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State Technology and Science Index 2010

Enduring Lessons for the Intangible Economy

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Executive Summary

Eight years after releasing the Milken Institute's first State Technology and Science Index, it is even more apparent that successful state and regional economic development in the United States is increasingly tied to harnessing and nurturing the innovation assets present within their borders. The recent financial and economic crisis highlights the critical role that technological entrepreneurship plays in providing a diverse and flexible economic structure. With many countries making progress in competing against the U.S.—and in some cases exceeding it—in many measures of future preparedness, states must fashion their own strategic direction.

- Massachusetts continued its reign with an overall score of 82.61, but has slipped from 84.9 in our inaugural 2002 index. Massachusetts is a breeding ground of research with world-renowned universities and cutting-edge firms fueling its economy.
- Maryland, second overall with a score of 77.05, trailed Massachusetts in research and development inputs but took first in human capital capacity. The state ranked first in academic R&D per capita, thanks largely to Johns Hopkins University being the top recipient of NIH funding in the country.
- Colorado maintained the same position as in 2008, third overall, and was second in technology concentration and dynamism.
- California, holding steady at fourth, remained a national leader in technology-derived economic development, but measures of human capital continued to fall.
- Utah climbed three places to fifth this year. Utah retained its throne as the top-ranked state in technology concentration and dynamism. Risk capital availability has improved in the state.
- Rounding out the top 10 are Washington (sixth), New Hampshire (seventh), Virginia (eighth), Connecticut (ninth) and newcomer Delaware (10th).
- Alaska and Ohio had the greatest improvement in ranking (both seven), followed by Indiana, North Carolina (both five), and Delaware (four).

The State Technology and Science Index provides a nationwide benchmark for states to assess their science and technology capabilities, along with their ecosystems for converting them into companies and high-paying jobs. There are 79 individual indicators. Each indicator is computed and measured relative to population, gross state product (GSP), number of establishments, number of businesses, and other factors. Data sources include government agencies, foundations, and private sources. The states are ranked in descending order with the top state being assigned a score of 100, the runner-up a score of 98, and the 50th state a score of 2.

Table 1. State Technology and Science Index
Overall rankings, 2010

State	Rank 2010	Rank 2008	Rank change 2008 to 2010	Average score	State	Rank 2010	Rank 2008	Rank change 2008 to 2010	Average score
Massachusetts	1	1	0	82.61	Michigan	26	26	0	50.74
Maryland	2	2	0	77.05	Idaho	27	27	0	49.84
Colorado	3	3	0	75.73	Indiana	28	33	5	49.70
California	4	4	0	73.85	Ohio	29	36	7	49.47
Utah	5	8	3	71.26	Missouri	30	30	0	48.44
Washington	6	5	-1	70.23	Alabama	31	29	-2	47.29
New Hampshire	7	9	2	68.69	Iowa	32	35	3	46.59
Virginia	8	6	-2	68.05	North Dakota	33	31	-2	46.39
Connecticut	9	7	-2	66.56	Nebraska	34	34	0	45.53
Delaware	10	14	4	63.26	Montana	35	32	-3	44.37
New Jersey	11	12	1	62.97	Hawaii	36	28	-8	43.87
Minnesota	12	11	-1	62.65	Alaska	37	44	7	42.79
North Carolina	13	18	5	61.42	South Dakota	38	41	3	41.48
Pennsylvania	14	13	-1	60.78	Oklahoma	39	38	-1	40.32
Arizona	15	17	2	60.21	Florida	40	37	-3	39.96
New York	16	15	-1	59.47	Tennessee	41	40	-1	38.85
Vermont	17	19	2	59.30	Maine	42	39	-3	37.56
New Mexico	18	16	-2	59.05	South Carolina	43	42	-1	36.84
Texas	19	20	1	58.33	Wyoming	44	43	-1	35.76
Illinois	20	21	1	57.13	Louisiana	45	46	1	35.27
Oregon	21	23	2	56.53	Nevada	46	45	-1	34.03
Rhode Island	22	10	-12	55.54	Kentucky	47	47	0	32.70
Kansas	23	24	1	55.48	Mississippi	48	50	2	32.43
Wisconsin	24	22	-2	55.02	West Virginia	49	49	0	30.33
Georgia	25	25	0	51.71	Arkansas	50	48	-2	25.63
								State average	**52.38**

These indicators are subdivided into five equally-weighted major composites:

Research and development inputs: The R&D capabilities that can be commercialized for future state and regional technology growth. The category includes measures such as industrial, academic, and federal R&D, Small Business Innovation Research awards, and the Small Business Technology Transfer program, among others.

Risk capital and entrepreneurial infrastructure: The entrepreneurial capacity and risk capital infrastructure of states are the ingredients that determine the success rate of converting research into commercially viable technology services and products. We include several measures of venture capital that capture the amount placed relative to the size of a state's economy and recent growth. It includes patenting activity, business formations, and initial public offerings.

Human capital capacity: Human capital is the most important intangible asset of a regional or state economy. This component includes measures of stocks and flows in various areas of educational attainment. Examples include the number of bachelor's, master's, and Ph.D.s relative to a state's population and measures of specific science, engineering, and technology degrees.

Technology and science workforce: The intensity of the technology and science workforce indicates whether states have sufficient depth of high-end technical talent on the ground. Intensity is derived by finding the percent share of employment for a particular field relative to total state employment; it indicates whether potential human capital is being combined with R&D and financial capital and is actually being transformed into a thriving economy. There are three main categories of computer and information science, life and physical science, and engineers. All together there are 18 different occupation categories.

Technology concentration and dynamism: This is a measure of technology outcomes. By measuring technology growth, we are able to assess the effectiveness of policymakers and other stakeholders in transforming regional assets into regional prosperity. This includes measures such as the percent of establishments, employment, and payrolls that are in high-tech categories. It further includes a variety of measures on growth in a number of technology categories. Combined, it provides a number of stock and flow measures of tangible success in technology-based economic development.

The Top Ten

Massachusetts continued its reign as the leader in technology and science, but has seen its score slip from 84.9 in our inaugural 2002 index. Nevertheless, the state maintained its solid edge over second-place Maryland. Massachusetts topped the charts in three components: R&D inputs, risk capital and entrepreneurial infrastructure, and technology and science workforce. Massachusetts is a breeding ground of research with world-renowned universities and cutting-edge firms fueling its economy. In human capital capacity, the state recorded a stellar second-place performance. Its weakest performance was in technology concentration and dynamism, where it ranked seventh.

The state has maintained its elevated score in R&D inputs over the years (consistently above 92). Its score has slipped slightly in risk capital and entrepreneurial infrastructure, but it still ranks first. Massachusetts' biggest challenge is its steady decline in technology concentration and dynamism, to seventh from second in 2002. In part, the decline reflects an improvement in other states' ability to channel innovation assets into technology firms and job creation, but it also highlights the challenges of sustaining the full economic benefits of innovation in a high-cost, regulation-heavy state.

Massachusetts recognizes these challenges and is taking actions to maintain its top overall position in technology-based economic growth. Governor Deval Patrick was able to convince the Legislature to keep funding the state's 10-year, $1.0 billion Life Sciences Initiative. The fiscal year 2011 budget includes $10 million for the Massachusetts Life Sciences Center charged with overseeing the effort, the same as FY 2010.[1] Other initiatives include the Advanced Manufacturing Initiative, which provides low-cost loans to help companies adopt new innovations and purchase technologically advanced equipment[2]; the MassChallenge Venture Funds Competition, which seeks to raise $25 million to support 25 to 30 start-ups per year[3]; and a statewide consortium undertaking development of a $100 million green computing center in the western part of the state.[4]

1 FY 2011 Budget Summary, State of Massachusetts, August 6, 2010. *http://www.mass.gov/bb/gaa/fy2011* (accessed September 23, 2010).

2 Press release, Governor of Massachusetts, "With economic recovery growing, Governor Patrick announces initiative to bolster Massachusetts advanced manufacturing sector," May 21, 2010. *http://www.mass.gov/?pageID=gov3pressrelease&L=1&L0=Home&sid=Agov3&b=pressrelease&f=052110_superconductor&csid=Agov3* (accessed September 26, 2010).

3 "*Massachusetts launches MassChallenge Venture Funds Competition*," TotalCIO blog, IT Knowledge Exchange, June 10, 2009. *http://itknowledgeexchange.techtarget.com/total-cio/massachusetts-launches-masschallenge-venture-funds-competition* (accessed September 26, 2010).

4 Mike Plaisance, "Former site of Mastex Industries chosen as home for Holyoke's high performance computing center," The (Springfield, Mass.) Republican, August 9, 2010. *http://www.masslive.com/news/index.ssf/2010/08/former_site_of_mastex_industri.html* (accessed September 26, 2010).

Maryland, in second place overall with a score of 77.05 (down from 80.04 in 2008), trailed Massachusetts in R&D inputs but took first in human capital capacity. Its weakest performance came in risk capital and entrepreneurial infrastructure, with a rank of 14th. Maryland's overall position has improved over the years; it ranked fourth in 2002.

Maryland's second place in R&D is largely attributable to its exceptional ability to garner federal funding. In federal R&D per capita, first-place Maryland's funding is almost 40 percent greater than that of second-place New Mexico's. Home to leading research facilities such as the National Institutes of Health, no other state has the concentration of federal innovation assets that Maryland has. Another key strength is its top position in academic R&D per capita, led by Johns Hopkins University, the top recipient of NIH funding in the country. But with a weaker entrepreneurial environment than many other leading states, Maryland hasn't been quite as successful at converting these federal and academic research assets into business births and the expansion of gazelle firms (companies that have grown at least 20 percent a year for four years, from a base of at least $100,000 in revenues).

Maryland Governor Martin O'Malley and other state leaders recognize that they must enhance the innovation milieu to capture the full economic benefits of these strong assets. In June, the governor proposed the InvestMaryland program, which would provide tax credits to insurance companies so they could invest either directly in start-up firms or through a venture capital firm.[5] Additionally, the FY11 budget includes $8 million in tax credits for biotech firms and $10.4 million for stem cell research.[6] Lastly, the governor signed legislation that codifies the R&D tax credit through 2020.[7]

Like the top two states, **Colorado** held its ground at third overall, but its score decreased from 78.32 to 75.73 this year, just edging out California. In contrast to Massachusetts, Colorado's strongest performance was in the technology concentration and dynamism component, where it ranked second. Colorado maintained most of its excellent performances across the technology concentration and dynamism indicators, and even climbed six places to sixth in the number of Inc. 500 companies per 10,000 business establishments. These fast-growing, job-creating firms have led to its ascension in technology concentration and dynamism.

Colorado's weakest area was sixth in risk capital and entrepreneurial infrastructure. Colorado's strengths were second in technology concentration and dynamism, and third in human capital capacity. Colorado was second only to Massachusetts in the percentage of its adult population with a bachelor's degree or better. High concentrations of telecommunication services and software explain much of its strength in educational attainment, along with the extensive number of universities and colleges.

5 Press release, Office of Governor Martin O'Malley, "Governor Martin O'Malley Announces InvestMaryland Proposal to Spur Jobs, Investments in Maryland's 'Innovation Economy,'" June 1, 2010. *http://www.governor.maryland.gov/pressreleases/100601.asp* (accessed September 27, 2010).

6 "Maryland Budget Supports BIO 2020 Initiative," SSTI Weekly Digest, April 28, 2010. *http://www.ssti.org/Digest/2010/042810.htm* (accessed September 27, 2010).

7 *http://mlis.state.md.us/2010rs/bills/sb/sb0064t.pdf* (accessed September 26, 2010).

Composite Indexes

The top states in the five subindexes that make up the bigger State Technology and Science Index:

Research and Development Inputs Composite Index

State	Rank 2010	Rank 2008
Massachusetts	1	1
Maryland	2	2
New Hampshire	3	5

Risk Capital and Entrepreneurial Infrastructure Composite Index

State	Rank 2010	Rank 2008
Massachusetts	1	2
California	2	1
Connecticut	3	11

Human Capital Investment Composite Index

State	Rank 2010	Rank 2008
Maryland	1	1
Massachusetts	2	2
Colorado	3	3

Technology and Science Workforce Composite Index

State	Rank 2010	Rank 2008
Massachusetts	1	1
Maryland	2	3
Delaware	3	7

Technology Concentration and Dynamism Composite Index

State	Rank 2010	Rank 2008
Utah	1	1
Colorado	2	5
Washington	3	8

Colorado is prioritizing developing a clean energy economy. Governor Bill Ritter signed legislation that he believes will make the state "a national leader in the New Energy Economy."[8] Colorado's Jobs Cabinet, convened by the governor, has released a series of recommendations in its "Economic Competitiveness through Collaboration, Talent Development and Innovation" report. [9] Colorado is moving forward with developing a long-term plan for higher education, with Ritter stating that "the best economic-development strategy and the best anti-poverty strategy is an education strategy."[10]

California held steady in fourth position with a score of 73.85, a slight decline from 74.62 in the 2008 index but a significant drop from 80.37 in the first index in 2002, when California ranked third. This year it performed well in risk capital and entrepreneurial infrastructure (second), R&D inputs (fourth), and technology concentration and dynamism (fifth). But in human capital capacity, it ranked far below the top three states at 13th. California even fell in the Technology and Science Workforce Composite Index, to seventh from sixth in 2008, due largely to the continued outsourcing of computer, semiconductor, and communications equipment manufacturing abroad and to other states. Most troubling for California is the falloff in recent graduates in the sciences, engineering, and biomedical fields.

Despite these foreboding trends, California remains a national leader in technology-derived economic development. Based on our research, California has five of the top 10 technology clusters in the nation, and Silicon Valley (the San Jose metro area) remains the preeminent high-tech cluster in the world.[11] California has considerable strength in the newly emerging fields of nanotechnology, clean technology, and green technology, and is a leading innovator in public policy to support these areas. Governor Arnold Schwarzenegger signed legislation in March 2010 that provides a sales tax exemption for equipment used by manufacturers in the clean-tech sector.[12] California has been without a formal state economic development office since 2003, when it was a casualty of the last budget crisis. The governor corrected this by signing an executive order in April authorizing the Governor's Office of Economic Development.[13]

Utah shot up three spots to fifth, edging out 2008's fifth-ranked Washington by 1.0 point with a score of 71.26. Utah retained its throne as the top-ranked state in technology concentration and dynamism, and finished in the top eight in all components except R&D inputs, where it was a still respectable 13th. Driving its ascent were a four-place improvement in R&D inputs, an 11-place leap in risk capital and entrepreneurial infrastructure, and a three-place gain in technology and science workforce. Risk capital availability has improved in the state with its venture capital placements relative to GSP now fifth in the nation.

8 Bill Summary, House Bill 10-1333, Sixty-seventh General Assembly, State of Colorado. *http://www.leg.state.co.us/CLICS/CLICS2010A/csl.nsf/fsbillcont3/EF619483FD7DC170872576A80027B7F3?Open&file=1333_01.pdf* (accessed September 26, 2010).

9 "Report to the Governor: Economic Competitiveness Through Collaboration, Talent Development and Innovation," Colorado Jobs Cabinet. *http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1239166115839&ssbinary=true* (accessed October 1, 2010).

10 State of the State Address, Office of the Governor, State of Colorado, January 14, 2010. *http://www.colorado.gov/cs/Satellite/GovRitter/GOVR/1251569957669* (accessed September 27, 2010).

11 Ross DeVol, Kevin Klowden, Armen Bedroussian, and Benjamin Yeo, "North America's High-Tech Economy: The Geography of Knowledge-Based Industries" Milken Institute, June 2009, pp. 2-3.

12 "California Gov. Signs Bill Incentivizing Clean Tech Entrepreneurs," SSTI Weekly Digest, March 31, 2010. *http://www.ssti.org/Digest/2010/headlines10.htm* (accessed September, 16, 2010).

13 Press release, "Governor Schwarzenegger Establishes Office of Economic Development," Office of the Governor, State of California. *http://gov.ca.gov/press-release/14844* (accessed October 5, 2010).

Medical devices are an important technology sector for the state with Brigham Young University playing a major role in promoting Utah's life sciences sector. Utah has had success in transforming its R&D assets, as commercialization rates and start-ups in the life sciences show. Not to be left out of the energy race, Utah Governor Gary Herbert announced the Utah Energy Initiative in his 2010 State of the State address, stating, "I am assembling the best minds in the state and charging them with creating a 10-year strategic energy plan whose purpose is threefold: to ensure Utah's continued access to our own clean and low-cost energy resources; to be on the cutting edge of new energy technologies; and to foster economic opportunities and create more jobs."[14]

Washington slipped to sixth overall this year with its score sliding from 72.09 in 2008 to 70.23. The state recorded an impressive third place in technology concentration and dynamism, fourth in technology science workforce, and sixth in R&D inputs. Its overall score suffered most from a six-spot decline to 21st in human capital capacity. Washington was at its weakest in various measures of state appropriations for higher education, and in graduate students in science, engineering, and health sciences. Its strength in technology concentration and dynamism is attributable to Microsoft and its spin-offs, along with other start-up firms, positioning the Seattle area as one of the global centers of software. Seattle is no longer the corporate headquarters of Boeing, but retains a substantial amount of the firm's employment and operations, and related suppliers.

New Hampshire gained ground in the overall rankings, jumping to seventh from ninth in 2008. The state ranked 13th in 2002 and has inched higher with every edition of our index. New Hampshire gained an impressive four points in R&D inputs to 81.01, displacing California in third. New Hampshire had strong positions in funding received from the National Science Foundation (NSF) and in State Technology Transfer Research (STTR) and Small Business Innovation Research (SBIR) awards. With these solid statistics, it was no surprise to see the state leap from fifth in 2008 to its current third in R&D inputs. Given these strengths, New Hampshire is beginning to look more like its neighbor to the south, Massachusetts. Governor John Lynch has made attracting and retaining young workers in New Hampshire a top priority, and his task force on the subject has released a detailed set of recommendations.[15]

Virginia remained in the top 10, but fell from sixth to eighth. Virginia registered its best performances in technology concentration and dynamism (fourth), and technology and science workforce (sixth). Much of this strength stems from the Eastern Virginia suburbs of Washington, D.C., which have benefitted from their proximity to the federal government, a cluster of data-processing firms, and defense and aerospace contractors. Virginia's overall slippage was attributable partly to a decline in human capital investment from eighth in the 2008 index to 15th this year. Virginia's indigenous innovation ecosystem that spawns new firms is less extensive than those of Massachusetts and California. But Governor Bob McDonnell has signed bills in support of his "jobs and opportunity agenda" that attempt to address this gap. The legislation will exempt capital gains taxes on investments in start-up tech or biotech firms.[16]

Connecticut slipped two positions to ninth, with a remarkable eight-place leap in risk capital and entrepreneurial infrastructure. Connecticut recorded great gains in measures of access to venture capital. The state jumped from 13th to first in the growth of venture capital based on figures for 2009.

14 State of the State Address, Office of the Governor, State of Utah, January 26, 2010. Available at *http://www.jayseegmiller*.com/?p=62 (accessed December 5, 2010).

15 "Final Report," The Governor's Task Force for the Recruitment and Retention of a Young Workforce for the State of New Hampshire, *http://www.usnh.edu/initiatives/documents/TaskForceFinal061809.pdf* (accessed October 1, 2010).

16 "Virginia Jobs Plan Advances; $50M Econ. Dev. Increase Requested," SSTI Weekly Digest, February 24, 2010. *http://www.ssti.org/Digest/2010/headlines10.htm* (accessed September 24, 2010).

Connecticut ranked fifth in human capital capacity, where it was third in the number of adults with an advanced degree. The presence of aerospace and financial services explains much of the high ranking. Governor Jodi Rell signed a jobs bill that provides a number of credits to investors in start-up businesses in designated sectors.[17]

Delaware cracked the top 10, up from 14th in 2008. Delaware saw its biggest advance in risk capital and entrepreneurial infrastructure, rising seven places to 29th. It also leaped from seventh to third in technology and science workforce. In terms of the concentrations of biochemists and biophysicists, and microbiologists, Delaware ranks first and second, respectively, stemming largely from the presence of AstraZeneca and smaller biotechnology firms. It is also strong in concentrations of computer systems analysts, and database and network administrators, ranking no lower than third.

Delaware is taking steps that could improve its ranking of 29th in risk capital and entrepreneurial infrastructure, and as a result, its position overall. The state plans to convert a former Chrysler plant into a center for high-tech laboratories, health sciences, alternative energy R&D, and other emerging industries. Delaware Governor Jack Markell outlined his vision for economic development in his State of the State Address in January 2010: "Businesses want to locate where the best and the brightest of our youth come to learn. Whether it be the alternative energy inventions of tomorrow that will spring from the University of Delaware, the optics research being advanced at Delaware State University, or the thousands of future workers who will garner their skills at Delaware Tech, we must entice businesses and jobs today with the promise of a better tomorrow."[18]

Biggest Gainers

Ohio improved its overall position from 36th in 2008 to 29th, tying **Alaska** for the biggest gain in the latest index. Ohio's economy contracted more than the nation's during the Great Recession due to its heavy dependence on traditional manufacturing industries such as autos and steel, but witnessed some clear returns on the investments that were made in its innovation economy under the auspices of the Third-Frontier Project. This is evident in Ohio's 20-place jump in risk capital and entrepreneurial infrastructure and eight-position improvement in R&D inputs from 2008. Leading the overall gains were a notable leap in the number of business starts, a better position in venture capital growth, and a jump from 30th to 21st in academic R&D.

Alaska's biggest gain was in technology and science workforce, followed closely by technology concentration and dynamism. Alaska ranks third in the category of other engineers on a per capita basis. The state has implemented a new program to promote building human capital: High school students who complete four years of math and science will be eligible for college grants if they have a high G.P.A.[19]

Indiana's gains are across several categories, but the risk capital and entrepreneurial infrastructure component is responsible for the bulk of its overall advance from 33rd to 28th this year. Indiana vaulted from 37th in 2008 to 19th in that category, and ranked fourth in venture capital growth this year, gaining ground in both venture capital relative to GSP (from 26th to 17th) and business start-up rates (also 26th to 17th). Indiana University has grown more aggressive in supporting new firm birth, launching a venture capital fund to invest in technology start-ups and dedicating a new Innovation

17 "CT Gov Signs Jobs Bill, FY11 Budget Agreement," STSI Weekly Digest, May 12, 2010. *http://www.ssti.org/Digest/2010/051210.htm* (accessed December 5, 2010).

18 "Restoring Delaware's Promise and Prosperity," State of the State Address, Governor of Delaware, January 21, 2010. *http://governor.delaware.gov/speeches/2010stateofstate.shtml* (accessed October 1, 2010).

19 State of the State Address, Office of Governor Sean Parnell, January 20, 2010. *http://gov.alaska.gov/parnell/press-room/full-press-release.html?pr=5246* (accessed October 5, 2010).