.3%	17	15
Virginia	33.4%	35.2%	6	6
Wisconsin	25.5%	26.8%	30	29

Source: US Census, American Community Survey, NDED calculations.

All benchmark states increased the proportion of residents with at least a bachelor's degree. Nebraska's percentage was higher than four of the benchmark states in 2009 and remained higher than those four—Iowa, Oklahoma, Tennessee, and Wisconsin—in the 2013 data.

Based on the above review, we conclude that Nebraska's performance in measures of educational attainment is mixed. Battelle's description of Nebraska performance as generally slightly below the national average remains true based on the available data. However, in nearly every measure, Nebraska's performance has improved, and moved closer to the national average. In addition, Nebraska's performance in education measures has generally been better than those of the benchmark states taken as a whole. That is, during the challenges of the Great Recession, Nebraska was able to improve on its educational attainments compared to some of the benchmark states.

Innovation Potential Measured as Entrepreneurial Activity

Battelle's next measure of Nebraska's preparedness to develop an innovation-driven economy is based on entrepreneurial activity in Nebraska. Entrepreneurial activity was measured in terms of the growth in new business establishments, job creation from new business establishments, and *Inc.* magazine's listing of the fastest growing US businesses. The 2010 Battelle report concluded that "[i]n measures of entrepreneurial activity, Nebraska seems to be lagging the nation and benchmark states" [Battelle, 2010, p. 21].

Table 7a presents the average annual growth rate in business establishments for the US, Nebraska, and the benchmark states. The table covers three time periods, 2001-2007, 2008-2012, and the entire 2001-2012. Based on the US Census of Business Dynamics, over the 2001 to 2012 period (the latest years available), Nebraska grew its new business establishments by 9.8%, on average, each year compared with 11.2% for the nation. Nebraska's rate of new business formation was behind other benchmark states, except for Iowa and Wisconsin, during this period.

Breaking the data in to pre-2008 and post-2008 periods, in Table 7a, the relative performance of Nebraska in business establishment growth is similar to the experience of the other benchmark states. Most benchmark states' average annual business establishment growth was about 2 percentage points lower since the start of the Great Recession. The exception is Utah, which lost nearly four percentage points in growth, from 16.0% to 12.3%, between the pre-Great Recession and Great Recession to current time periods. Nebraska's establishment growth rate was higher than only two of the benchmark states in the 2001–2007 period, and was higher than three benchmark stares in the 2008–2012 period.

Table 7a. Key Indicators: Entrepreneurial Activity, Business Establishment Growth

State	Average Annual Growth in New Business Establishments		
	2001–2007	**2008–2012**	**2001–2012**
United States	**11.2%**	**9.9%**	**11.2%**
Nebraska	**10.6%**	**8.7%**	**9.8%**
Iowa	10.1%	8.1%	9.2%
Kansas	11.0%	8.6%	10.0%
Minnesota	11.5%	9.1%	10.5%
Oklahoma	11.6%	9.5%	10.7%
Tennessee	11.4%	9.1%	10.5%
Utah	16.0%	12.3%	14.5%
Virginia	12.1%	9.7%	11.1%
Wisconsin	10.2%	8.0%	3.4%

Source: US Census Business Dynamics Statistics, Longitudinal Business Database 1977–2012.

The job creation rate from these new business establishments averaged 4.7% in Nebraska from 2001 through 2012, compared with 5.5% for the nation (Table 7b). Among the benchmark states, Nebraska outperformed Iowa and Wisconsin, but was well behind Utah and Oklahoma, in terms of job creation due to new business establishments.

Breaking the data into pre-2008 and post-2008 periods, in Table 7b, the pattern is similar to that of establishment growth, in that job growth was faster in the earlier period than in the later period. The average annual job creation rate between 2001 and 2007 was 5.3% for Nebraska, which was lower than all of the benchmark states except Iowa and Wisconsin. In the later period, Nebraska's growth rate from new business establishments was 3.9%. This rate was tied with Minnesota, among the benchmark states, but lower than all but Iowa and Wisconsin.

Table 7b. Key Indicators: Entrepreneurial Activity, Job Creation from New Business Establishments

State	Job Creation Rate from New Business Establishments		
	2001–2007	2008–2012	2001–2012
United States	**6.2%**	**4.7%**	**5.5%**
Nebraska	**5.3%**	**3.9%**	**4.7%**
Iowa	4.7%	3.5%	4.2%
Kansas	5.8%	4.3%	5.2%
Minnesota	5.5%	3.9%	4.8%
Oklahoma	6.3%	4.9%	5.7%
Tennessee	5.8%	4.3%	5.2%
Utah	7.3%	5.2%	6.4%
Virginia	6.1%	4.7%	5.5%
Wisconsin	4.9%	3.4%	4.3%

Source: US Census Business Dynamics Statistics, Longitudinal Business Database 1977–2012.

In 1982, *Inc.* magazine began publishing a list of the fastest-growing companies in the US. In 2007 the list was expanded from 500 to 5,000. The list features 5,000 private US-based companies with the highest revenue growth during the previous four-year period. In order to qualify for the list, a business must be privately held, for-profit, and operating as of the first week of January in the first of the four calendar years measured. Nebraska had 28 companies that were included in the *Inc*. 5,000 list for both 2007 and 2014 (Table 7c).

Among the benchmark states, Nebraska had the fewest number of *Inc*. 5,000 businesses. However, Nebraska also has the smallest population of these states. Taking population into account, Nebraska had 1.57 firms per 100,000 populations, in 2007, and 1.49 in 2014. This compares with 1.66 and 1.57 per 100,000 for the US in 2007 and 2014, respectively. Compared to the benchmark states in the 2010 Battelle list, Nebraska was behind all states except Iowa, Oklahoma, and Tennessee. Nebraska ranking among the benchmark states improved on the 2014 list. Only three of the benchmark states, Minnesota, Utah, and Virginia, scored better than Nebraska when the 2014 list is adjusted for state population. While Nebraska's number of *Inc*. 5,000 firms per 100,000 persons decreased between the 2007 and 2014 lists, only two of the benchmark states improved their score, Utah and Virginia.

Table 7c. Table Key Indicators: Entrepreneurial Activity, Revenue Growth

State	*Inc*. 5,000 Firms 2007	*Inc*. 5,000 Firms 2014	*Inc*. 5,000 Firms 2007 per 100,000 population	*Inc*. 5,000 Firms 2014 per 100,000 population	State Rank 2001 per 100,000	State Rank 2014 per 100,000
United States			**1.66**	**1.57**	**N/A**	**N/A**
Nebraska	**28**	**28**	**1.57**	**1.49**	**21**	**21**
Iowa	35	30	1.17	0.97	34	35
Kansas	40	36	1.44	1.24	27	26
Minnesota	115	94	2.21	1.72	10	11
Oklahoma	46	30	1.27	0.77	33	38
Tennessee	87	80	1.41	1.22	28	27
Utah	71	86	2.73	2.92	4	2
Virginia	232	284	2.99	3.41	2	1
Wisconsin	119	70	2.12	1.22	11	28

Source: *Inc.*; US Census; NDED calculations.

Notes: To qualify for the Inc. 5,000 list, companies are required to be US-based, privately held, for profit, and independent (not subsidiaries or divisions of other companies). The ranking is based on percentage revenue

growth over the last four calendar years. The company must have been founded by, and generating revenue in the first week of the year so that four full years of revenue are available.

Once again, using measures similar to those employed by 2010 Battelle study to measure entrepreneurial activity, the Battelle report's original conclusions about Nebraska remain valid. Nebraska appears to be lagging somewhat behind the nation and the benchmark states in terms of entrepreneurial activity. However, Nebraska has improved somewhat compared to the benchmark states.

Innovation Potential Measured as Risk Capital

Battelle's third measure of Nebraska's preparedness to develop an innovation-driven economy is based on risk capital available for financing emerging businesses. The availability of risk capital is measured in terms of venture capital invested in the state, and Small Business Innovation Research (SBIR) grants awarded to entrepreneurs in the states. In these measures, the 2010 Battelle report concluded that "Nebraska has little in the way of venture financing for emerging firms" [Battelle, 2010, p. 21].

The State Science and Technology Institute (SSTI) publishes annual data from a survey conducted by the National Venture Capital Association and PricewaterhouseCoopers. This information is broken down by state and is reported in terms of the number of dollars invested and the number of venture capital deals. The data from 2009 to 2014 show that over 50% of the venture capital investment in the US occurs in just two states, California and Massachusetts, and those two states received more than 65% of the capital and nearly 51% of the deals in 2014.

Given that, it appears difficult that any relatively small state in the interior of the country would receive much venture capital. However, looking at the amount of venture capital on a per capita basis provides more insight on the relative share of venture capital among the benchmark states. For example, the amount of venture capital investment per capita for the US as a whole is $575.01 for the 2009-2014 period. This compares to Massachusetts, the 2nd ranked state in terms of total dollars invested, but 1st in terms of dollars invested per capita, with nearly $2,873 per resident, and California, 1st in terms of dollars invested but 2nd, at $2,485, in terms of investment per capita.

Nebraska has the smallest amount of venture capital of the benchmark states at $67.2 million, ranking 41st among all states (Table 8a). In terms of deals, Nebraska's 36 deals between 2009 and 2014 were higher than those in Iowa and Oklahoma among the benchmark states, and ranked 35th among all states during that period. On a per capita basis, Nebraska received $36.47 million in venture capital investment during the 2009-2014 period. This ranked 30th among the states, and was lower than any of the benchmark states except Oklahoma (Table 8b). Finally, in venture capital measured as the number of venture capital deals per million population, Nebraska ranked 30th among all states, with 19.5 projects per million persons. Among the benchmark states, this was greater than Iowa, Oklahoma, and Wisconsin.

Table 8a. Key Indicators: Risk Capital, Venture Capital Invested, and Venture Capital Deals, Cumulative Data 2009–2014

State	Total Cumulative Venture Capital Invested ($ Millions)	State Rank, Total Cumulative Venture Capital Invested	Total Cumulative Venture Capital Deals	State Rank, Total Cumulative Venture Capital Deals
United States	**$179,241.5**	**N/A**	**23,167**	**N/A**
Nebraska	**$67.2**	**41**	**36**	**35**
Iowa	$225.8	30	27	39
Kansas	$238.4	29	132	23
Minnesota	$1,593.8	16	218	20

State	Total Cumulative Venture Capital Invested ($ Millions)	State Rank, Total Cumulative Venture Capital Invested	Total Cumulative Venture Capital Deals	State Rank, Total Cumulative Venture Capital Deals
Oklahoma	$99.4	39	32	38
Tennessee	$600.7	23	281	16
Utah	$1,981.7	14	232	19
Virginia	$2,654.1	10	406	10
Wisconsin	$446.7	26	110	25

Source: National Venture Capital Association/PricewaterhouseCoopers; State Science and Technology Institute.

In terms of Small Business Innovation Research (SBIR) grants awarded to Nebraska businesses, Battelle used the number of grants as a measure of risk capital within their measures of innovation. This is a highly competitive program that encourages domestic small businesses to engage in federal research and development that has the potential for commercialization. "By including qualified small businesses in the nation's R&D arena, high-tech innovation is stimulated and the United States gains entrepreneurial spirit as it meets its specific research and development needs" [US Small Business Administration, https://www.sbir.gov/about/about-sbir]. The size of the program is based on the budgets of 12 federal agencies with R&D budgets.

Because the size of the budget changes from year to year, the number of dollars over time is not a particularly good measure of performance. Furthermore, since the awards can be linked to some extent to the size of their budgets, the number of grants per state may not be the best measure for comparing states to each other or over time. In an attempt to overcome these difficulties, the Research Division developed an index designed to compare each state's proportion of available grants awarded to each state's proportion of the US population. This score is multiplied by 100, with a score of 100 meaning that the state's entrepreneurs received SBIR grants in the same proportion as their state's share of the population. States with more successful small entrepreneurs per capita have an index greater than 100.

Table 8b. Key Indicators: Risk Capital, Venture Capital Invested, and Venture Capital Deals per Million Population, Cumulative Data 2009–2014

State	Total Cumulative Venture Capital Invested per Million Population	State Rank, Total Cumulative Venture Capital Invested per Million Population	Total Cumulative Venture Capital Deals per Million Population	State Rank, Total Cumulative Venture Capital Deals per Million Population
United States	**$575.01**	**N/A**	**74.3**	**N/A**
Nebraska	**$36.47**	**38**	**19.5**	**30**
Iowa	$73.68	33	8.8	42
Kansas	$83.06	30	46.0	16
Minnesota	$298.02	14	40.8	18
Oklahoma	$26.26	42	8.5	43
Tennessee	$93.88	27	43.9	17
Utah	$703.90	4	82.4	8
Virginia	$327.25	11	50.1	14
Wisconsin	$78.24	31	19.3	31

Source: National Venture Capital Association/PricewaterhouseCoopers; State Science and Technology Institute; US Census, population estimate for 2011 used to determine per capita amounts.

SBIR statistics for benchmark states are presented in Table 8c, and the SBIR index results for benchmark state are presented in Table 8d. Nebraska had the smallest number of SBIR awards between 2001 and 2014. On a per 100,000 population basis, Nebraska was tied with Iowa for the smallest number across the entire 2001-2014 period, and tied with Iowa for the smallest number in the 2001-2007 subperiod. However, Nebraska did better on the basis of grants per 100,000 population in the later, 2008-2014 period. Nebraska tied Iowa and Kansas and had more projects per 100,000 than Tennessee in the later period.

Table 8c. Key Indicators: Small Business Innovation Research Program

State	Total Cumulative SBIR Awards	Total Average SBIR Awards, per 100,000 Population, 2001–2014		
	2001–2014	2001–2014	2001–2007	2008–2014
United States	**79,843**	**1.9**	**2.1**	**1.7**
Nebraska	**132**	**0.5**	**0.6**	**0.5**
Iowa	224	0.5	0.6	0.5
Kansas	246	0.6	0.8	0.5
Minnesota	1,102	1.5	1.7	1.3
Oklahoma	284	0.6	0.8	0.4
Tennessee	517	0.6	0.7	0.5
Utah	693	1.9	2.3	1.5
Virginia	4,829	4.4	4.8	4.1
Wisconsin	859	1.1	1.2	1.0

Source: US Small Business Administration, State Summary Reports, various years; NDED calculations.

In terms of the SBIR awards index, Nebraska had the lowest score across the entire study period, and the lowest score in the first subperiod, compared to the benchmark states. Nebraska performed better than Iowa among these states in the second subperiod. In terms of 50-state rankings, Nebraska's rank improved to 42nd from 46th between the two subperiods, is now ahead of Iowa, and ranks just below Kansas, 41st, and Tennessee, 40th. This provides some indication that Nebraska is moving in the right direction in its innovation community.

Table 8d. Key Indicators: Small Business Innovation Research Program Index

State	Index of SBIR Awards			State Rank Index of SBIR Awards		
	2001–2014	2001–2007	2008–2014	2001–2014	2001–2007	2008–2014
United States	**100.0**	**100.0**	**100.0**	**N/A**	**N/A**	**N/A**
Nebraska	**27.8**	**26.7**	**29.1**	**45**	**46**	**42**
Iowa	28.2	27.6	28.7	44	43	44
Kansas	33.2	36.4	29.6	39	38	41
Minnesota	79.9	83.1	76.2	23	22	22
Oklahoma	29.4	36.7	21.1	42	36	48
Tennessee	31.7	33.3	30.0	41	42	40
Utah	100.3	110.3	90.7	16	14	18
Virginia	234.8	230.2	240.4	5	5	5
Wisconsin	58.0	55.9	60.3	27	29	27

Source: US Small Business Administration, State Summary Reports, various years; NDED calculations.

The conclusions of the 2010 Battelle report regarding the availability of risk capital appear to remain valid. There is not a lot of venture capital finding its way to Nebraska, compared to either the nation as a whole or compared to the benchmark states. In terms of SBIR grants, looking at the share of awards based on population, and

comparing Nebraska to the benchmark states, Nebraska inventors are becoming relatively more successful in attracting federal grant money.

Innovation Potential Measured as Research and Development Expenditures

Battelle's fourth measure of Nebraska's preparedness to develop an innovation-driven economy is based on R&D expenditures in both the academic and industrial sectors of the economy. In this area of innovation, Battelle concluded that "Nebraska performs well in academic R&D expenditures with respect to both size relative to the state's economy and growth rate, while the state's smaller-than-average industrial R&D base made strong gains during the 2001 through 2007 period" [Battelle, 2010, p. 22].

In terms of academic R&D expenditures, Nebraska's overall level of expenditure was less than every benchmark state except Oklahoma in both 2007 and 2013. In addition, Nebraska had the lowest percentage increase of the benchmark states over that period (Table 9a). However, when the level of academic R&D expenditures is measured as a proportion of the state's economic output, Nebraska academic R&D expenditure is relatively intense. Measuring academic R&D in terms of dollars per $1,000 of a state's gross domestic product (GDP), Nebraska ranked well against the benchmark states as the Battelle report noted, "Nebraska's level of academic R&D expenditures relative to the state's overall economic output is well above the national level and one of the highest among the benchmark states" [Battelle, 2010, p. 22].

Table 9a. Key Indicators: Academic R&D Expenditures and Intensity

State	Academic R&D Expenditure Levels (Millions of Dollars			Academic R&D Expenditure per Thousand Dollars of Gross Domestic Product		
	2007	2013	Percent Change 2007–13	2007	2013	Percent Change 2007–13
United States	**$49,406**	**$63,370**	**28.3%**	**$3.34**	**$4.11**	**23.1%**
Nebraska	**$365**	**$420**	**15.1%**	**$4.26**	**$4.27**	**0.1%**
Iowa	$587	$693	18.1%	$4.13	$4.56	10.4%
Kansas	$376	$500	33.0%	$2.98	$4.17	28.5%
Minnesota	$637	$870	36.6%	$2.38	$3.06	28.7%
Oklahoma	$299	$385	28.8%	$2.19	$2.44	16.1%
Tennessee	$761	$980	28.8%	$2.99	$2.99	20.9%
Utah	$413	$673	63.0%	$3.50	$5.41	54.5%
Virginia	$972	$1,323	36.1%	$2.38	$3.10	30.0%
Wisconsin	$1,067	$1,278	19.8%	$4.18	$4.80	15.0%

Source: National Science Foundation Survey of R&D Expenditures at Universities and Colleges; US Bureau of Economic Analysis; National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development.

Note: GDP is in chained 2009 dollars. The last three columns of Table 9a present a measure of the intensity of academic R&D expenditures for 2007 and 2013. In 2007, $4.26 worth of R&D expenditures occurred at Nebraska's academic institutions for every $1,000 of the state's economic output. This was nearly $1 more than academic R&D spending in the US as a whole, and more than every benchmark state. In 2013, Nebraska's academic R&D spending per $1,000 of output increase by one cent, to $4.27. US spending on this measure increased by 23.1% to $4.11, and by 2013, Iowa, Utah, and Wisconsin were spending more than Nebraska on academic R&D.

In industrial R&D, Nebraska similarly had a relatively low level of R&D expenditures. In 2010, the Battelle report noted that between 2001 and 2007, Nebraska has a small but fast-growing base. Industry R&D grew 59.6% during

this period, compared to the US growth rate of 33.3%. Moreover, only Virginia, among the benchmark states, saw industry R&D grow at a faster rate [Battelle, 2010, p. 23].

Table 9b presents the levels of industry R&D expenditures, the intensity of those expenditures, and the growth rates from 2006 to 2012, the last year data is available for industry R&D spending. In 2006, $447 million were spent on R&D in an industrial setting, rising by 29.3% to $578 million in 2012. Industry R&D spending in Nebraska was below all of the benchmark states in 2006, but by 2012 had surpassed one state, Oklahoma. The growth rate over the 2006–2012 period, 29.3%, continued to outpace US growth, and all of the other states except Iowa, Utah, and Wisconsin. During the period of the Great Recession, three benchmark states experienced less R&D in 2012 compared with 2006, and two other states had positive, but nearly flat, growth between those two years.

In terms of intensity, measured as industry R&D spending per $1,000 of state economic output, Nebraska's experience is more modest. At $5.29, industry R&D is much less than the $16.71 rate experienced at the national level. In 2006 Nebraska trailed in the intensity of industry R&D spending compared to the benchmark states, with R&D greater than only $3.38 in Oklahoma. Growth in Nebraska's industry R&D between 2006 and 2012, at 15.3%, nearly matched the US growth rate, and was greater than five of the benchmark states, which incidentally experienced less industry R&D spending per unit of economic output in 2012 than in 2006.

Table 9b. Key Indicators: Industry R&D Expenditures and Intensity

State	Industry R&D Expenditure Levels (Millions of Dollars			Industry R&D Expenditure per Thousand Dollars of Gross Domestic Product		
	2006	2012	Percent Change 2006–12	2006	2012	Percent Change 2006–12
United States	**$243,853**	**$292,675**	**20.0%**	**$16.71**	**$19.32**	**15.6%**
Nebraska	**$447**	**$578**	**29.3%**	**$5.29**	**$6.10**	**15.3%**
Iowa	$1,055	$1,763	67.1%	$7.69	$11.84	54.3%
Kansas	$2,064	$2,072	0.4%	$17.05	$15.82	-7.2%
Minnesota	$6,296	$6,216	-1.3%	$23.52	$22.33	-5.0%
Oklahoma	$474	$463	-2.3%	$3.38	$2.98	-11.7%
Tennessee	$1,428	$1,437	0.6%	$5.55	$5.38	-3.0%
Utah	$1,274	$2,134	67.5%	$11.46	$17.80	55.3%
Virginia	$4,816	$4,756	-1.2%	$11.89	$11.18	-6.0%
Wisconsin	$3,020	$4,135	36.9%	$11.87	$15.88	33.8%

Source: National Science Foundation Survey of R&D Expenditures at Universities and Colleges; US Bureau of Economic Analysis; National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development.
Note: GDP is in chained 2009 dollars.

In terms of R&D expenditure and intensity, Nebraska did reasonably well compared to the benchmark states on this measure of innovation. Nebraska's academic institutions especially appear ready to lead Nebraska to an innovation-driven economy.

Innovation Potential Measured as Research and Development Expenditures

Battelle's final measure of Nebraska's preparedness to develop an innovation-driven economy is based on patent generation and university technology transfer activity. The Research Division is unable to compare patent information directly with the Battelle report, as Battelle used proprietary data to develop their estimates. It appears that differences between the Battelle data and the data used in this report result in similar conclusions.

Table 10a is based on data from the US Patent and Trademark Office. The state from which a patent originates is considered in the tables below to be the state of the first-named inventor on the patent. Between 2001 and 2014, Nebraska inventors were granted 3,143 US patents. This is less than half the number awarded by Oklahoma inventors, the next closest state. In terms of the number of patents per 100,000 of population, Nebraska fared somewhat better compared to the benchmark states, but still had fewer patents awarded on this measure than all of the benchmark states. The last two columns of the table present the number of patents awarded per 100,000 population in two time periods, 2001–2007 and 2008–2014. Once again, Nebraska's performance appears to have improved in the later period, and Nebraska's performance improved against the benchmark states. Nebraska inventors were awarded more patents per 100,000 residents than Oklahoma and Tennessee between 2008 and 2014.

Table 10a. Key Indicators: Patents Granted

State	Total Patents	Patents per 100,000 Population		
	2001–2014	2001–2014	2001–2007	2008–2014
United States	**1,366,257**	**451.97**	**201.65**	**248.87**
Nebraska	**3,143**	**175.02**	**78.49**	**96.09**
Iowa	10,123	336.25	153.16	182.57
Kansas	8,070	288.06	106.14	180.24
Minnesota	44,472	851.96	373.93	475.50
Oklahoma	6,832	186.65	96.70	90.17
Tennessee	11,113	180.13	84.10	95.60
Utah	11,846	452.78	189.42	258.24
Virginia	18,450	236.94	100.39	135.16
Wisconsin	24,066	429.13	212.92	216.15

Source: US Patent and Trademark Office. NDED calculations.
Note: Origin of a patent is determined by the residence of the first-named inventor.

The growth rate of patent applications between periods is addressed in Table 10b. In this table, annual growth rates were computed and averaged to determine average growth rates for the entire 2001 to 2014 time period and for the 2001–2007 and 2008–2014 subperiods that were used previously. Note that Nebraska inventors were awarded patents at a growth rate slightly higher rate than the US through the entire time period. However, much of that growth occurred during the later subperiod. Nebraska's rate of patents awarded also grew faster than four of the benchmark states.

Nebraska's average annual growth rate in patents granted declined between 2001 and 2007, but at a much lower average rate than the US as a whole. During this time period only two states, Kansas and Minnesota, saw the average annual rate of growth in patents increase, and Nebraska's average annual patent growth, while negative, was higher than any of the benchmark states that saw negative average annual growth rates during this period.

Through the 2008 to 2014 time period, the average annual growth rate in number of patents issued grew much faster than in the earlier period for the US as a whole and for all of the benchmark states. Between 2008 and 20014 the average annual growth rate of patent awards to Nebraska inventors, 12.2%, was greater than that for the US and for five of the benchmark states. It is interesting that the later subperiod saw faster average annual patent growth than the earlier subperiod. This is especially interesting since the first period contained a short recession in mid-2001 followed by a normal recovery that lasted through the end of 2007, and the second time period covered a deep recession from January 2008 through June of 2009.

In terms of 50-state rankings, Nebraska's average annual growth rate in number of patents, for any of the periods, is in the top 20 of all states, and Nebraska did relatively better during the 2001–2007 period, climbing to 14th best,

when the rate of patent growth was slow. For the entire period, Nebraska's average annual growth rate was higher than 32 states, and higher than four of the benchmark states, Iowa, Oklahoma, Tennessee, and Wisconsin.

Table 10b. Key Indicators: Patents Granted, Average Growth Rates

State	Patents Granted Average Annual Growth Rate			State Rank Patents Granted Average Annual Growth Rate		
	2001–2014	2001–2007	2008–2014	2001–2014	2001–2007	2008–2014
United States	**4.5%**	**-1.1%**	**11.3%**	**N/A**	**N/A**	**N/A**
Nebraska	**4.8%**	**-0.7%**	**12.2%**	**18**	**14**	**19**
Iowa	2.9%	-2.9%	10.2%	35	31	32
Kansas	10.6%	6.9%	16.1%	2	3	4
Minnesota	5.2%	0.2%	11.1%	13	10	27
Oklahoma	1.2%	-1.7%	6.1%	46	24	46
Tennessee	3.0%	-4.0%	11.3%	34	42	24
Utah	6.0%	-1.0%	13.9%	7	16	8
Virginia	5.8%	-1.3%	13.4%	9	20	13
Wisconsin	1.6%	-3.8%	8.0%	43	42	42

Source: US Patent and Trademark Office. NDED calculations.
Note: Origin of a patent is determined by the residence of the first-named inventor.

The Research Division was unable to follow up on technology transfer activity. The Battelle report used proprietary data to which we do not have access. After reviewing descriptions of the data used, we questioned how this data should be interpreted. Some licensing revenue is the result of "running royalties (royalties earned on sales of products)," while other is based on license issue fees, payments under options, termination payment, annual minimums not supported by product sales, or cash-in equity [AUTM US Licensing Activity Survey FY2013 Highlights, p. 4, https://www.autm.net/FY2012_Licensing_Activity_Survey/14318.htm]. Given the size of running royalties for some universities, it would be hard to know if an increase is due to new technology or larger sales of existing products.

The conclusions of the 2010 Battelle report regarding the development of intellectual property and technology transfer in Nebraska appear to remain valid. In terms of "intellectual property Nebraska has been well below average in terms of patent generation" [Battelle, 2010, p. 23]. Nebraska remains well below average in terms of patent generation both during and after the period of the Battelle report. However, it appears that Nebraska's performance has improved in the last few years, and the growth rate in the number of patents appears to be increasing faster than average. As far as technology transfer, the Research Division has no new data, but notes that license income to the University of Nebraska appears to have increased dramatically since 2008. A 2012 *Chronicle of Higher Education* story calls Nebraska a "newcomer to the list of big earners. Its revenue from licensing grew from just over $3.7 million in 2010 to more than $16.7 million in 2011" [Universities Report $1.8 Billion in Earnings on Inventions in 2011, *Chronicle of Higher Education* Aug. 28, 2012, http://chronicle.com/article/University-Inventions-Earned/133972/].

Conclusions

This review and update of the 2010 Battelle report's assessment of Nebraska's preparedness for an innovation-driven economy came to many of the same conclusions as the original report. Where the Research Division was able to reproduce Battelle's original work, the update from 2008 through the most recent available year, showed that in many areas Nebraska remained below the nation and most of the benchmark states. However, in a number of areas, Nebraska's measure has shown some improvement over the original 2001 through 2007 timeframe.

In measures of educational achievement, Nebraska remained below the national averages for science and engineering degrees as a percentage of all higher education degrees, science and engineering doctorate degrees as a percentage of science and engineering degrees, and science and engineering doctorate degrees per 100,000 of population, and the percentage of the population over age 25 with a bachelor's degree or higher. However, in each of these measures, Nebraska moved closer to the US figures in the later years of the analysis. Nebraska was higher than the national average in terms of science and engineering degrees conferred per 100,000 of population, and Nebraska's ranking on this measure among all the states also improved between 2007 and 2011.

In measures involving entrepreneurial activity, average annual growth in new business establishments, job creation rate from new business establishments, and the number of high revenue growth businesses, Nebraska again lagged behind the nation as a whole. But once again, Nebraska's measures improved relative to the national measures in the later time periods, indicating that Nebraska's entrepreneurial activity was increasing relative to the rest of the country.

The availability of risk capital, measured in terms of venture capital dollars and deals, showed Nebraska to be behind the nation and behind most of the benchmark states in terms of venture capital investment and venture capital deals, and also in terms of per capita venture capital investments and per capita venture capital deals. There was not enough data to look at Nebraska's performance over time, on venture capital measures, so the Research Division cannot say if Nebraska has improved over time on either of these measures. Another measure of risk capital availability used by Battelle is the number of awards through the Small Business Innovation Research program. On a per capita basis, Nebraska was well below the national average in the time periods reviewed, and below most all of the benchmark states in each time period.

In the measures of R&D capability, Nebraska's academic R&D spending levels were below most of the benchmark states in terms of expenditures; however, in terms of R&D intensity—R&D dollars spent per $1,000 of state economic output—Nebraska ranked higher than the national level, and higher than most of the benchmark states. In measures of Industry R&D spending, Nebraska's expenditure levels were below most of the benchmark states. In terms of the intensity of industry R&D spending, Nebraska was well below the national average and most of the benchmark states. Nebraska did improve in these areas between 2006 and 2012.

In Battelle's final measure of an innovation-ready economy, intellectual property generation and technology transfer, Nebraska again showed poor performance compared to national averages and against the benchmark states. Measuring intellectual property generation by the number of patents granted on a per capita basis, Nebraska had less than half of the patent awards per capita than the national rate in all time periods reviewed. Nebraska had the lowest rate of patents awarded per capita of the benchmark states in 2001 through 2007 period. However, Nebraska's rate of patent awards per capita was higher than two benchmark states in the 2008 through 2014 period.

Overall, the update of innovation in Nebraska, based on Battelle's measures, shows that Nebraska tended to improve over time, both against national measures and against benchmark states. Perhaps the most impressive part of this improvement is that Nebraska managed this improvement during a very challenging economy, beginning with the start of the Great Recession and continuing through a slow recovery.