Rhode Island Innovates:
A Competitive Strategy for the Ocean State

Prepared by Battelle Technology Partnership Practice in association with the Metropolitan Policy Program at Brookings with support from Monitor Deloitte and TEConomy Partners, LLC.

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Executive Summary

Rhode Island has done it before.

When the state's initial trade glory ebbed after the American Revolution, the ingenuity of Rhode Islanders prevailed, and the state not only shifted into manufacturing but also launched America's industrial age at the Slater Mill by opening the first successful water-powered cotton-spinning factory in the United States.

The state innovated, transformed its drifting economy, and prospered.

Now, the state needs to do it again.

After several decades of drift, the Ocean State needs to transform itself once more by further leveraging its assets, ingenuity, and, yes, its beautiful rocky coastline and "hipness factor," to reverse substantial decline.

The moment is urgent. Ever since the Great Recession exposed deep structural erosion beneath the collapse of an outsized real estate bubble, Rhode Island has struggled to regain its economic footing at a time of technological disruption and "winner-take-all" markets.

The state's traded sectors—its most critical sources of prosperity—have been losing jobs since the 1970s and are only now stabilizing, though much reduced. Incomes are stagnating. A significant skills-building task has become urgent as a far more diverse younger population clamors for connection and more relevant training. And, for that matter, poverty and economic disparities have increased, with the median income of black households now standing at less than 60 percent and that of Hispanic households at just 50 percent that of white families.

Which is to say that Rhode Island—a small state in a large nation in a fiercely competitive world—is facing an existential choice about its future. Are the state's business, civic, university, and government leaders prepared to think deeply and act decisively as their predecessors did in order to meet profound uncertainty with innovation and ingenuity? Or will they merely make the best of slow decline?

Fortunately, the moment is propitious for renewal. The national economic backdrop is at last generally positive. An uptick in state revenues has modestly improved the budget outlook as has a refinancing of

state debt. And meanwhile, new leadership in key quarters has created space for a serious reassessment of the state's economic positioning and route toward improved performance.

Most notably, the administration of Gov. Gina Raimondo—focused on sparking an Ocean State comeback—has been working closely with the General Assembly to develop more strategic approaches for promoting increased and higher-value growth. Last summer, specifically, the Assembly passed and Gov. Raimondo signed a 2015–2016 budget equipped with a number of new incentive programs aimed at spurring growth in a variety of sectors, including in what the Brookings Institution calls high-value "advanced industry" clusters. Though billed as only down-payment on growth the programs represented an important first step toward reorienting a drifting economy.

And yet, to go further and intervene more decisively, the state needs to know more about itself: about the state of its current economy; about the industries it has and their competitiveness; about the supportive assets it does and does not have. In short, what Rhode Island has needed is a fact-based, third-party analysis of the state's competitive position that leads to a compelling strategy and action steps for economic growth.

Which is why in spring 2015 a number of Rhode Island foundations and state-connected individuals supported work by the Metropolitan Policy Program at Brookings along with its analytic partner the Battelle Technology Partnership Practice (now TEConomy Partners, LLC) and in collaboration with Monitor Deloitte, Deloitte Consulting LLP to provide a detailed economic assessment and actionable recommendations for the state's economic development planning, with an emphasis on growing the state's critical advanced industries.

Hence this report: Designed to provide a fact-driven basis for action, **"Rhode Island Innovates: A Competitive Strategy for the Ocean State"** undertakes to provide a detailed assessment of the state's present situation and best opportunities for high-quality economic growth, with the goal of promoting an advanced economy that works for all.

To that end, the chapters that follow reflect the results of an intense six-month inquiry that sought to: distill the economic challenges the state faces; identify the state's best opportunities for industry expansion and high-value economic growth; assess the strengths and weaknesses of the state's growth platform; and provide an action plan for realizing the state's economic opportunities.

Along these lines, the pages that follow draw a number of conclusions about the state as it considers how to catalyze the next wave of Ocean State growth:

1. Rhode Island possesses unique assets but the decline of its core advanced industries has left the state adrift

Rhode Island embarks on the next phase of its economic history with a strategic geographic location and many assets. Rhode Island sits at the center of a 33-million-person megalopolis that stretches from

Portland, ME, to metropolitan New York. Each year this region produces a combined economic output of $2.1 trillion and a combined innovation output of 16,000 patents.

Home to premier academic and research institutions in fields ranging from biotech, company management, the culinary arts, and design to IT, oceanography, and undersea warfare, Rhode Island also possesses a diversified portfolio of knowledge assets. And with 400 miles of coastline and a network of towns and cities rich in charm and urban cool, the state remains an attractive place to live.

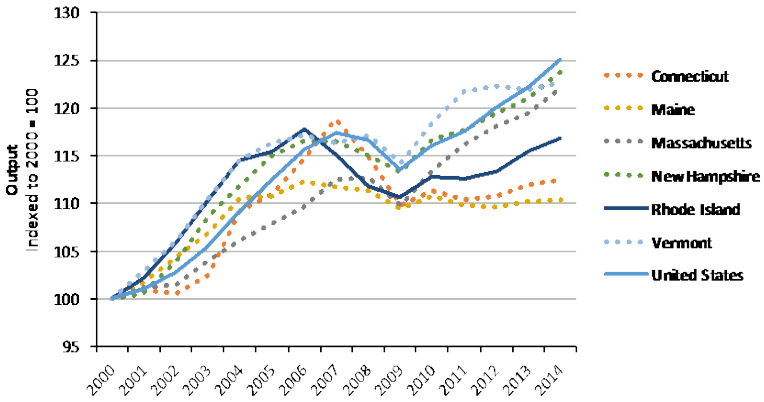
However, despite these strengths, reports Chapter 2, the state's economy has underperformed in recent years relative both to its neighbors and the nation as a whole. Three major findings bear notice:

- **Rhode Island's economy has lost growth capacity and is now a middling performer.** If Rhode Islanders are in a dour mood currently, it likely owes to a downward shift in the state's economic performance, even though in truth the state's economic condition is less dire than middling.

  In the early 2000s, Rhode Island's economy was a leader in New England and enjoyed relatively strong performance across economic measures relative to the United States. Annual job growth between 2000 and 2006 led the region and over the same time period the state enjoyed nearly double Massachusetts' annual GDP growth. In addition average wage growth generally tracked the nation's through the 1990s, and at times the unemployment rate was lower in the Ocean State than in the United States as a whole.

  However, the traumatic experience of the Great Recession and Rhode Island's unusually slow recovery have intensified fundamental problems while reducing the state's relative economic standing. Rhode Island slogged through the most severe recession of any New England state in the years 2007 to 2010 and it has continued to lag the region on certain measures of labor market health. Most notably, the state saw its unemployment level spike higher and decline slower than every other New England state. Today the state's highest-in-the-region unemployment rate of 5.4 percent still exceeds the state's pre-recession low unemployment rate of 4.8 percent. The state is also still over 10,000 jobs short of returning to its pre-recession employment levels and has

Output growth in Rhode Island has lagged the nation, Massachusetts, New Hampshire, and Vermont since the reset of the Great Recession



Source: Brookings-Battelle analysis of Moody's Analytics data.

seen one of the largest increases in inequality among states post-recession. While topline indices are for the most part not calamitous, they are just passable.

With that said, the most crucial trend data for the last decade suggest a fundamental problem: Rhode Island's growth capacity has deteriorated.

As a result, the economic reset of the recession has moved from the front to the middle of the pack on a variety of key performance measures.

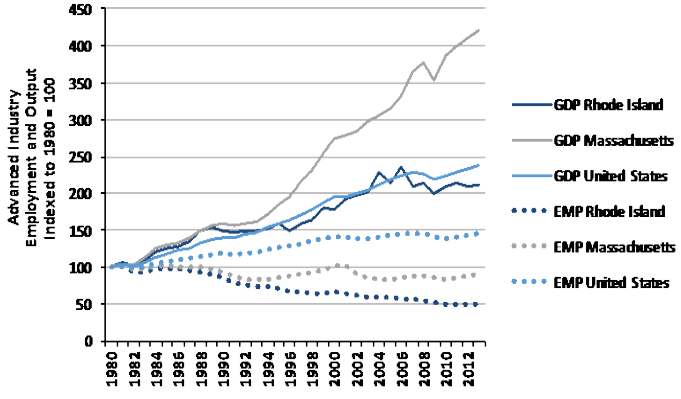
Output and job growth now tend to lag the nation's, as does average growth worker compensation. Within New England, Rhode Island's economic future looks even less clear. Prior to the recession, the economies of New England states largely moved together. In more recent years, performance has diverged with Massachusetts and New Hampshire pulling ahead, Connecticut and Maine falling behind, and Rhode Island drifting in between

- **Rhode Island's advanced industry employment base has shrunk.** Beneath the headline story of recent drift lies deeper structural change involving the industrial composition of the state economy. Most notably, Rhode Island's critical advanced industry base—anchored by its historical manufacturing sector—has lost both size and traction.

  Advanced industries as defined by the Brookings Institution are a group of 50 individual industries (ranging from aerospace manufacturing and shipbuilding to renewable energy to biotech and computer systems design) that conduct large amounts of R&D and employ a disproportionate share of science-technology-engineering-mathematics (STEM) workers. Given their orientation towards innovation, technology application, and exports, these industries anchor the U.S. economy by supporting long supply chains, driving productivity growth, generating knowledge spillovers, and paying high wages to workers with a variety of degrees. The success of these industries is a prerequisite for broadly shared prosperity.

  Over the past few decades, however, Rhode Island's advanced industry base has eroded. Total advanced industry employment declined at a faster rate in Rhode Island than in any other state from 1980 to 2013. Most of this decline reflects calamitous job losses in the state's declining jewelry, toy, and textiles manufacturing industries, which though moderately advanced remained relatively labor-intensive and low value-add—and thus susceptible to offshoring. At the same time, advanced industry output growth has been

Stagnant advanced industries output growth (GDP) exacerbated job losses (EMP) in Rhode Island



Source: Brookings-Battelle analysis of Moody's Analytics data

sluggish and located exclusively in Rhode Island's advanced services—a sector that has only somewhat offset the decline of the state's manufacturing base.

With that said, it bears noting that while Rhode Island advanced manufacturing output growth has been negative since 2000, the state's advanced services—IT, software, computer systems design, R&D—have been performing very well. Rhode Island boasted the highest advanced services output and employment growth in New England from 2000 to 2013.

And yet, the present-day situation is not yet advantageous. Rhode Island now combines best-in-region growth in advanced services (from a small base) with worst-in-region growth in advanced manufacturing (from a larger base). As a result, Rhode Island's critical advanced industries generate a smaller portion of state GDP and represent a smaller share of employment than the national average and any other New England state except Maine

- **Without new growth drivers, the state's economy will continue to drift.** Basically, the collapse of the state's legacy advanced industries combined with the too-slow emergence of new ones has left the state without a growth engine. Erosion of the state's advanced industry base and the failure to nurture new advanced industries has left the state adrift. In order to get back on track, Rhode Island needs to build more resilient, future-oriented industry specializations capable of securing prosperity for the next generation.

  Neighboring states Massachusetts and New Hampshire show the way forward. These states made successful transitions from legacy industries to more future-oriented knowledge- and innovation-based ones. As a result, Massachusetts has 4.8 percent more jobs today than it did at its pre-recession peak in 2008, and New Hampshire has witnessed a 10.1 percent jump in per-capita income since its nadir in 2010.

  Rhode Island, by contrast, remains 2.1 percent below its pre-recession employment peak and only 7 percent ahead of its per-capita income trough. The consequences of these trends can be seen in the long-term divergence of living standards between Rhode Island and its neighbors. In 1980, per capita personal income in Rhode Island was 98 percent that of New Hampshire, 92 percent that of in Massachusetts, and 80 percent that of Connecticut. By 2013, Rhode Island's relative incomes had slumped to 91 percent, 82 percent, and 74 percent, respectively. Rhode Island is beginning to see the consequences of losing much of its advanced industries base.

2. Five advanced industry growth areas and two "opportunity industry" growth areas hold out solid potential for rebuilding Rhode Island's high-value economic base and cultivating widely shared prosperity.

To rectify the losses of recent decades, Rhode Island needs to identify and nurture new sources of high-potential, high-value economic growth. To help the state identify such growth possibilities, Brookings

and Battelle (TEConomy) employed a data- and consultation-intensive process that assessed industry potential through objective and systematic analytics rather than anecdotes or trend picking.

In this fashion, Battelle executed a rigorous three-step process for identifying the most significant detailed industries and cluster connections in Rhode Island; assessing where the state's deeper competencies and assets across industry and research institutions differentiate clusters with special know-how and depth; and considering whether the identified potential growth areas provide a clear "line-of-sight" to large-scale market expansion. Informed by this analysis, Chapter 3 of the report recommends the state focus its economic development activities on seven broad growth areas and 15 or more "priorities within the priorities."

Five of these growth areas encompass "advanced industries"—industries that invest heavily in R&D and STEM workers, prize innovation, and demonstrate high productivity, strong exports, and higher pay. According to Brookings these advanced industries "…encompass the nation's highest-value economic activity…[and]…are the country's best shot at innovative, inclusive, and sustainable growth." Rhode Island's advanced industry growth areas include:

- ***Biomedical Innovation*****:** This growth area advances scientific knowledge of biological processes and systems in ways that are reshaping the diagnosis and treatment of disease. These advances converge with technological developments in electronics, information technology, imaging, and nanosciences to offer new insights that inform the creation and improvement of various biomedical products. Rhode Island has particularly strong market opportunities in neuroscience-related therapeutics; medical devices for orthopedic, biosensing, and neurological applications; and health care informatics and digital innovations

- ***IT / Software, Cyber-Physical Systems, and Data Analytics*****:** As the world transitions into the next phase of the information technology revolution, a range of technologies—including wireless communications, sensing and imaging data, and the Internet of Things—are converging with rising demand for technologies and applications capable of storing, processing, and analyzing large, complex datasets to inform real-time decisions. Specific opportunities for the state include cyber-physical systems and data analytics, autonomous underwater vehicles, remote medical device monitoring systems, environmental and energy monitoring, and smart grid infrastructure

- ***Defense Shipbuilding and Maritime*****:** Rhode Island is home to a wide range of maritime industry activities, including boat building, defense-related ship and submarine building, ocean cartography and engineering, and marine tourism. A highly integrated maritime economy that encompasses manufacturing, services, and research reinforces the state's competitive advantages as the Ocean State

- ***Advanced Business Services*****:** Modern corporations rely on back-office and headquarter operations such as web services, data processing, marketing, client management, human resources, financial services, and strategy and product development support. Applying advanced

technologies to these activities can help firms improve their competitiveness in the marketplace. Rhode Island can drive growth in this area by leveraging existing strengths and its strategic geographic location

- ***Design, Food, and Custom Manufacturing*****:** Industrial design provides significant competitive advantages for companies. Driven by rapid technological developments, falling costs, and 3D printing technology, industrial design is an increasingly important part of product and service development. Meanwhile, a burgeoning maker movement is lowering the barriers to designing and manufacturing goods. Particular opportunities for Rhode Island include rising demand for industrial design and growing interest in food manufacturing that stands at the nexus of food and health

In addition, two growth areas encompass "opportunity industries"—industries that offer good jobs with livable wages for individuals with varying levels of educational attainment. These two area hold out particular promise for the state:

- ***Transportation, Distribution, and Logistics*****:** This growth area encompasses the state's multi-modal freight transportation system, which includes ocean shipping, rail shipping, and trucking. These activities inform decisions about warehouse siting and distribution networks as well as demand for logistics services. Rhode Island has particular opportunities in grocery wholesaling and warehousing and storage

- ***Arts, Education, Hospitality, and Tourism*****:** This growth area brings together creative and recreational services across the arts, higher education, hospitality, full-service restaurants, conventions, gambling, and tours and sightseeing. Opportunities include expanding on an already vibrant tourism industry and expected employment gains in higher education

RHODE ISLAND GROWTH AREAS	
Advanced Industry Growth Areas	
Biomedical Innovation	• 31,548 jobs in 2013 • Priority areas: biopharmaceuticals, medical devices, digital health
IT/ software, cyber-Physical Systems, and Data Analytics	• 12,538 jobs in 2013 • Priority areas: data sciences, cyber-physical systems
Shipbuilding and Maritime	• 19,107 jobs in 2013 • Priority areas: submarine & boat building, ocean sciences, marine/coastal tourism

Advanced Business Services	• 34,780 jobs in 2013 • Priority areas: back office operations
Design, Materials, Food, and Custom Manufacturing	• 11,045 jobs in 2013 • Priority areas: product design, food processing
Opportunity Industry Growth Areas	
Arts, Education, Hospitality, and Tourism	• 42,801 jobs in 2013 • Priority areas: marine/coastal tourism, colleges & universities
Transportation, Distribution, and Logistics	• 21,322 jobs in 2013 • Priority areas: grocery wholesale, warehousing & storage

Overall, Chapter 3's detailed examination of the industries powering Rhode Island's present economy reveals that the state possesses a number of promising industry development growth areas. At the same time, the chapter suggests that the state would not be well served by an economic development strategy that relies on heavy investment in individual industry targets. Rhode Island lacks industries that are large enough and competitive enough to warrant narrowly focused industrial policy. Instead, the analysis shows that Rhode Island's intricate webs of smaller interconnected industries, when aligned with core competencies, add up to a finite set of legitimate broader growth opportunities.

3. To leverage its growth opportunities Rhode Island should pursue a focused strategy of investing in the most critical advanced industries growth drivers while improving its statewide platform for growth

Ultimately, "Rhode Island Innovates" calls on the state to embrace three growth initiatives: "Rhode Island Innovates," "Rhode Island Competes," and "Rhode Island Acts." The prioritization of these themes reflects, first, the central importance of strengthening the state's advanced industries, and second, the need to shore up the broad platform for growth on which all firms and industries rely.

Along these lines, Chapter 4 of the report asserts that a relatively short list of crosscutting sources of competitive advantage matters inordinately to Rhode Island's future.

In the foreground are three critical **competitiveness drivers** that lie at the center of any state's growth platform, especially when it comes to its advanced industry base. These drivers include the state's *innovation capacity*, or its ability to generate new products, services, processes, and ways of managing; its *quality of place*, or the unique set of physical and human qualities that define the state's locales and make them attractive; and its *talent and skills*, or the collective value of the knowledge, competencies, and know-how of its workforce. Supporting these competitiveness drivers are crosscutting **supporting**

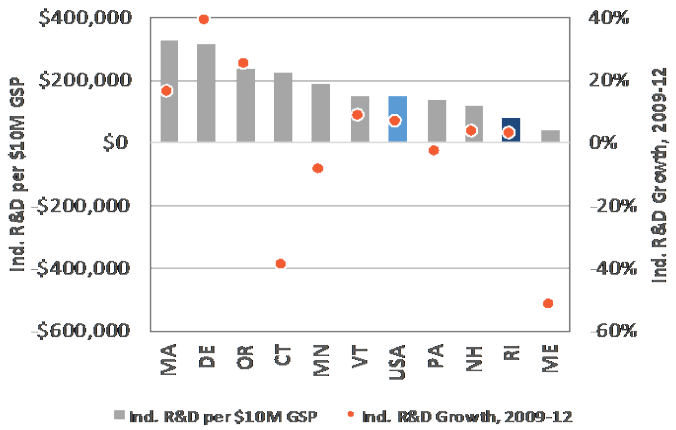
platforms, none more salient in Rhode Island than the state's *business environment* and its governance, especially its *business-led civic engagement*.

In keeping with that framework, a multi-state benchmarking of Rhode Island's capacity for economic growth across key platform dimensions yields a mixed picture of the state's growth capacity:

- On the key **drivers of advanced industry competitiveness:**
    - The state's **innovation capacity** is anchored by its solid university research base and the presence of the Naval Undersea Warfare Center (NUWC). However, these assets' impact is undercut by a paucity of industry-sponsored research and weak commercialization activities
    - The state's **quality of place** is alluring and increasingly well-known, and includes not just the shoreline and historic charm but distinctive cities and towns, vibrant food and art scenes, and an increasing "coolness factor." However, the innovation community remains atomized and lacks the focal points, collaboration spaces, and state-of-the-art "innovation districts" and neighborhoods that are needed to retain and attract talent
    - Although the **talent and skills** of Rhode Island's workforce are competitive, especially at higher levels of education, demographic and education/training system challenges raise questions about whether the state will be able to keep up with the rising demand for the skilled STEM/STEAM workers that drive advanced industry growth

Rhode Island lags the nation and peer states in industry research and development relative to the size of its economy

Industry R&D expenditures per $10 million of gross state product, 2012 and growth from 2009-2012



Source: National Science Foundation BRDIS, 2013

- On the **supporting platforms for growth:**
    - Recent tax and regulatory progress has begun to send positive signals about the state's **business environment** inside and outside the state but a heavy overhang of burdensome provisions continues to earn the state negative ratings on national assessments. At the same time, a shortage of large development ready land parcels and suboptimal rail service may be preventing Rhode Island from taking full advantage of regional growth opportunities

- Although the state's multiple small-scale business and civic organizations (and several strong chambers) reflects a degree of **business-led civic engagement** it is not paired with the presence of a central high-powered CEO organization that can mobilize money and organize at a decisive scale

Turning to strategy, Chapter 5 of the report concludes that the realities depicted in the situational analysis argue for the state to embrace a multi-dimensional set of linked initiatives and action steps aimed at systematically upgrading the state's growth platform. Specifically, the state and its business and civic partners should:

- **Launch a Rhode Island Innovates initiative** to invest in the state's innovation capacity, quality of place, and skilled workforce. This three-pronged initiative should:
  - Invest to spur technology innovation through: targeted faculty recruitment; grant support for proof-of-concept testing; a Rhode Island Global Innovation Challenge accelerator program; and a Rhode Island Entrepreneurs in Residence program that could attract and retain foreign entrepreneurs who would be enabled to set up and grow their companies in Rhode Island
  - Strengthen several innovation districts or neighborhoods around the state by developing several place-based industry-university-laboratory collaboration centers and engaging in strategic placemaking that will enhance their status as focal points for idea exchange and talent attraction and retention
  - Complement a strong statewide PK20 STEAM education and training agenda with RI Codes—a coding initiative to prepare more Rhode Islanders for careers in tech
- **Launch a Rhode Island Competes initiative to** upgrade the state's business environment. Key moves would:
  - "Plus up" the state's underperforming R&D tax credit; reform the unemployment insurance payroll tax; modernize the state's permitting regulations and processes; take Rhode Island's e-permitting initiative statewide; reform occupational licensing requirements; and reduce or eliminate the restrictions of the state's non-compete rules
  - Expand state-wide land-assembly and site-preparation
  - Improve Rhode Island's rail connections by targeting new subsidies and spearheading the development of a new app-based "Rhody Pass" ticket option
- **Launch a Rhode Island Acts initiative to increase the state's capacity for business-led civic engagement** by establishing a business-led Partnership for Rhode Island to facilitate strategic action among private-, civic-, and public-sector leaders

STRATEGIES AND ACTIONS FOR ADVANCING RHODE ISLAND'S ECONOMY

Rhode Island Innovates

Rhode Island Innovates

$ = Low cost: < $1m/yr	$$ = Moderate cost: $1 m - $5 m/yr	$$$ = High cost: $10m +/yr

Launch a multi-dimensional initiative to spur Rhode Island technology innovation

Recruit and support impact faculty at Rhode Island universities	$$$
Support proof-of-concept grants for new advanced-industry products	$
Prioritize matching funds for industry-university technology development	No budget implications
Support a Rhode Island Global Innovation Challenge	$$
Create a Rhode Island Entrepreneurs in Residence Program	$$

Strengthen several innovation districts or neighborhoods around the state by targeting them for place-based technology collaboration centers and strategic placemaking

Create one or two industry-university-laboratory tech collaboration centers	$$$
Offer priority access to collaborative innovation centers to a range of state innovation programs	No budget implications
Targeted Rhode Island Innovates! place-based tax incentives	$$
Incorporate placemaking into the planning of major innovation districts or neighborhoods	No budget implications
Bolster Main Street RI program to support enhanced placemaking	$$
Ensure state marketing targets young professionals and brands "hipness," especially with regard to food and design	No budget implications
Partner to deliver "pop-up" urbanism	$
Establish a state-level New Urban Mechanics (NUM) team	$

Complement a strong statewide STEAM education and training agenda with RI Codes—a coding initiative to prepare more Rhode Islanders for careers in tech

Designate a STEAM Champion	$
Roll out a large-scale statewide marketing campaign	$ - $$
Invest in ongoing, high-quality professional development by bringing UTeach to URI and/or Rhode Island College	$
Establish a STEAM Workforce Challenge grant program	$$
Scale up Wavemaker	$$
Provide free access to online learning platforms like Treehouse, Thinkful, or Bloc to teach coding skills	$$
Make short-term tech training available at CCRI	Negligible funding required (administrative support)
Expand LaunchCode's Partnership for Real IT Jobs to help firms create tech apprenticeships that lead to promising jobs	$
Create an RI Diversity Initiative to cultivate a more diverse tech workforce	$
Incorporate computer science into the P-12 curriculum	Negligible funding required
Encourage more students to sit for the Advanced Placement computer science exam	$

Rhode Island Competes

Continue improving the state's suboptimal tax and regulatory structures

"Plus up" Rhode Island's underperforming R&D tax credit by raising the cap on deductions and making the credit refundable	$$
Reform the unemployment insurance payroll tax by reducing its incidence on young firms	Revenue neutral
Create the nation's first-ever "A-Corp" corporate designation	$$
Modernize permitting regulations and processes to make it easier for businesses to start and grow	No budget implications

Take Rhode Island's e-permitting initiative statewide to cover all municipalities and permit types	$$
Reform occupational licensing requirements to make them competitive with neighboring and peer states	No budget implications
Reduce or eliminate restrictions of the state's non-compete agreements	No budget implications

Build on success to create a statewide land assembly and site management body

Assemble and prepare more pad-ready commercial-industrial building sites	$$$

Improve Rhode Island's rail connections to Boston and beyond to strengthen regional economic links

Target new rail subsidies and spearhead the development of a new app-based "Rhody Pass" ticket option	$$
Establish new express commuter rail service between Providence and Boston and expand intercity rail service	$$$
Drive new station improvements and transit hub developments, highlighted by a new Pawtucket/Central Falls commuter rail station	$$$

Rhode Island Acts

Develop a Partnership for Rhode Island

Establish a Partnership for Rhode Island to facilitate strategic action among private, civic, and public sector leaders	No budget implications
Create a small implementation unit to oversee implementation of the new strategy	$

* * *

A few final notes are in order: First, although no formal cost-benefit analysis has been carried out for "Rhode Island Innovates" given the difficulty of extrapolating **impacts and outcomes** for the sorts of recommendations advanced here, extremely conservative assessments suggest that implementation of these actions could appreciably accelerate output and job growth over time—perhaps enough to move the state up a quintile or more in the state growth rankings. In any event, the study team believes that the significant government, private, and philanthropic investments advanced here are justified by the need for urgent action at scale and, if implemented successfully, could energize the state.

Second, it should be stated that while each of the initiatives and action steps advanced here could add value in isolation, the array of items presented is intended as a comprehensive **package**. Significant economic literature suggests that the impact of the various actions will be multiplied by the kinds of synergies and spillovers that occur in dense local economies and between, especially, innovation, place, and talent dynamics.

Finally, it should be observed that while the report recommends significant state-government outlays, it more notably proposes a new degree of **partnership** across the public, private, civic, and philanthropic sectors. Quite simply, the nature and scale of the economic challenges facing Rhode Island—intensive global competition; an unreliable national government; persistent budgetary stress; and the need to invest continuously in innovation, quality places, and skills development—require a new kind of collaborative governance that brings together the private, public, and civic sectors. No one sector has the capacity or expertise to design, finance, execute, and sustain the kinds of initiatives with the potential to set the state onto a more prosperous trajectory. Instead, all sectors will need to engage in coordinated ways:

- **State government,** in partnership with the private sector, local intermediaries, and third-party experts, should lead on several initiatives including: innovation activities such as the design of competitions for the industry-university-laboratory tech collaboration centers; STEAM and coding initiatives; and business environment reforms related to tax, regulatory affairs, land development, and rail

- The **private sector** can lead and/or contribute on multiple fronts, including by helping provide resources for impact faculty and create a Global Innovation Challenge and Rhode Island Entrepreneurs in Residence Program; supporting STEAM and coding initiatives, several of which will be delivered by private intermediaries; and helping mobilize business community support for key initiatives

- **Philanthropy and the civic sector** should also lead and/or contribute on multiple fronts, including the recruitment and support of impact faculty; the support of placemaking activities and "pop-up urbanism"; and in the testing and scale-up of critical STEAM and coding initiatives

In short, "Rhode Island Innovates" envisions state government more as a catalyst and leader of co-developed problem-solving than as the sole owner of all actions. Granted, such co-development of bold solutions will be a challenge to an often-splintered state. However, in the end, the strategies and action

steps proposed here are challenging but warranted. Strong actions will be necessary to locate large new sources of growth in the state, just as they were when Moses Brown and Samuel Slater triggered the state's shift from farm to factory.

Certainly the task is large, but the fact remains that Rhode Island has done it before.

1. Introduction

Rhode Island has done it before.

When settlement period squabbles with expansionist Massachusetts and Connecticut limited development to subsistence farming in the 1600s, the colony's merchants worked out an imaginative—and highly remunerative—carrying trade on the high seas (albeit touched by slaving).

They innovated, transformed their drifting economy, and prospered.

When trade ebbed after the Revolution, the ingenuity and experimentation of Rhode Islanders prevailed again, and the state not only shifted into manufacturing but reinvented it at Slater Mill in Pawtucket.

There the English immigrant Samuel Slater, working for the venturesome merchant Moses Brown, applied the newest technology from Britain and in 1790 opened the first successful water-powered cotton-spinning factory in the United States, launching a new age of industrialization.

Rhode Islanders had again innovated, transformed their economy, and prospered.

In each case, the state prevailed through a combination of individual initiative, government supportiveness, and business-civic enterprise that leveraged the state's special advantages and know-how. The results were not just stopgaps but inventions through which the state placed itself in the midst of the most advanced economic dynamics of the time to build true prosperity based on creativity and making things.

Now the state needs to do it again.

After decades of drift, the Ocean State needs to transform itself once more by leveraging its assets, insights, and ingenuity (and yes, it's "hipness factor" and beautiful rocky coastline) to avoid substantial decline.

The moment is urgent. Ever since the Great Recession exposed deeper-set erosion beneath the collapse of a sizable real estate bubble, Rhode Island has struggled to regain its economic footing, at a time of technological disruption and "winner-take-all" markets. The state's traded sectors—its most critical sources of prosperity—have been losing jobs since the 1970s and are only now stabilizing, much reduced. Employment growth is tepid and incomes are stagnating. A significant skills-building task has become urgent as a younger more diverse population clamors for connection and more relevant training. And meanwhile, poverty and economic disparities have increased, with the median income of black households now standing at less than 60 percent that of white families and that of Hispanic households at just 50 percent. Too few Rhode Islanders are sufficiently linked to the state's too-limited opportunity areas. Too many are seeing their standard of living erode.

Compounding the urgency of the moment is a crisis of confidence borne of passive leadership over several decades and several public corruption scandals, Rhode Islanders have become a skeptical lot.

Which is to say, a small state in a large nation in a fiercely competitive world is facing an existential choice about its future. Are the state's business, civic, university, and government leaders prepared to think deeply and act decisively as their colonial predecessors did in order to master a moment of profound uncertainty with innovation and ingenuity? Or do they prefer to proceed through steady routines and business-as-usual merely to make the best of decline?

In any event, a community the size of Rhode Island does not get a pass. The state is on its own and will thrive and prosper only if parochial concerns are put aside and fragmentation—across jurisdictions, across sectors, across demographic groups—is overcome. Other states—like Colorado, Tennessee, and yes, Massachusetts, are making their moves to build advanced and opportunity industry-driven prosperity. What will Rhode Island do?

Fortunately, the moment is propitious for such a decisive renewal. The national economic backdrop is at last generally positive. An uptick in state revenues has modestly improved the budget outlook as has a refinancing of state debt. And for that matter new leadership in key quarters has created a plausible moment for a serious reassessment of the state's economic positioning and route toward improved performance.

Most notably, the administration of Gov. Gina Raimondo—focused on sparking a Rhode Island comeback—has been working closely with the General Assembly to reform the past reactive practice of economic development and promote more higher-quality growth in foundational innovation and professional services sectors.

Specifically, Raimondo has been alert to the fact that state and regional prosperity flows directly from regional strengths in what the Brookings Institution's Metropolitan Policy Program calls "advanced industries"—high-value innovation- and skills-intensive industries like biotech and pharma, IT and software, shipbuilding, food and precision manufacturing, and company management that are the prime movers of regional and state prosperity in the United States.[1]

And so the state has begun to respond to the current juncture.

In 2014, the General Assembly recognized the need to better coordinate the state's economic development activities and established the new Executive Office of Commerce to coordinate economic development, workforce, business regulation, and housing functions, with a focus on growth.

Then, last summer, the Assembly passed and Gov. Raimondo signed a 2015–2016 budget equipped with a number of new incentive programs aimed at spurring growth, including in high-value advanced industry clusters. Though relatively cautious in nature and scale, the programs represent an important initial effort to begin reorienting a drifting economy.

And yet, to go further and intervene more decisively, the state needs to know more about itself: about the current state of its economy; its industries and their competitiveness; the supportive assets it has

and does not. In short, what Rhode Island needs in order to proceed more decisively is a fact-based, third-party analysis of the state's competitive position and potential economic development opportunities to serve as a basis for strategy development.

Which is why in spring 2015 Gov. Raimondo invited the Metro Program at Brookings along with its analytic partners the Battelle Technology Partnership Practice (now TEConomy Partners, LLC) and in collaboration with Monitor Deloitte, Deloitte Consulting LLP to provide a detailed economic assessment and actionable recommendations for the state's economic development planning, with an emphasis on growing the state's advanced industries.

To that end, Brookings and its partners—supported by a number of Rhode Island philanthropies and private individuals with ties to Rhode Island—engaged in an intense six-month inquiry that sought to:

- Distill the economic challenges the state faces
- Identify the state's best opportunities for industry expansion and high-value economic growth
- Assess the strengths and weaknesses of the state's growth platform
- Provide an action plan for realizing the state's economic opportunities

Throughout the inquiry the study team engaged in:

- An extensive literature review to synthesize the best existing work, avoid duplication, and identify knowledge gaps
- Fresh economic analysis
- Structured in-state consultation with key private- and public-sector stakeholders to inform empirical and strategy development work
- Substantial best-practice and policy research

Out of this process has emerged a detailed, often blunt, but cautiously optimistic assessment of the state's present situation and prospects.

Along these lines, the report that follows assembles several strands of research into a single starting point for strategy development.

Chapter 2 analyzes Rhode Island's current economic predicament and concludes that massive manufacturing job losses in the state's critical advanced industries sector have not nearly been offset by recent growth in newer high-tech services such as computer systems design. The section insists that the state will not secure broad-based, inclusive growth without catalyzing faster growth in these industries and related follow-on industries.

Chapter 3, “Industry Growth Areas for Rhode Island,” systematically assesses the state’s 33 detailed industry clusters, their strengths, and their relationships to each other in order to identify the state’s best growth opportunities. The analysis drills down on the clusters, assesses the degree to which they align with unique state competencies, and considers whether they participate in growing industries with bright futures. Ultimately the analysis identifies five advanced industry priority growth areas and two additional “opportunity industries” that are generating significant numbers of accessible good jobs. These seven growth areas represent the state’s best potential sources of high-quality future growth.

Following that, Chapter 4 assesses the strengths and weaknesses of the state’s asset base focusing on the most critical elements of a crosscutting growth platform. While the benchmarking against peer and competitor states identifies genuine strengths, particularly in the state’s quality of place, much work will be needed if the state hopes to build a competitive basis for growth.

Finally, Chapter 5 advances an ambitious but achievable set of initiatives and action steps for public-, private-, and civic-sector collaboration aimed at remediating the weaknesses of the state’s growth platform and better leveraging its strengths.

In the end, the strategies and action steps proposed here are challenging but warranted. Strong actions will be necessary to locate large new sources of growth in the state, just as they were when Rhode Island's early entrepreneurs threw themselves into global trade, or when Moses Brown and Samuel Slater triggered the state's shift from farm to factory.

Certainly the task is large, but the fact remains that Rhode Island has done it before.

2. Rhode Island's Economic Challenge

Rhode Island embarks on the next phase of its economic history with a strategic geographic location and an abundance of assets. The state lies at the center of a 3-million-person megalopolis—the country's densest—stretching from Portland, ME, to metropolitan New York with a combined economic output of $2.1 trillion and a combined innovation output of 16,000 patents every year.[2] Home to premier academic and research institutions in the culinary arts and food manufacturing, data sciences, design, the humanities, mathematics, oceanography, psychology, and even undersea warfare, Rhode Island's portfolio of knowledge assets is unique and diversified. With 400 miles of coastline and a network of towns and cities rich in charm and cultural heritage, Rhode Island remains an attractive place to live.

And yet despite these strong fundamentals, the state's economy has underperformed in recent years relative to its neighbors and to the nation as a whole. Currently, Rhode Island appears to be an economy adrift without growth drivers strong enough to advance its economic development. Three major findings bear notice:

- Rhode Island's economy has lost growth capacity and is now a middling performer
- Rhode Island's advanced industries base shrunk
- Without distinctive new growth drivers the state's economy will remain adrift

Together these findings depict a state in need of a new growth strategy.

Rhode Island's economy has lost growth capacity and is now a middling performer

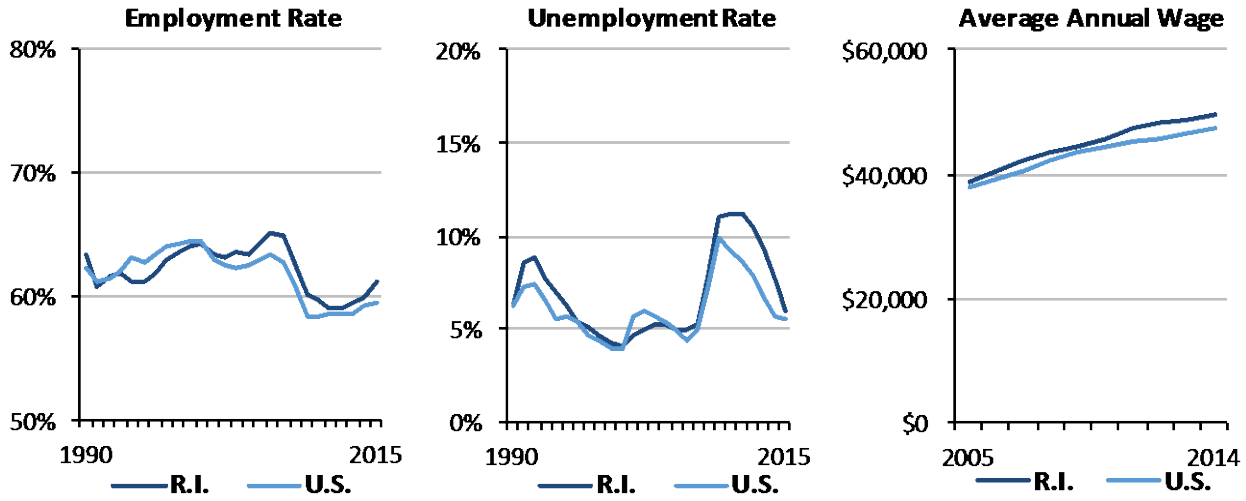
Rhode Islanders are currently in a dour mood about their state economy, due in large part to the state's slow recovery from the Great Recession.

Rhode Island slogged through the most severe recession of any New England state between 2007 and 2010 and has continued to lag the region on certain measures of labor market health. Most notably, the state saw its unemployment level spike higher and decline more slowly than in every other New England state. Today Rhode Island's highest-in-the-region unemployment rate of 5.4 percent significantly exceeds the state's pre-recession low of 4.8 percent.[3] Rhode Island is still over 10,000 jobs short of its pre-recession employment levels and has had one of the largest increases in income inequality—as measured by the state's Gini coefficient—among U.S. states post-recession.

Even still, Rhode Island's economic condition is less dire than middling as it struggles to reclaim growth.

In the early 2000s, Rhode Island's economy was a leader in New England and enjoyed relatively strong performance across economic measures relative to the United States. Annual job growth between 2000 and 2006 led the region and over the same time period the state enjoyed annual GDP growth nearly double that of Massachusetts.[4] Average wage growth generally tracked the United States through the 1990s and even pre- and post-recession, and at times the unemployment rate was lower in the Ocean State than in the United States as a whole.

In recent decades Rhode Island's labor market has performed well enough compared to the United States



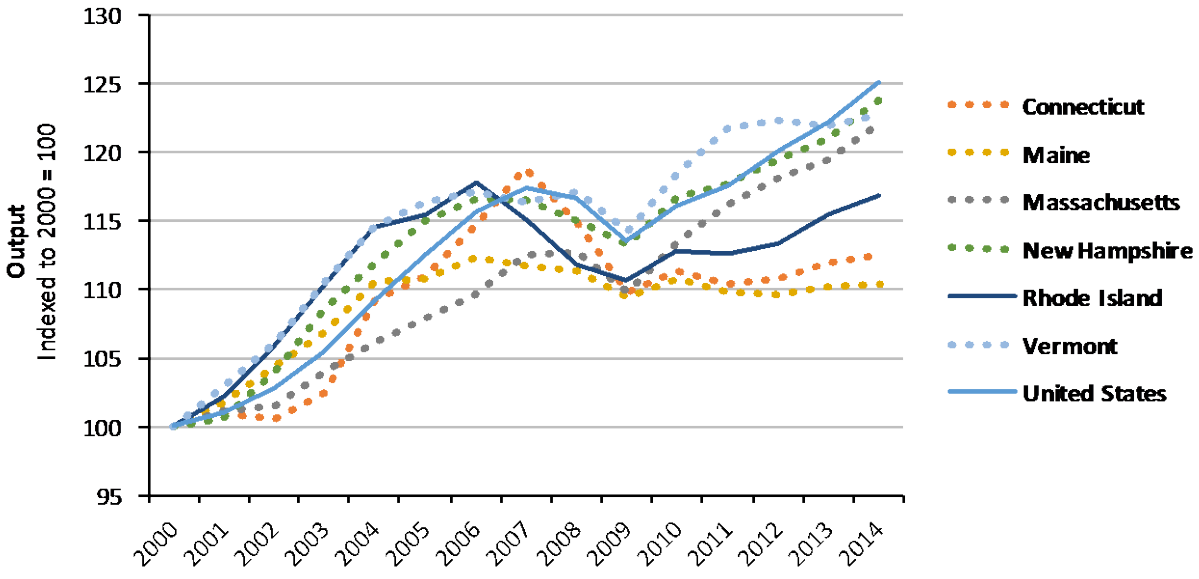
Source: Brookings-Battelle analysis of Moody's Analytics data

That said, trend data for the last decade suggests a fundamental problem: The state's growth capacity has deteriorated.

Part of that impression owes to the fact that no state in New England saw per-capita mortgage debt increase more between 2002 and 2006, which made Rhode Island's economy slow more precipitously than others once the economic crisis began. [5]

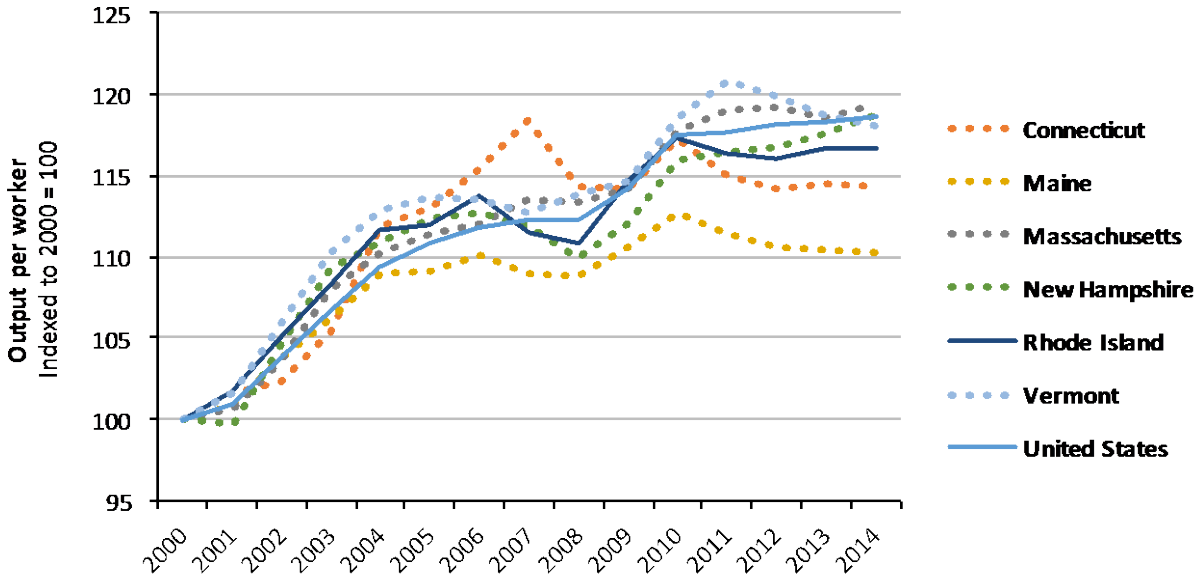
But beyond that, the economic reset of the recession has seen Rhode Island go from the front to the middle of the pack on a variety of key performance measures. Its output and job growth now tend to lag the nation's. Average compensation for Rhode Island workers used to grow faster than the national trend; now it too lags.[6] Within New England, the state has slipped from leadership on productivity growth, output, and employment gains in the early 2000s to middling status since 2010, after a recession that started earlier and lasted longer than in peer states. Prior to the recession, the economies of New England states largely moved together. Coming out of the recession, performance has diverged, with Massachusetts and New Hampshire pulling away, Connecticut and Maine falling behind, and Rhode Island drifting in between.

Output growth in Rhode Island has lagged the nation, Massachusetts, New Hampshire, and Vermont since the reset of the Great Recession



Source: Brookings-Battelle analysis of Moody's Analytics data

Output per worker in Rhode Island has fallen behind some New England peers



Source: Brookings-Battelle analysis of Moody's Analytics data.

Rhode Island's advanced industry employment base has shrunk

Beneath the headline story of recent drift lies a deeper structural change in the industrial composition of the state economy. Most notably, the state's critical advanced industry base—anchored by a longstanding manufacturing sector—has lost both size and traction.

Advanced industries as defined by the Brookings Institution are a group of 50 individual industries that conduct large amounts of R&D and employ a disproportionate share of STEM workers.[7] Given their orientation towards innovation, technology application, and exports, these industries anchor the U.S. economy and its constellation of regional economies by supporting long supply chains, driving productivity growth, generating knowledge spillovers, and paying higher wages. Ultimately their success is a prerequisite for broadly shared prosperity—in metropolitan areas, in states, and across nations.

Unfortunately, Rhode Island's advanced industry base has been eroding in recent decades. Total advanced industry employment dwindled at a faster rate in Rhode Island than in any other state from 1980 to 2013, as it slid from 18 percent of employment (74,700 positions) in 1980 to just 8 percent (37,800 positions) in 2013.[8] Factoring in total direct and indirect jobs, Rhode Island's advanced sector has shrunk from 134,500 jobs in 1980 to 68,600 jobs in 2013. Especially hard hit were the state's advanced manufacturing industries.

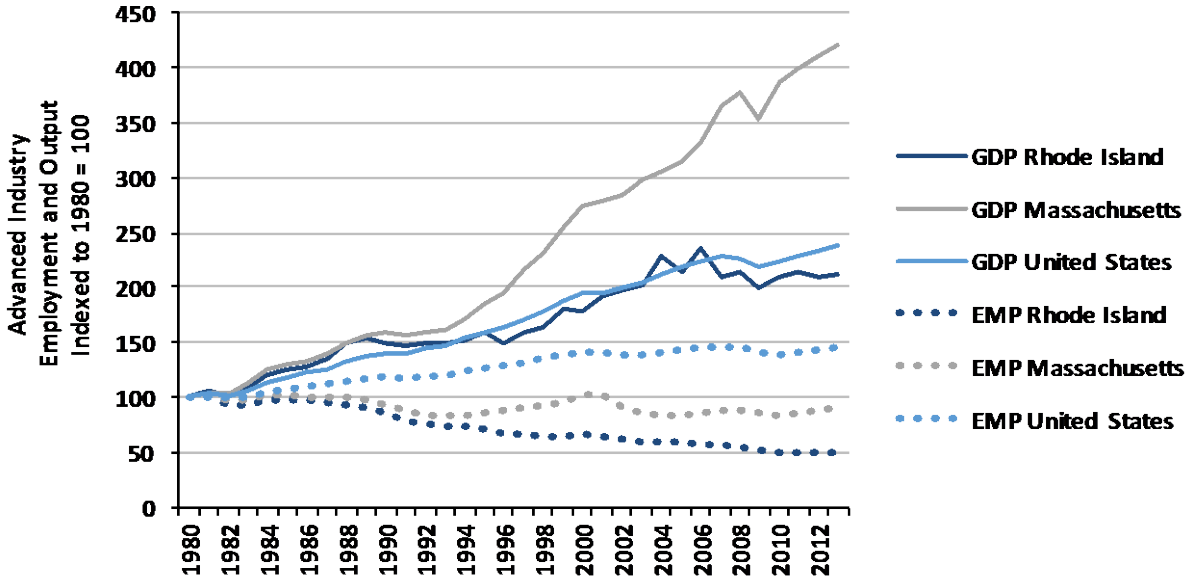
Rhode Island has lost more than half of its advanced industries employment since 1980

State	Advanced industries employment share 1980	Advanced industries employment share 2013	Advanced industries GDP share 1980	Advanced industries GDP share 2013
Connecticut	18%	10%	15%	15%
Maine	7%	6%	7%	9%
Massachusetts	16%	11%	10%	21%
New Hampshire	17%	9%	10%	15%
Rhode Island	**18%**	**8%**	**10%**	**11%**
Vermont	20%	8%	8%	13%

Nationally, by contrast, employment in the overall advanced sector increased slightly between 1980 and 2013, while in Rhode Island it fell by half. Output growth in Rhode Island has been sluggish and has come exclusively in the state's advanced services—a sector that has grown substantially since 1980 and has somewhat offset the decline of a once-strong manufacturing base. By contrast, high-tech and advanced-services-heavy Massachusetts suffered a sharp contraction in advanced industries employment in the years around 1990 but pulled out of decline shortly thereafter and has seen the sector's employment growth track national trends ever since, while its advanced industry output has

quadrupled over the same period. While large and vibrant advanced industries drive prosperity, Rhode Island's sector lacks size and traction and has been in decline, in large part because of its orientation to manufacturing industries that have lost ground.

Stagnant advanced industries output growth (GDP) exacerbated job losses (EMP) in Rhode Island



Source: Brookings-Battelle analysis of Moody's Analytics data

That said, the state's advanced industry problem is not monolithic and the sector even has bright spots. Most notably, the weak performance of Rhode Island's advanced manufacturing contrasts sharply with strong recent performance in advanced services industries. Growth in high-value services outside of Brookings advanced industries definition, including management of companies, finance, and insurance, further offset Rhode Island's decline in advanced manufacturing while partially masking the structural economic change occurring in the state.

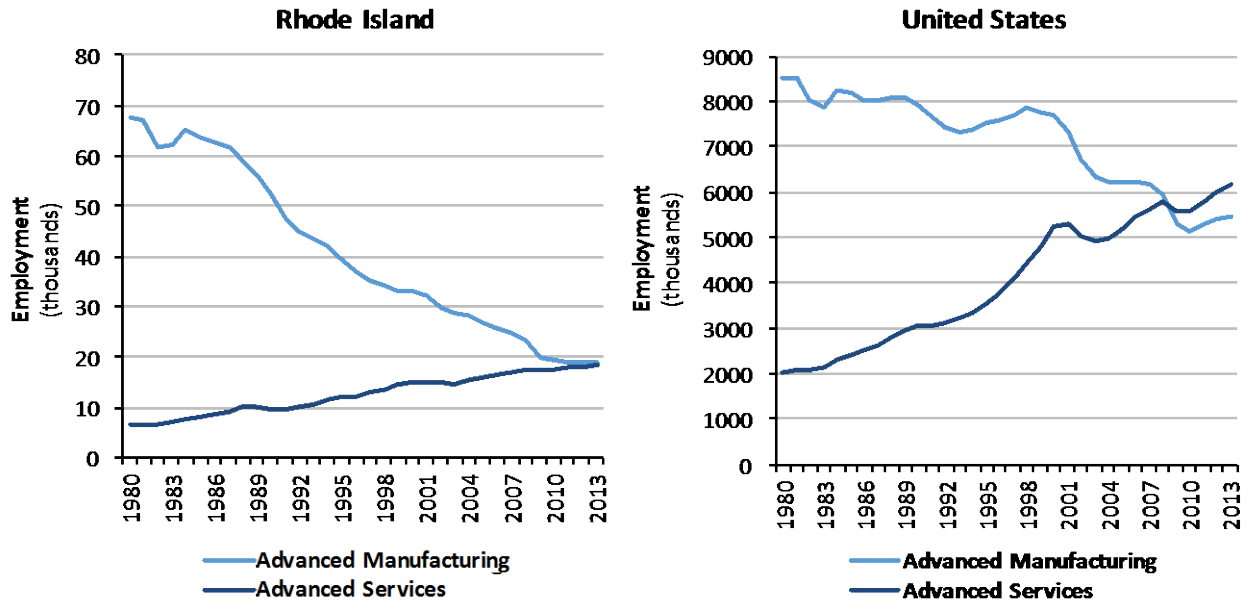
Rhode Island possesses a diverse advanced industries sector

NAICS	Industry Title	Output (Mil. U.S. 2005)		CAGR		Employment		CAGR	
		1980	2014	1980–2014	2010–2014	1980	2014	1980–2014	2010–2014
	Advanced Manufacturing								
3241	Petroleum & Coal Products	29.4	18.6	-1.3%	-2.4%	640	32	-8.2%	0.0%
3251	Basic Chemicals	47.0	26.2	-1.7%	0.4%	503	127	-3.9%	-1.9%
3252	Resins & Synthetic Rubbers	20.7	65.7	3.4%	19.7%	554	360	-1.2%	17.2%
3253	Pesticides & Fertilizers	1.8	2.7	1.1%	3.9%	53	16	-3.4%	2.7%
3254	Pharmaceuticals	15.3	374.6	9.6%	4.7%	298	1,434	4.6%	1.6%
3259	Misc. Chemicals	44.4	116.6	2.8%	0.8%	1,284	790	-1.4%	-0.8%
3271	Clay & Refractory Products	2.0	0.9	-2.3%	-0.5%	40	11	-3.6%	1.9%
3279	Stone & Mineral Products	11.6	21.6	1.8%	5.3%	223	250	0.3%	6.4%
3311	Iron & Steel Products	5.0	42.5	6.3%	-5.4%	139	277	2.0%	2.4%
3313	Aluminum Products	42.3	33.7	-0.6%	-6.5%	1,276	286	-4.2%	2.3%
3315	Foundries	22.4	21.2	-0.2%	-7.8%	842	212	-3.9%	0.9%
3331	Agri., Constr., Mining Machinery	0.6	2.3	3.7%	3.7%	20	20	0.0%	2.1%
3332	Industrial Machinery	27.9	29.2	0.1%	4.3%	683	243	-2.9%	2.4%
3333	Commer. & Service Machinery	3.3	8.2	2.6%	2.3%	84	74	-0.4%	1.1%
3336	Engine & Power Equipment	74.1	82.1	0.3%	3.9%	2,018	672	-3.1%	1.8%
3339	General Purpose Machinery	10.6	14.3	0.9%	3.9%	299	136	-2.2%	1.9%
3341	Computer Equipment	1.1	19.6	8.4%	5.5%	250	83	-3.1%	-2.7%
3342	Communications Equipment	2.9	41.4	7.9%	9.9%	611	255	-2.5%	0.6%
3343	Audio & Video Equipment	0.1	1.0	7.6%	5.1%	23	8	-3.0%	-2.3%
3344	Semiconductors	11.0	64.8	5.2%	6.1%	2,970	448	-5.3%	-2.4%
3345	Precision Instruments	31.7	360.2	7.2%	5.2%	6,749	2,474	-2.8%	-2.6%
3346	Magnetic & Optical Media	0.4	7.5	8.7%	6.7%	88	49	-1.7%	-3.0%
3351	Electrical Lighting Equipment	36.5	37.7	0.1%	11.6%	893	240	-3.7%	1.9%
3352	Household Appliances	10.3	13.3	0.7%	12.7%	269	80	-3.4%	1.8%
3353	Electrical Equipment	7.8	4.6	-1.5%	12.5%	183	24	-5.6%	1.8%
3359	Misc. Electrical Equipment	161.4	151.5	-0.2%	8.6%	3,960	876	-4.2%	-0.9%
3361	Motor Vehicles	8.1	4.3	-1.8%	4.7%	203	53	-3.8%	6.9%
3362	Motor Vehicle Body & Trailers	2.2	4.1	1.8%	6.6%	93	90	-0.1%	10.4%
3363	Motor Vehicle Parts	28.1	1.6	-7.8%	-5.1%	795	29	-9.0%	-3.1%
3364	Aircraft Products & Parts	1.9	4.8	2.6%	5.6%	47	40	-0.5%	6.6%
3365	Railroad Rolling Stock	15.0	37.2	2.6%	6.0%	504	418	-0.5%	6.7%
3366	Ships & Boats	143.9	294.7	2.1%	5.6%	4,861	3,802	-0.7%	6.9%
3369	Misc. Transportation Equipment	0.0	0.0	0.2%	4.0%	-	-	N/A	N/A
3391	Medical Equipment & Supplies	82.3	193.5	2.5%	-3.0%	2,817	1,412	-2.0%	-0.7%
3399	Jewelry, Sporting Goods	747.4	434.6	-1.5%	-6.1%	32,980	4,214	-5.7%	-4.1%
	Advanced Manufacturing Total	**1650.7**	**2536.9**	**1.2%**	**1.6%**	**67,252**	**19,535**	**-3.5%**	**0.3%**
	Advanced Energy								
2111	Oil & Gas Extraction	0.0	1.2	N/A	64.9%	-	-	N/A	N/A
2122	Metal Ore Mining	0.0	0.0	-0.6%	1.0%	-	-	N/A	N/A
2211	Power Generation & Supply	359.4	366.3	0.1%	-3.3%	902	606	-1.1%	0.6%
	Advanced Energy Total	**359.4**	**367.5**	**0.1%**	**-3.2%**	**902**	**606**	**-1.1%**	**0.6%**

NAICS	Industry Title	Output (Mil. U.S. 2005)		CAGR		Employment		CAGR	
		1980	2014	1980–2014	2010–2014	1980	2014	1980–2014	2010–2014
	Advanced Services								
5112	Software Products	25.1	305.1	7.4%	3.8%	308	945	3.3%	2.0%
5152	Cable & Other Programming	0.7	1.9	2.9%	-10.1%	13	3	-4.1%	-19.7%
5172	Wireless Telecom Carriers	8.9	235.6	9.8%	15.5%	88	431	4.6%	5.7%
5174	Satellite Telecommunications	0.2	2.0	6.8%	10.8%	3	3	0.0%	0.0%
5179	Other Telecommunications	40.0	268.5	5.6%	8.8%	402	438	0.2%	1.5%
5182	Data Processing & Hosting	20.0	298.1	8.0%	-5.1%	872	2,541	3.1%	-2.7%
5191	News & Media	6.1	33.6	5.0%	-2.0%	457	588	0.7%	1.9%
5413	Architecture & Engineering	156.6	432.1	2.9%	-0.5%	1,765	3,631	2.1%	0.2%
5415	Computer Systems Design	117.9	871.1	5.9%	2.9%	970	6,067	5.4%	3.5%
5416	Management Consulting	47.2	301.3	5.4%	3.6%	446	2,428	5.0%	5.0%
5417	R&D Services	36.8	145.9	4.0%	7.0%	404	892	2.3%	6.1%
6215	Med. & Diagnostic Laboratories	50.4	81.9	1.4%	-1.1%	743	988	0.8%	-0.8%
	Advanced Services Total	**509.9**	**2977.2**	**5.2%**	**2.6%**	**6,471**	**18,955**	**3.1%**	**1.8%**
	Advanced Industries Total	**2519.9**	**5881.7**	**2.5%**	**1.8%**	**74,625**	**39,096**	**-1.8%**	**1.0%**

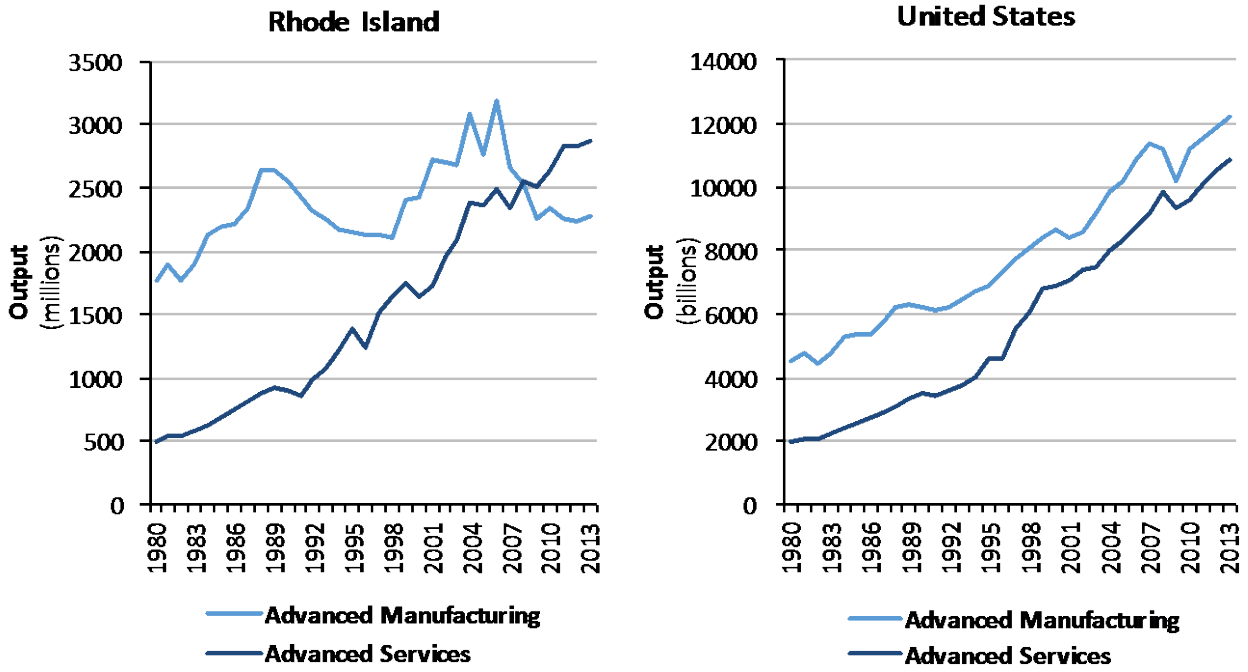
Rhode Island's manufacturing story is familiar. Catastrophic losses in the manufacturing sector decimated the state's higher-value growth engine and prompted the loss of nearly 50,000 advanced manufacturing jobs since 1980. These losses reflect the state's heavy involvement in manufacturing goods that have proved susceptible to competition from Chinese imports, namely jewelry, toys, and textiles.[9] While these industries were technically advanced, they tend to be relatively labor-intensive and low value-add—and thus susceptible to offshoring. As a result, the state has seen some of the worst manufacturing losses in the region and the crack-up of a crucial legacy source of productivity. While advanced manufacturing employment declined sharply, employment in advanced services—industries such as computer systems design, software, Internet publishing, management consulting, and scientific R&D—has been increasing. High-value services like these have added nearly 12,000 jobs in Rhode Island since 1980. In fact, the number of Rhode Islanders employed in such activities has risen almost every year and withstood the Great Recession with only a small decline in employment from 2009 to 2010. However, although many of these industries have been growing since 2010, the rise in advanced services employment has not been large enough or fast enough to offset the severe loss of advanced manufacturing jobs. Meanwhile, the national rate of growth in advanced services jobs has proven more than sufficient to offset the jobs shed by the nation's increasingly efficient advanced manufacturing sector.

Rhode Island's advanced manufacturing industries have shed jobs relentlessly for decades; the state's advanced services sector remains too small to compensate



Source: Brookings-Battelle analysis of Moody's Analytics data

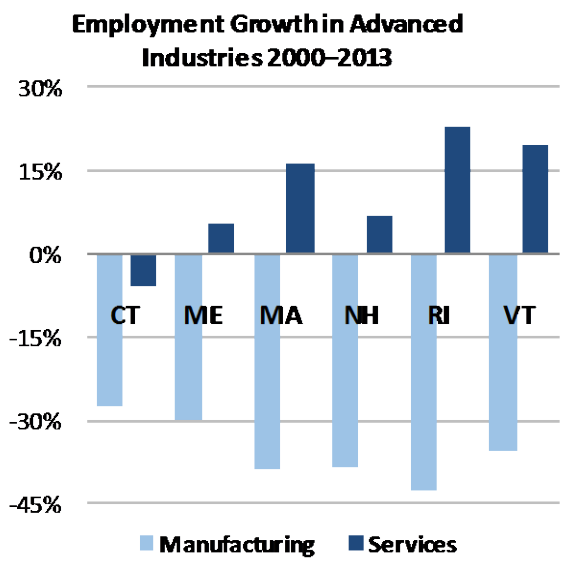
Rhode Island's advanced services industries have matched national output growth, but the productivity of the state's advanced manufacturing industries have declined

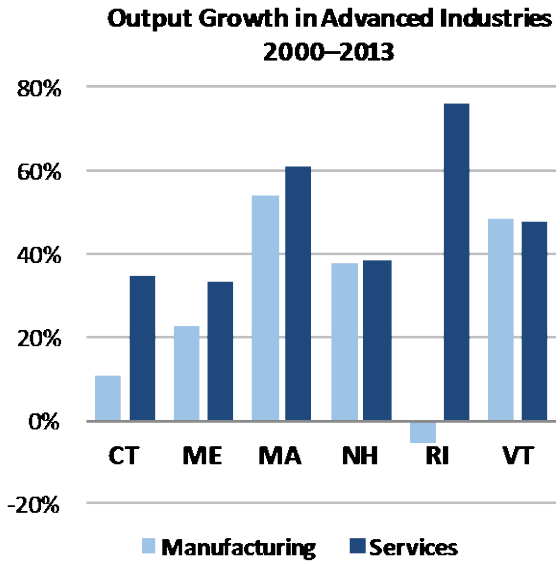


Source: Brookings-Battelle analysis of Moody's Analytics data

Output measures confirm the story. While Rhode Island manufacturing output growth has been negative since 2000, the state's advanced services have performed well and matched the rate of national growth (albeit from a small base). Rhode Island also boasted the highest advanced services output and employment growth in New England from 2000 to 2013. Add in recent output and employment growth in other high-value business services and a valuable emerging growth center can be identified.

Rhode Island's advanced industries have performed well in recent years



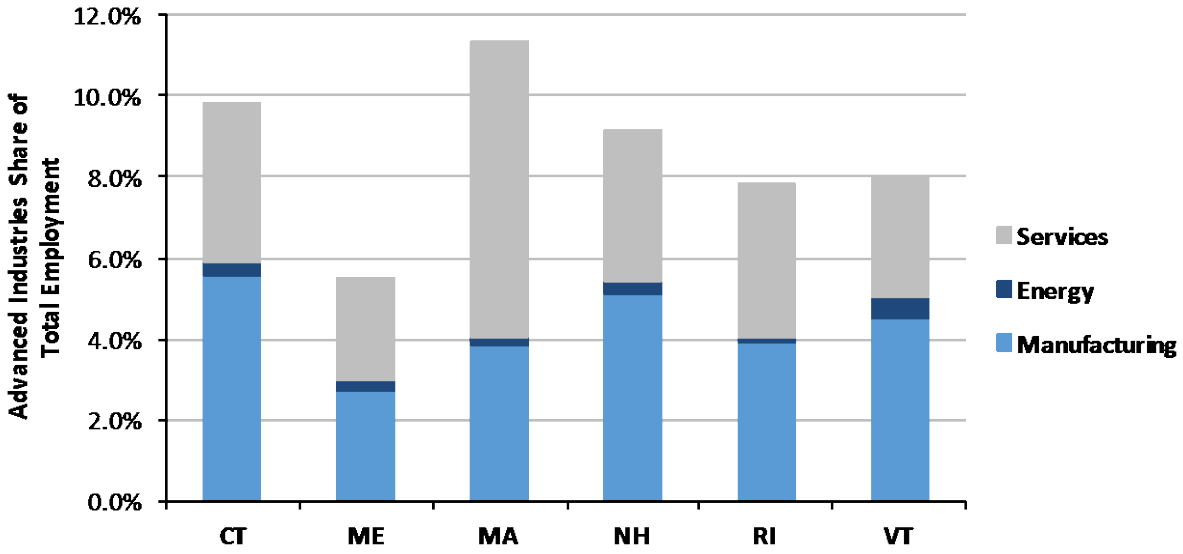


Source: Brookings-Battelle analysis of Moody's Analytics data

That said, the present-day situation is not advantageous. Rhode Island has combined best-in-region growth in advanced services (from a small base) with worst-in-region growth in advanced manufacturing (from a larger base). Advanced services output grew nearly five-fold from 1980 to 2013 in Rhode Island, outpacing even the national growth rate. By contrast, the state's ailing advanced manufacturing sector generated only 25 percent more output in 2013 than it did in 1980, while at the national level advanced manufacturing increased its output by 172 percent during that same period. While the state's advanced services are growing, they are not sizable enough to offset substantial losses from the state's relatively low-end advanced manufacturing enterprise, which needs to move into higher-value, higher-tech production niches.

As a result, critical advanced industries today generate a smaller portion of Rhode Island's GDP and represent a smaller share of its employment than the national average and any other New England state except Maine.

Rhode Island's advanced industries sector remains undersized relative to peers



Source: Brookings-Battelle analysis of Moody's Analytics data.

Without distinctive new growth drivers, Rhode Island's economy will remain adrift

Ultimately, the collapse of the state's legacy advanced industries combined with the too-slow emergence of new ones has left the state without a growth engine.

Although nominally advanced, several of Rhode Island's traditional specializations in industries such as jewelry, toy, and textile manufacturing have more closely resembled labor-intensive commodity manufacturing vulnerable to offshoring and low-cost imports than high-tech, high value-added advanced manufacturing.[10] Of the 12 advanced industries that employed more than 500 people and were specialized in Rhode Island in 2000—the state's key growth drivers—only ship- and boat-building and data processing and hosting increased output and added a sizable number of jobs over the 14 years to 2014.[11]

At the same time, while high-tech advanced services emerged over the decade, other high-end services exhibiting strong growth, including insurance, securities, and company headquarters and management, have generated minimal innovation activity. That lack of innovation takes away some of their potential to drive true, differentiating competitive advantage for the state. The industries that comprise sectors like arts, education, and tourism face a similar challenge. The potential for these industries to drive steady, meaningful growth is limited because these industries tend to follow the business cycle rather than drive it.

All of which stages Rhode Island's economic challenge. Erosion of the state's advanced industry base and the failure to nurture new advanced industries has left the state adrift. As a result, Rhode Island needs to build more resilient, future-oriented industry specializations to secure prosperity for the next generation.

Neighboring states Massachusetts and New Hampshire show the way forward. These states enjoyed successful transitions from legacy industries to knowledge- and innovation-based industries. As a result, Massachusetts has 4.8 percent more jobs today than it did at its 2008 pre-recession peak and New Hampshire witnessed a 10.1 percent jump in per-capita income since its per-capita income nadir in 2010.[12]

Rhode Island, meanwhile, remains 2.1 percent below its pre-recession employment peak and only 7 percent ahead of its per-capita income trough. The consequences of these trends can be seen in the long-term divergence of living standards between Rhode Island and its neighbors. In 1980, per capita personal income in Rhode Island was 98 percent of that in New Hampshire, 92 percent of that in Massachusetts, and 80 percent of that in Connecticut; by 2013, Rhode Island incomes had slumped to 91 percent, 82 percent, and 74 percent, respectively.[13]

Rhode Island is beginning to see the consequences of losing its advanced industries base. Having lost traction in many of its highest-value export industries, it has lost the economic driver that produced jobs and business activity across the rest of the economy.

3. Industry Growth Areas for Rhode Island

Rhode Island needs to identify and nurture new sources of high-value economic growth in order to counter the erosion of its legacy industries.

Only such a strategy will let the state build the resilient industry specializations that can secure prosperity for all. Without such an intervention Rhode Island will continue to see its standard of living deteriorate.

This chapter identifies and describes a set of leading opportunities for near-, medium-, and long-term industry development in Rhode Island. Such industry opportunities represent the state's best prospects for fostering new drivers of economic growth.

Which is not to say that the chapter is about picking corporate winners and losers. Rather, the pages that follow focus on identifying industry clusters and groups of clusters that have significant and quantifiable growth momentum and promise in Rhode Island by dint of their documented industry strengths, local assets and capacities, and alignment with growing market opportunities. The section highlights key areas of economic activity that build on core competencies and special capabilities present in the state; offer a highly promising trajectory in the foreseeable future; and can generate greater prosperity for Rhode Island. In this sense, the section is not speculative or anecdotal but rather describes the results of an objective and systematic process of industry identification.

Competencies Matter

Best practice in economic development has long recognized that economic success depends upon identifying how a state's industries can be differentiated based on technical know-how, workforce skills, entrepreneurial development and other assets in order to gain competitive advantage. As Michael Best explains in *The New Competitive Advantage,* state and regional economies:

> *"…can be thought of as developing specialized and distinctive technology capabilities, which give them unique global market opportunities. The successful pursuit of these market opportunities in turn reinforces and advances their unique regional technological capabilities. Regional specialization results from cumulative technological capability development and the unique combinations and patterns of intra- and inter-firm dynamics that underlie enterprise and regional specialization."*

This chapter reports that:

- An analytics- and consultation-intensive process was employed to identify growth opportunities among the state's industry clusters
- Each step of the three-step analysis furnished significant intelligence on the size, nature, and prospects of Rhode Island's web of potential growth opportunities
- Five advanced industry growth areas for Rhode Island (along with two opportunity areas that provide significant numbers of jobs that pay well) emerged from the process
- The industries that comprise the state's growth opportunities are not even distributed across the state but cluster in different combinations across the state's counties

An analytics- and consultation-intensive process was employed to identify growth opportunities among Rhode Island's industry clusters

Not all industries have the same ability to advance economic prosperity. Typically, economic development professionals distinguish between traded industries, which serve customers and markets outside the state, and non-traded industries, which serve local customer needs within the state.

Recent economic circumstances have thrown into relief what matters for economic development. There is a growing recognition that the ability of traded industries to raise U.S. standards of living derives from their capacity to apply technological and business-model innovation to drive growth. This perspective reflects the emergence of a hyper-competitive, knowledge-based world economy characterized by increased globalization of industries, rapid technology change, and the growing economic strength of developing nations. Innovation is without doubt the central driver of growth in today's economy.

Numerous studies affirm the role that innovation plays in fostering economic growth and increasing standards of living. In 2005, a report from the National Academies entitled *Rising Above the Gathering Storm* reported that approximately half of U.S. economic growth since World War II was the result of innovation.[14] Other studies have found that 90 percent of the variation in worker income growth across nations is due to how effectively human and physical capital are used as measured by productivity gains (a surrogate measure of the impact of innovation).[15] The Congressional Budget Office estimates that nearly half of U.S. projected growth in the 2014–2024 period will be due to rising productivity from innovation.[16]

There is not a standard set of traded industries that drive state and regional economies, so each state and region needs to evaluate its growth opportunities across its traded industries and innovation activities. The steps taken to assess Rhode Island's situation are set out below.

Battelle adhered to a three-part analytic process when identifying growth opportunities in Rhode Island. The methodology deployed by Battelle applies a proven set of analytical tools to identify a focused portfolio of industry clusters that maximize opportunities for economic development and employment growth in Rhode Island. The methodology is designed to identify areas of existing and expanding strength that align with the state's core competencies and have a line-of-sight to significant future market opportunities and, by extension, sustained employment growth. Rather than simply picking "hot" areas in the domestic or global economy for Rhode Island to try to attract, this approach examines Rhode Island's existing industries and their performance and compares it against national and regional benchmarks. It also calls attention to core competencies in the state's R&D base and elsewhere that can support high performance clusters and drive ongoing innovation-based growth.

Several terms used in the analysis merit definition:

- **Industry clusters**—Industry clusters are geographic concentrations of interconnected businesses, suppliers, service providers, coordinating intermediaries, and associated institutions like universities or community colleges in a particular field (e.g., information technology in Seattle, aircraft in Wichita, or advanced materials in Northeast Ohio). The identification of industry clusters is an intermediate step on the path to identifying Rhode Island's economic growth areas. Using sophisticated clustering algorithms and industry-targeting analysis tools, this analysis identifies groups of industries in Rhode Island that are performing well in terms of growth and market share. (See appendix B for more on the variables used to assess Rhode Island's industry clusters)

- **Core competencies**—In an innovation-driven economy, advances tend to be made through nexuses of distinctive R&D activity and expertise, which Battelle calls core competencies. Battelle's analysis examines patent clusters, research publication clusters, startup activity, and other metrics in order to identify innovation core competencies in the state. Connecting strong industry clusters with robust core competencies provides a powerful base for driving innovation-based economic development

- **Line-of-sight to markets**—This term refers to the connection of an industry cluster, core competency, and/or economic growth area to relevant real-world markets with significant potential for growth. Although the detailed analysis performed by Battelle identifies many areas of strength within Rhode Island, not all strengths are equal in terms of their prospects for generating significant economic growth and job creation. Some areas represent highly focused niche activities with limited potential to generate large-scale employment growth, while other R&D core competencies may be exceptionally good but too focused on basic science that has a long time horizon to realizing economic activity from innovations.

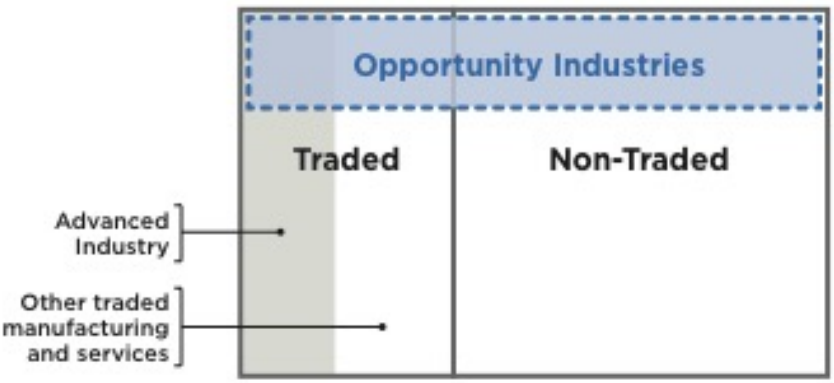
- **Potential economic growth areas**—The detailed analysis performed by Battelle seeks to home in on those clusters of economic activity that present opportunities for sustained growth and job creation. Potential economic growth areas by definition must connect to large-scale near- and mid-term growth opportunities. Through detailed examination of specific industry sector

performance, growth trends, inter-industry networks, innovation metrics such as patents and research publications, and other core assets, the Battelle analysis works through all options to identify Rhode Island's strongest economic growth areas

- **Advanced industries**—As noted earlier, the Brookings Institution Metropolitan Policy Program has identified a set of 50 advanced industries that together constitute the commercial innovation sector that turns technical invention into industrial-scale business enterprise. These advanced industries are defined by deep investments in R&D and STEM workers; an intense orientation towards innovation; and high productivity, good pay, and strong export levels. They include a wide range of manufacturing industries such as boatbuilding as well as engineering, software and computer services, and commercial research and testing services. Because of their long supply chains and sizable multiplier effects these industries drive inordinate amounts of a location's economic activity. Advanced industries anchor the U.S. economy by "encompass[ing] the nation's highest-value economic activity. As such, these industries are the country's best shot at innovative, inclusive, and sustainable growth."[17]

- **Opportunity industries**—Brookings refers to industries that offer good jobs with livable wages as "opportunity industries." Traditionally, the key metric of economic development success is "jobs, jobs, jobs." But far too many low-skilled jobs do not offer wages and benefits that afford a decent standard of living. This reality has prompted a new appreciation of industries outside the advanced industry sector that generate jobs that offer livable wages, benefits, and pathways to career advancement for workers without a bachelor's degree. While opportunity industries tend to be locally oriented, some bring new income and economic growth to Rhode Island by selling goods or services outside of the state. For instance, the arts, hospitality, and tourism sector, which employs many less-educated workers, helps grow Rhode Island's economy by serving out-of-state visitors. Local-serving industries like construction and hospitals can also provide good jobs for Rhode Islanders. The graphic below illustrates the interplay between advanced industries and opportunity industries

Traded-sector advanced industries drive prosperity, while mostly local-serving opportunity industries deliver goods and services and provide numerous jobs that pay well



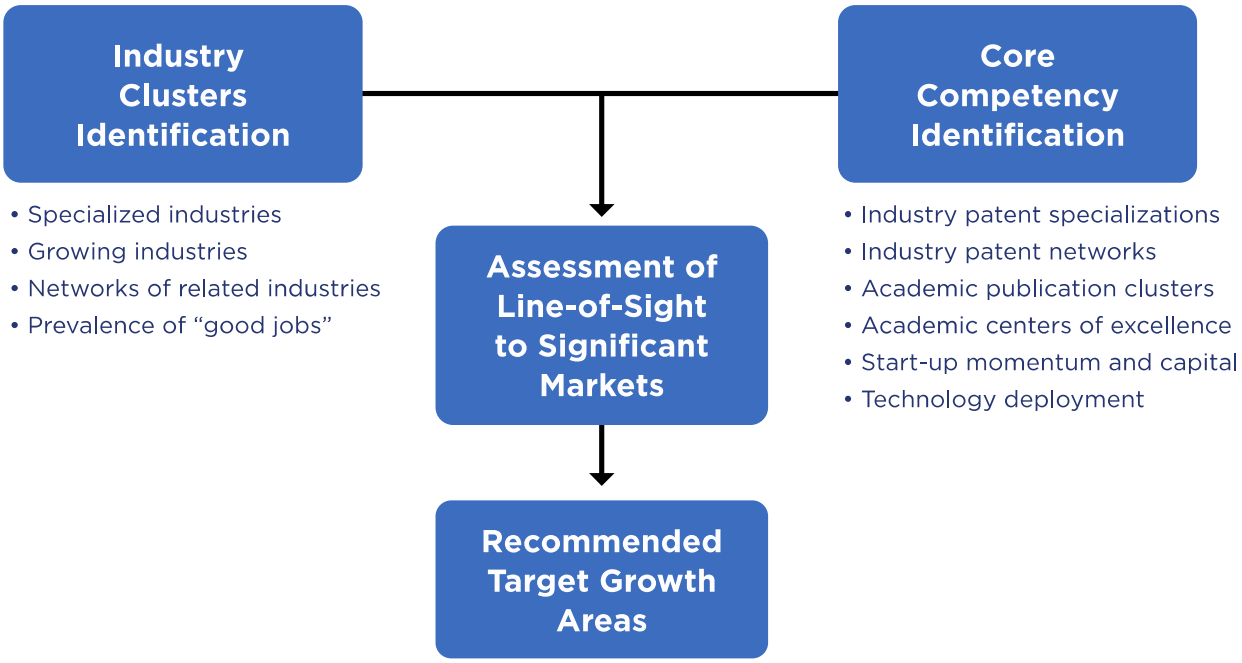
Battelle executed a rigorous three-part process for identifying the most significant industry clusters in Rhode Island; assessing where Rhode Island's deeper competencies and assets best support them; and considering whether the identified potential growth areas provide a clear line-of-sight to significant market opportunities that can help drive economic growth. Along these lines, three analytic steps were carried out:

- **Step one: Assess Rhode Island's evolving industry base and determine how specific industries and clusters of industries are positioned for economic growth based on their performance since 2009**. The analysis begins with a granular bottom-up study of Rhode Island's industry base. It employs detailed 6-digit North American Industry Classification System (NAICS) industry data to examine the industry groups that power the state's economy. These industry groups serve as the building blocks of broader industry clusters that are tend to be well suited for economic development interventions. The full suite of 6-digit NAICS industries in Rhode Island were examined using specialized clustering algorithms incorporating variables related to shared markets, defined supply chains, and/or shared bodies of knowledge (such as in biosciences, materials or information technology). Battelle identified 33 industry groups that were then examined further in terms of traditional industry targeting metrics (location quotient, employment growth, and market share over time) to identify eight key industry clusters. The period since 2009 is used because it provides a clear focus on trends since the Great Recession

- **Step two: Assess Rhode Island's core competencies and analyze where they align with the state's industry clusters.** Growing Rhode Island's economy will depend upon the state's broader capacity to innovate, deploy technology, and generate good jobs. In this step, core competency analysis was used to surface distinctive and robust areas of expertise in the state as measured by patents, research publications, and other metrics. The identification of core competencies serves to highlight the existence of specialized assets, know-how, and innovation activity that can support the growth of existing businesses, generate new business development, and potentially attract other employers to Rhode Island

- **Step three: Identify the growth areas that offer the best opportunities for expansion over the next five to 10 years based on a line-of-sight analysis exploring how well Rhode Island's industry clusters and core competencies align with large-scale market opportunities**. The final step of the analysis considers whether a promising local industry cluster is aligned with growing market opportunities. Given the small size of Rhode Island, this analysis is particularly important for ensuring that the state understands the prospects its local industries may or may not enjoy

Identifying Rhode Island's potential growth areas involved three discrete steps



Areas where Rhode Island has **real, differentiating potential**

Because this exercise employs standard NAICS industry classifications and data, some broad and intuitively understood sectors of economic activity surface in multiple, sometimes surprising, industry categories. The most prominent example is Rhode Island's multi-dimensional defense sector. Because the sector consists of a number of distinct industries that cut across several NAICS categories, it appears in several industry clusters and growth areas.

Each step of the three-step analysis furnished significant intelligence on the size, nature, and prospects of Rhode Island's web of potential growth opportunities

Implementation of Battelle's three-step industry survey yielded a rigorous mapping of the state's industries, competencies, and market positioning. This work affirms and sharpens previous work while adding new insights.

Step One: Assessment of Rhode Island's evolving industry base finds that the state possesses an intricate, interrelated array of detailed industries that can be rolled up into broader clusters of promising industries. The starting point for the identification of industry clusters in Rhode Island was a bottom-up examination using advanced data analytics of the state's industry base at the most detailed 6-digit NAICS level. This process involved more than 1,000 industry codes maintained under NAICS. Using computer-based statistical techniques, Battelle's analysis identified similarities and relationships across industries. This approach is at the cutting-edge of industry cluster definition techniques and offers a much richer picture of Rhode Island's industry structure than previously available.[18] With this analysis in hand, Battelle deployed industry targeting analysis techniques to further examine the industry clusters identified.

The data analytics assessment of Rhode Island's industry base identified 33 groups of significantly interrelated industries that serve as building blocks for the industry clusters. This approach first measured similarities across more than 1,000 industries classifications in Rhode Island based on several cluster analysis variables including the geographic location of establishments; industry structure and growth trends; occupational skill mix; innovation activities; and regional supply chains.[19] The 33 industry groups include a broad mix of advanced industries and opportunity industries. (See table below for the complete list.)

Key Measures of Industry Performance

Relative concentration of the industry cluster—This measures how specialized an industry is in Rhode Island relative to the nation, and so gauges the state's competitive advantage in that industry relative to the nation. The specific measurement of relative concentration is known as a location quotient. A location quotient is the share of Rhode Island's employment found in a particular industry cluster divided by the share of total industry employment in that industry cluster nationwide. A location quotient greater than 1.0 indicates a higher relative concentration, whereas a location quotient of less than 1.0 signifies a relative underrepresentation. A location quotient greater than or equal to 1.20 denotes an employment concentration significantly above the national average, and is thus considered "specialized."

Job generation for the industry cluster—A straightforward measure of whether an industry is growing is whether it has been gaining or losing jobs over the 2009–2013 period.

Relative growth of the industry cluster—A measure of whether an industry in Rhode Island is gaining or losing competitive share compared to the nation. It is measured as the difference between the percentage change in employment in an industry cluster in Rhode Island minus the percentage change in employment in that same industry cluster for the nation over the 2009–2013 period.

Despite its middling economic performance, Rhode Island possesses a wide range of industries with sizable economic potential. Although Rhode Island's economy has seen lagging top-line performance, the bottom-up view of detailed industry groups contains good news for the state and identifies a wide range of industries that are demonstrating promising economic performance. (See appendix D for specifics on the 33 detailed industry groups.)

Twenty-one of the 33 detailed industry groups performed well in at least two of these three standard regional economic analysis measures:

- high relative concentration (compared to the national average)
- job creation
- relative employment growth (compared to national trends)

Most notable among these well-performing industry clusters are:

- Thirteen clusters that do well on all three measures of industry performance: arts, hospitality and tourism; biopharmaceuticals; boat and ship building; corporate and administrative offices; finance and insurance; food services; industrial machinery; metal refining and metalworking; plastic laminates and films; specialty chemicals and resins; packaging; perishable food products; and retail displays and signs
- Six emerging industry clusters that are growing jobs at a pace faster than the nation, but are not highly concentrated in Rhode Island: freight transportation; glass and stone products; medical devices; R&D and medical labs; warehousing; and wholesale distribution
- Two industry groups that are doing well on two measures of performance: fabricated metals (high relative concentration and growing jobs, but at a pace slower than the nation) and textile mills (high relative concentration but losing jobs, though at a rate below the national average)

Twenty-one of the 33 detailed industry clusters performed well on at least two of three standard regional economic analysis measures

Detailed Industry Cluster	2013 Employment Size	Performance Category		
		Industry Specialization, 2013	Adding jobs, 2009–2013	Relative Growth Faster than U.S., 2009–2013
Advanced Industry				
Biopharmaceuticals	1,448	✓	✓	✓
Boat & Ship Building	3,755	✓	✓	✓
Computer Systems & Software	6,662		✓	✓
Corporate, Administrative Offices	11,330	✓	✓	✓
Data Processing & Internet	2,778	✓		
Electronics	841			
Fabricated Metals	5,259	✓	✓	
Finance and Insurance	23,902	✓	✓	✓
Industrial Machinery	1,425	✓	✓	✓
Jewelry	3,578	✓		
Medical Devices	1,190		✓	✓
Metal Refining & Metalworking	1,560	✓	✓	✓
Plastic Laminates and Films	2,534	✓	✓	✓
R&D and Medical Labs	1,190		✓	✓
Sensors and Instruments	2,247	✓		
Specialty Chemicals & Resins	1,388	✓	✓	✓
Toys and Games	453			
Wiring and Related Products	1,083	✓		
Opportunity Industry				
Arts, Hospitality, and Tourism	31,502	✓	✓	✓
Design Services	226			
Retail Displays/Signage	924	✓	✓	✓
Food Services	40865	✓	✓	✓
Freight Transportation	2,293		✓	✓
Furniture	571			
Glass and Stone Products	494		✓	✓
Hospitals and Healthcare	27,279	✓		
Logistics Support Services	1,027			
Perishable Food Products	2,934	✓	✓	✓
Packaging	1,608	✓	✓	✓
Private Higher Education	11,300	✓		
Textile Mills	2,360	✓		✓
Warehousing	1,351		✓	✓
Wholesale Distribution	16,652		✓	✓

Thirty-three detailed industry groupings are far too many for pursuing targeted economic development efforts. Indeed many of the state's industry clusters lack the scale needed to drive major growth in the economy. Twenty-four of the 33 groups employ fewer than 5,000 workers. This scale problem is particularly pronounced in Rhode Island's advanced industry groups. Across that swath of industries the largest detailed industry group—computer systems and software—encompasses fewer than 7,000 jobs and the median size of the 33 groups standing closer to 2,000.

Fortunately, close examination of the fundamental characteristics of the 33 detailed clusters, when combined with consultations with Rhode Island industry associations and business leaders, prompted a novel solution: **The 33 detailed industry groups were rolled up into eight broader industry clusters** based on shared traits such as common markets, defined supply chains, and/or shared bodies of knowledge. The eight industry clusters that resulted from this consolidation included:

- Three groupings that represent primarily advanced industry clusters: **Software Systems and Internet**, which includes computer systems, software and data processing facilities; **Instruments, Electronics, and Defense**, which is composed of sensor-related activities and instrumentation and advanced electronics; and **Advanced Business Services**, which includes finance and insurance and corporate administrative offices and headquarters

- Three groupings that represent a mix of advanced and opportunity industries: **Health and Life Sciences**, composed of biopharmaceuticals, medical devices, R&D and medical labs, and healthcare; **Marine, Materials, and Machinery**, which includes boat and ship building, plastic laminates and films, packaging, specialty chemicals and resin, metals refining and metalworking, fabricated metals, and industrial machinery; and **Design, Consumer Products, and Food Processing**; which encompasses design services, jewelry, textiles, toys and novelty, furniture, and perishable food manufacturing

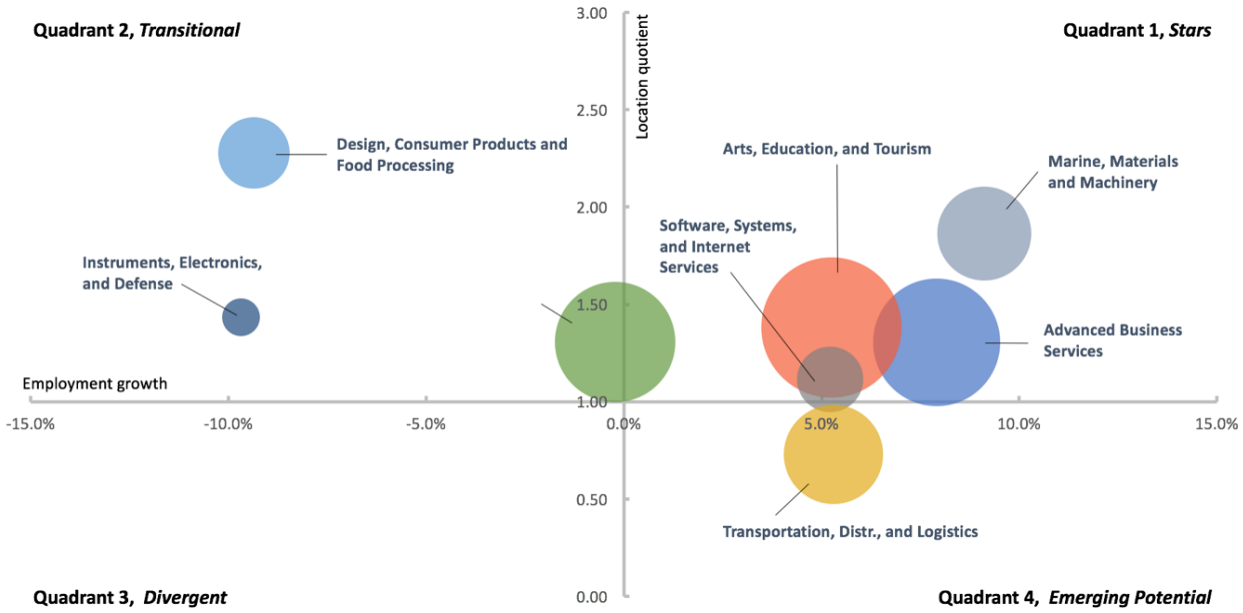
- Two groupings that represent primarily opportunity industry sectors: **Arts, Education, Hospitality, and Tourism**; and **Transportation, Distribution and Logistics**, which includes freight transportation, logistics support, warehousing, and wholesale distribution

Because the cluster analysis relies on NAICS categorizations and data, activities in the defense sector and the food sector surface in multiple categories: defense in Instruments, Electronics, and Defense (undersea warfare and cyber-physical systems such as are centered around the Naval Undersea Warfare Center or NUWC) and Marine, Materials, and Machinery (submarine building like that at Electric Boat); food in both Design, Consumer Products, and Food Processing (food manufacturing) and Arts, Education, Hospitality, and Tourism (restaurants and other consumer food activities). Defense in particular looms larger in Rhode Island than the cluster titling may indicate.

Within Rhode Island, these eight industry clusters are generally performing well, as should be expected given the process used in their identification. Six of the eight clusters have a high level of relative concentration in Rhode Island, while five have experienced significant recent employment

growth. Of the three industry clusters that have grown since the economic recovery began in 2009—Health and Life Sciences; Design, Consumer Products, and Food Processing; and Instruments, Electronics, and Defense—each enjoys a high relative concentration in Rhode Island.

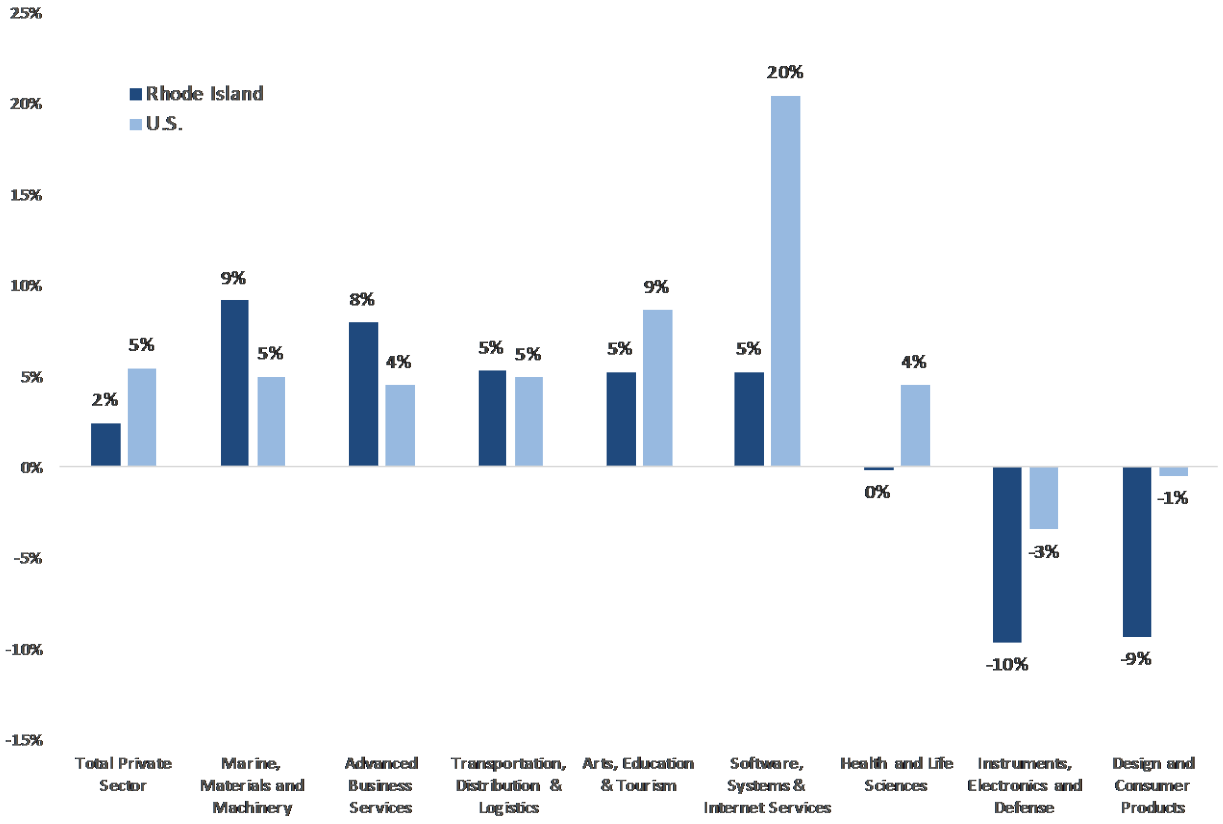
Relative concentration and job growth varies among Rhode Island's industry clusters



Source: Battelle analysis of BLS, QCEW data; enhanced file from IMPLAN

Even still, only two of the state's broad industry clusters have outpaced national growth rates and gained market share since the economic recovery began—Marine, Materials, and Machinery and Advanced Business Services. Among the other growing industry clusters in Rhode Island, only Transportation, Distribution, and Logistics kept pace with national growth. Software Systems, and Internet Services and Arts, Education, Hospitality, and Tourism both recorded job gains in Rhode Island, but their pace of growth was well off the national average. Similarly, Health and Life Sciences, which remained flat in Rhode Island, grew nationally. The remaining two industry clusters—Instruments, Electronics, and Defense and Design, Consumer Products, and Food Processing—declined sharply in Rhode Island compared to more moderate declines at the national level.

Employment growth 2009–13 in Rhode Island's industry clusters tended to lag national trends



Source: IMPLAN

From a multistate regional perspective, the performance of Rhode Island's eight broad clusters is mixed. Rhode Island stands out in the advanced industry clusters of Marine, Materials, and Machinery and Advanced Business Services. In both clusters the state has led the New England region in terms of industry specialization and growth rates since the economic recovery. Rhode Island's relative performance compared to other New England states in the opportunity industry clusters of Arts, Education, Hospitality, and Tourism and Transportation, Distribution, and Logistics has also been promising. However, in two advanced industry clusters—Health and Life Sciences and Design, Consumer Products, and Food Processing (where Rhode Island stands out as one of the leading states in New England in its level of industry specialization)—the state falls short on competitive employment growth. Rhode Island is also behind other New England states in Software Systems and Internet Services and Instruments, Electronics, and Defense. The graphic below summarizes the relative position of Rhode Island's key industry clusters compared to other New England states. This mixed performance of Rhode Island's industry clusters relative to the rest of New England points to a broader fall-off in Rhode Island's economy in recent years.

Rhode Island's regional position varies from one industry cluster to the next

Broad Industry Cluster Groupings	Regional Position of Rhode Island	
	Level of Industry Specialization	Growth Rate, 2009–2013
Advanced Industries		
Advanced Business Services	↑	↑
Design, Consumer Products and Food Processing	↑	↓
Health and Life Sciences	↑	↓
Instruments, Electronics and Defense	↔	↓
Marine, Materials and Machinery	↑	↑
Software Systems and Internet	↓	↓
Opportunity Clusters		
Arts, Education, Hospitality, and Tourism	↑	↔
Transportation, Distribution and Logistics	↔	↑

↑ = among leading states in New England ↔ = in the pack of New England states ↓ = lagging other New England states

Source: IMPLAN

The U.S. Bureau of Labor Statistics (BLS) projects that each of Rhode Island's eight broad industry clusters will experience significant economic output gains between 2013 and 2022. However, the employment growth outlook is more mixed.[20] Each of the Rhode Island's eight industry clusters is expected to expand its output, with six poised to outpace the national average. While these projections suggest that Rhode Island is well-positioned for growth in these sectors, employment growth projections are more cautious. In all eight clusters, BLS projects substantially lower employment growth than output growth, which indicates that high productivity gains are expected. For three of the clusters, employment is expected to decline despite rising economic output. The implication is that Rhode Island

must seek to drive innovation and deployment of advanced technologies to maintain its position and increase its competitiveness in order to outpace projected national trends.

National productivity growth is projected to outpace employment growth in the eight broad industry clusters, 2013–2022

Broad Industry Cluster Groupings	National Projections, 2013–2022	
	Annual Employment Growth	Annual Output Growth
All Private Sector Industries	**1.0**	**2.6**
Advanced Business Services	0.7	3.7
Design, Consumer Products, and Food Processing	-1.3	2.7
Health and Life Sciences	1.8	2.9
Instruments, Electronics, and Defense	-1.1	3.8
Marine, Materials, and Machinery	-0.6	2.1
Software Systems and Internet	2.4	4.9
Arts, Education, Hospitality, and Tourism	1.2	2.3
Transportation, Distribution and Logistics	0.9	3.6

Source: U.S. Bureau of Labor Statistics.

Rhode Island's economic performance is at best mixed and reflects the need for more focused and proactive state economic development efforts. While a number of industry clusters are performing well in Rhode Island, most are not keeping pace with growth or are declining faster than elsewhere in New England and the nation.

Step Two: The core competency analysis finds that Rhode Island possesses significant institutions and specialized know-how with potential for supporting certain types of innovation-based economic development. Having a detailed understanding of core competencies is critical for developing winning economic development strategies. To identify areas where a state has true technology innovation competencies requires augmenting traditional regional economic analysis to look more closely at the science, technology, and commercialization expertise found across the region's industry, university, and federal laboratory base.

As defined by Gary Hamel and C.K. Prahalad in *Competing for the Future*, a "competence is a bundle of skills and technologies representing the sum of learning across individual skill sets and organizational units."[21] From an economic development perspective, core competencies represent zones of endeavor where a place has the ability to grow. Core competencies indicate where there is a critical mass of expertise and creative activity across product development and process improvements that has the

potential to generate new intellectual property and startups. Finally, core competencies highlight where a state's firms and research institutions have the capacity not only to advance new research discoveries but also to apply them, mobilize talent, and create good jobs.

This core competency assessment pursues an in-depth quantitative analysis of documented innovation-related output within industry and research institutions in Rhode Island. At the heart of the analysis was an examination of patenting activity, which indicates practical innovation activity likely to have commercial potential, and output of basic and applied institutional research as measured by the volume and content of publications.[22] In addition, this assessment supplements quantitative data with qualitative input from one-on-one and small-group interviews with industry executives, industry associations, and senior leadership and leading faculty at Rhode Island research institutions. These conversations sought additional intelligence on the focus of innovation activity in the state. Additional analyses examined Rhode Island industries' ability to deploy know-how to drive productivity growth and support quality job creation. The findings reveal numerous opportunities for potential growth:

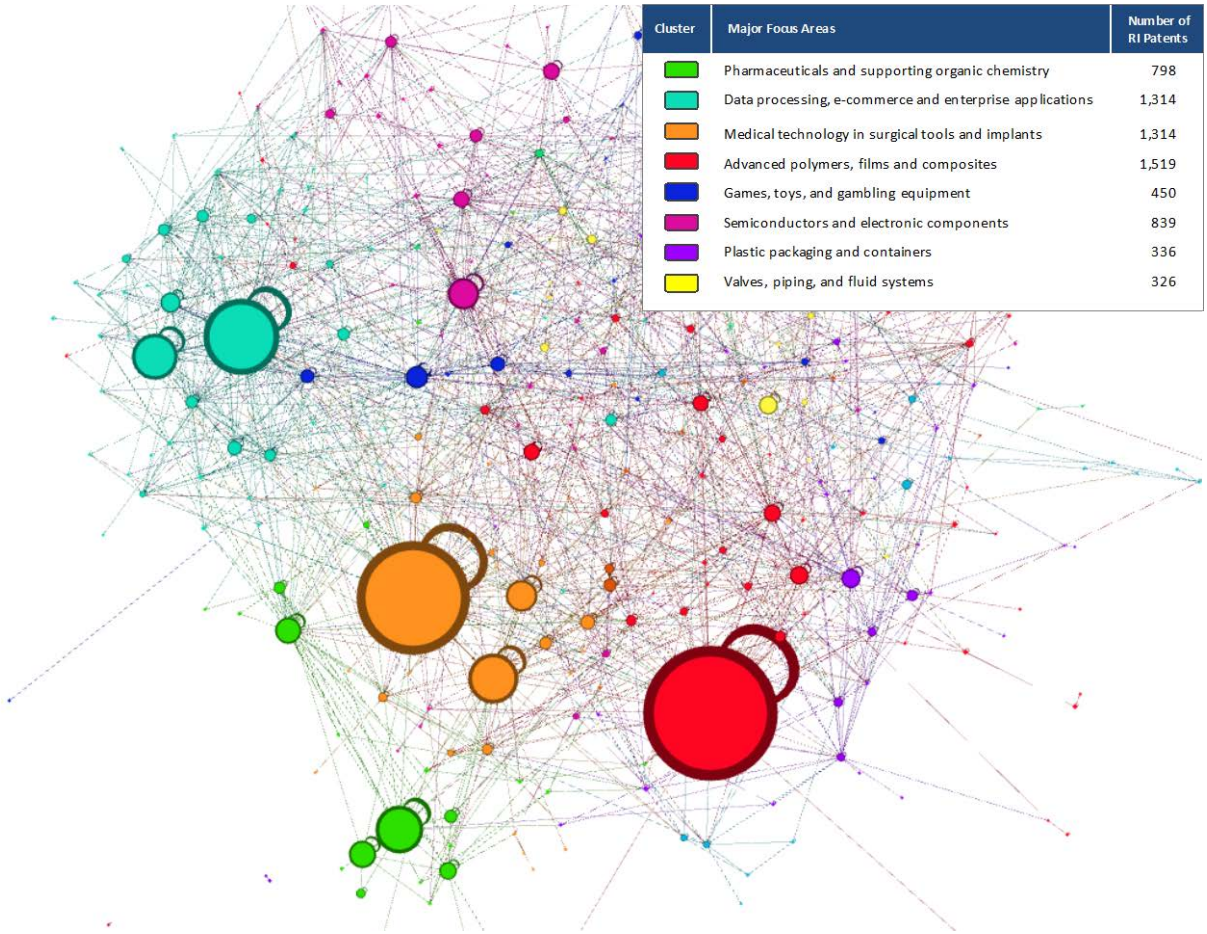
Multiple analyses confirmed significant industry-based core competencies in eight areas related to the state's leading clusters. Investigation of the state's industry-led core competencies involved the following analyses:

- **Identification of Rhode Island patent innovation networks.** The relationships reflected in the forward and backward citations of patents highlight close innovation relationships and clusters of innovation activity. Through the use of data analytics algorithms, Battelle was able to identify networks of active linkages in patent activities among different Rhode Island companies and research institutions based on patent citations

- **Focus and quality of industry-led patent activities.** Patents represent intellectual property generated largely, though not exclusively, by industry. To keep this analysis current, both patents awarded and patent applications were considered indicators of focused clusters of activity. In addition, this analysis measured patent performance to help understand the quality of patent activity taking place. These calculations are similar to measuring industry performance: one measure identifies a relative concentration in Rhode Island of patent activity and another looks for frequent citations of Rhode Island patents, with citations as a key measure of a patent's influence in the field

- **Presence of emerging innovation companies.** Another indicator of how core competencies are playing out in innovation-based economic development is the generation of new high-growth businesses. For this indicator, the number of emerging companies includes those receiving formal venture capital, federal Small Business Innovation Research (SBIR) grants, and/or other locally-based innovation capital supports, such as from the Slater Fund, BetaSpring and Cherrystone Angel Group

A network analysis of forward patent citations revealed a cohesive set of clusters arranged around a large volume of multidisciplinary ties across diverse groups of capabilities



Source: Thomson Innovation and analysis by Battelle

Ultimately, Battelle identified eight industry-led core competencies:

- **Advanced polymers, films, and composites** involving 1,519 patents invented in Rhode Island, with a focus on golf balls and products made from layered resins. Leading Rhode Island companies include Toray and Hasbro and the Naval Underwater Warfare Center is also active, though there are few emerging innovation companies

- **Medical technology** involving 1,314 patents invented in Rhode Island with a focus on surgical tools, spinal and bone prosthetics, and design of medical equipment. The leading companies include C.R. Bard, Illuminoss (an emerging innovation company involved in minimally invasive orthopedic implants that has raised over $48 million in venture funding since its founding in 2007), and Ximedica, which raised $4 million in venture funding and is becoming a national leader in medical products design. There are also over 15 other emerging innovative medical device companies in Rhode Island working in diverse areas such as neurotechnology, advanced imaging, and tissue engineering

- **Data processing, e-commerce, and enterprise applications** involving 1,314 patents invented in Rhode Island with a focus on image and text processing, computer payments and management systems, advanced algorithms, cybersecurity, sensor networks, and network administration and management. This is the leading area of emerging innovation companies in Rhode Island, with well over 60 startups identified. Among the major venture-backed companies are Swipely (which secured $40 million in venture capital between 2009 and mid-2015) offering payment marketing services, Greenbytes ($36 million) offering data storage solutions and ShapeUp ($9 million) offering wellness software management. In addition to ShapeUp, there are a number of emerging health informatics companies in Rhode Island that engage in a variety of activities ranging from wellness/health management to remote monitoring and bioinformatics. This is also an area for several fast-growth companies on the Inc. 5000 list, including Atrion, Gurnet Consulting, MojoTech, and Carousel Industries.

- **Semiconductors and electronic components** involving 839 patents invented in Rhode Island with a focus on electrical equipment, semiconductors with optical and electromagnetic sensors, fuel cells, and power conversion devices. Leading companies include International Rectifier Corporation, Schneider Electric/American Power Conversion Corporation, and Eaton. Although there are few emerging innovation companies in this area, there are several SBIR-funded companies based in Rhode Island that are actively involved in advanced instrumentation development for the military involving sonar systems, navigation systems, and radar systems. There are also a number of emerging energy and environmental management integrated device/software companies in Rhode Island, including Utilidata, which has raised $20 million in venture funding since 2009

- **Pharmaceuticals and supporting organic chemistry** involving over 798 patents invented in Rhode Island with a focus on organic active ingredients for pharmaceuticals, specialized drug delivery forms, and genetic engineering. This is also an active area for entrepreneurship with over 15 startups in recent years, including leading venture-backed companies Neurotech Pharmaceuticals ($29 million), and Mnemosyne Pharmaceuticals ($13 million). This area of patent innovation has considerable involvement from Rhode Island's research institutions, including Brown University and Rhode Island Hospital

- **Games, toys, and gaming equipment** involving 450 patents invented in Rhode Island with a focus on electronic game display and coin-free gaming machines. The two leaders in patent activity in Rhode Island are Hasbro and Gtech (now part of International Game Technology)

- **Plastics packaging and containers** involving 336 patents invented in Rhode Island with a focus on medical dispensers, food and drink biodegradable packages, and housing containers for birds. Leading companies in Rhode Island include Aspects, MEDport and Polytop

- **Valves, piping and fluid systems** involving 326 patents invented in Rhode Island with a focus on firefighting equipment, led by Tyco Fire Products. Other companies active in Rhode Island

include Quick Fitting Plumbing and Anvil International, which produces pipe hangers and pipe supports

Another suite of analyses confirmed the presence of 17 solid research institution core competencies in areas related to the state's leading clusters. These investigations examined:

- **Clusters of publications activity:** The Battelle-developed software cluster analysis tool OmniViz™ provides an objective view of research activities taking place in Rhode Island across its universities and federal labs. OmniViz™ uses real text pattern recognition algorithms to analyze the abstracts of research grants and publications, allowing for free association based on the usage of words and phrases rather than forcing clustering based on preselected keywords. As a result, there is no a priori bias to the clusters identified. This analysis also has an advantage of being well-suited to identifying multidisciplinary research areas that can be difficult to identify using traditional academic disciplinary classifications

- **Areas of specialization in publications and research funding:** This analysis considers those publication fields where Rhode Island has a high level of relative specialization compared to the nation based on publications compiled by Thomson Reuter's Web of Knowledge. The analysis also uses the National Science Foundation's university research and development expenditures database to determine where Rhode Island stands on research funding for specific fields

- **Presence of major research centers:** Major research centers across the research institutions in Rhode Island indicate institutional research priorities, particularly with regard to those that have secured highly competitive federal research center funding

- **National reputation:** Another indicator of excellence is the national reputation of Rhode Island research institutions in specific graduate fields. The U.S. News and World Report system offers as a readily available and well-understood methodology for ranking graduate school programs

The results of this assessment suggest that Rhode Island enjoys a wide breadth of research core competencies in both biosciences and non-bioscience areas. For the most part, the strengths identified result from work at either Brown University or the University of Rhode Island (URI), although some additional institutions also contribute.

In biosciences, nine core competencies were identified:

- **Neuroscience** with focuses in cognition and behavior, memory disorders, and vision

- **Psychiatry & behavioral sciences** with focuses in depression and mood disorders, obsessive compulsive disorders, behavioral therapy, and use of brain stimulation. Very high level of publication concentration relative to the nation

- **Infectious diseases** with focuses in immunology, microbiology and HIV/AIDS. Presence of Center in AIDS and multiple NIH grants

- **Fetal, newborn and maternal health** with focuses in perinatology, neonatal/pre-term births and mother/child behavior
- **Obesity and metabolism** with focuses in nutrition, diabetes and endocrinology
- **Aging and geriatrics** with focuses in basic biology of aging and clinical geriatrics. NIH program project grant in long-term care policies
- **Orthopedics and musculoskeletal sciences** with focuses in musculoskeletal and motion, including disorders of the bone and cartilage and a strong clinical research focus
- **Pharmaceutical sciences** with focuses in natural products, drug development and synthesis, pharmacology, and pharmaceutical engineering
- **Public health** with focuses in health care delivery, substance abuse, smoking, and HIV/AIDS

The analysis suggests that **neuroscience**, **infectious diseases** and **public health are** among the strongest innovation areas in the biosciences found in Rhode Island. In terms of national standing a number of the core competencies are among the top 50 in the nation (though not the top 10).

Rhode Island's research institutions have a range of core competencies in biosciences

University/Federal Innovation Areas	OmniViz Clusters	Publications Level and Location Quotient (LQ)	Presence of Centers and Institutes	National Standing (U.S. News Ranking or R&D Funding)
Aging and geriatrics	Crosscutting	–	●●●	–
Fetal, newborn, and maternal health	●●●	●	●●	–
Infectious diseases	●●●	●●●	●●●	–
Neuroscience	●●●	●●●	●●●	●
Obesity and metabolism	●●●	●●●	–	–
Orthopedics and musculoskeletal sciences	–	●●	–	–
Pharmaceutical sciences	Crosscutting	●●	–	●●
Psychiatry and behavioral sciences	–	●	●●●	●
Public health	●●●	●●●	●●●	●●
Criteria:	●●● > 500 publications ●● = 200–500 publications ● < 50–199 publications	●●● > 300 publications and LQ > 1.2 ●● = 100–200 publications and LQ > 1.0 ● 100+ publications and LQ< 1.0	●●● = NSF/NIH center grant & multiple university-designated center ●● = Multiple university-designated centers ● = Single university-designated center	●●● = Top 10 ●● = 11–25 ● = 25–35

In fields of research other than biosciences, eight core competencies were identified:

- **Advanced materials** with areas of focus in nanostructures, mechanics of materials, polymers, thin films, and coatings
- **Computer science** with areas of focus in data sciences, robotics, cybersecurity, and algorithms
- **Culinary arts** involving not only the craft and art of cooking but also the science and business behind the culinary arts
- **Design** with areas of focus in industrial design, graphic design, fine arts, printing, and ceramics[23]
- **Marine, oceanographic and aquatic sciences** with areas of in coastal sciences, marine sciences, and ocean mapping
- **Mathematics** with areas of focus in applied match, approximation, matrices, basic math, and diffusion
- **Sensors and instruments** with areas of focus in sensors, imaging and image analysis, spectroscopy, and optics
- **Physics** with areas of focus in particle physics, physics of force, chemistry, and physics for batteries and climate change

Rhode Island ranks among national leaders in several of these non-bioscience core competencies, including applied math and ocean sciences. Rhode Island also stands out in fine arts and design, led by the Rhode Island School of Design, and culinary arts, led by Johnson & Wales. These fields are not driven by research university metrics but are areas where Rhode Island has highly ranked national programs that generate top talent.

Rhode Island research institutions stand out in several non-bioscience core competencies

University/Federal Innovation Areas	OmniViz Clusters	Publications Level and Location Quotient (LQ)	Presence of Centers and Institutes	National Standing (U.S. News Ranking or R&D Funding)
Advanced materials	●●●	●	●●	●
Computer science	–	●	●●	●●
Culinary arts*	–	–	–	●●●
Design	–	–	–	●●●
Marine, oceanographic, and aquatic sciences	●●●	●●●	●●●	●●●
Mathematics	●●●	●●●	●●●	●●●
Physics	●●●	●●●	●●	
Sensors and instruments	●●●	●●●	●●●	●●
Criteria:	●●● > 500 publications ●● = 200–500 publications ● < 50–199 publications	●●● > 300 publications and LQ > 1.2 ●● = 100–200 publications and LQ>1.0 ● 100+ publications and LQ < 1.0	●●● = NSF/NIH center grant + multiple university-designated centers ●● = Multiple university-designated centers ● = Single university-designated center	●●● = Top 10 ranking ●● = 11–25 ranking ● = 25–35 ranking

* Note: Culinary arts rankings are from Full Service Restaurant (FSR) Magazine rankings

A final set of analyses confirmed the presence of multiple industry areas that demonstrate a capacity to deploy technologies and support the creation of good jobs. The technology-creation competencies found in industries, institutions of higher education, and federal laboratories are a necessary but insufficient means for a state to gain advantage. Also critical is the deployment of technology in the production of goods and services. Many of the most successful companies are not those inventing new products but rather those that deploy state-of-the-art technology to boost productivity and create business and employment. Industry performance in technology deployment is particularly important for Rhode Island's more mature industries such as consumer products, food processing, and metals manufacturing for sustaining competiveness in product manufacturing.

Given that, the present analysis undertook two additional analyses to assess Rhode Island's position in technology deployment:

- Value added per employee. State levels of value added per worker were compared to national levels in order to assess Rhode Island industries' efficiency in applying know-how. High ratings on this comparison likely suggest that a particular Rhode Island industry cluster is better able to make use of technological advances to produce goods and services that are more complex and

higher value. Lower levels of productivity, by contrast, raise questions about the competitiveness of an industry cluster

- **Capacity to generate good jobs**. Also relevant to the state's understanding of its industries' core competencies is an assessment of their capacity to generate good jobs at a time of marked poverty and income inequality. "Good jobs," as defined by Brookings, offer livable wages with benefits for full-time workers who have less than a four-year degree. The production of good jobs is an important attribute of high-value economies and tied to the ability of industries to apply know-how for the state's benefit

The results of these analyses offer generally good news for Rhode Island.

Five of the eight broad industry clusters identified by the industry and core-competency analyses exceed the U.S. level of value added per worker. These clusters are:

- Defense Shipbuilding and Maritime; Design, Materials, Food, and Custom Manufacturing; and Advanced Business Services in the advanced sector
- Transportation, Shipping, and Logistics and Arts, Education, Hospitality, and Tourism in the opportunity sector

This finding confirms the promise of these five industry groups, which are performing well compared to national trends and so may be expected to expand market share.

Of concern, however, is that a number of the more innovation-driven advanced industry-oriented clusters in Rhode Island are well below national productivity levels. Instruments, Electronics, and Defense and Software Systems and Internet are areas of particular concern. Their lagging productivity suggests that while these industries still perform relatively well, the local industry base is likely producing lower value products or lagging in the deployment of the latest production technologies. Actions focused on fostering better connectivity between the clusters and research institutions and/or supporting the deployment of advanced production technologies could help bring these lagging clusters up to par.

Value added per worker in 2013 varied by industry cluster in Rhode Island and the United States

Cluster Name	RI Value Added Per Worker (2013)	U.S. Value Added Per Worker (2013)	RI Compared to U.S.
Advanced Business Services	$126,495	$116,131	1.09
Design, Consumer Products, and Food Processing	$112,865	$77,957	1.45
Health and Life Sciences	$93,032	$106,227	0.88
Instruments, Electronics, and Defense	$103,220	$261,872	0.39
Marine, Materials, and Machinery	$177,709	$102,491	1.73
Software Systems and Internet	$98,069	$128,008	0.77
Arts, Education, Hospitality, and Tourism	$45,955	$40,719	1.13
Transportation, Shipping, and Logistics	$129,143	$125,053	1.03

Source: IMPLAN model, calculations by Battelle.

Meanwhile, a look at the job quality assessment reveals that the state has a modest base of good jobs, with most of its main clusters providing solid shares of them. **Six of the eight industry clusters employ a significant share of their workforce in good jobs**. These include:

- Marine, Materials, and Machinery and Health and Life Sciences, which place 57 percent and 50 percent, respectively, of their workforce in good jobs
- Instruments, Electronics, and Defense; Advanced Business Services; Software Systems and Internet: and Transportation, Distribution and Logistics, which employ between 40 and 49 percent of their workforce in good jobs

The share of good jobs varies across Rhode Island's industry clusters

INDUSTRY CLUSTERS	GOOD JOBS
Advanced Business Services	48%
Design, Consumer Products, and Food Processing	34%
Health and Life Sciences	50%
Instruments, Electronics, and Defense	49%
Marine, Materials, and Machinery	57%
Software Systems and Internet	44%
Transportation, Distribution and Logistics	42%
Arts, Education, Hospitality, and Tourism	16%

Source: Occupational-Industry Matrix from U.S. Bureau of Labor Statistics; Battelle identification of good jobs based on Rhode Island cost of living and wages paid.

For context, just over 230 occupations can be considered good jobs in Rhode Island. In 2014, these good jobs employed 126,820 people or 27 percent of all employment in the state. All but one of the industry clusters in the table above exceed the state's good job intensity, which further affirms the importance of these clusters to health of the Rhode Island economy. (See appendix C for a list of Rhode Island's good job occupations based on level of employment, job growth, and expected job openings.)

Pulling the core competency analyses together identifies clear opportunities for strengthening Rhode Island's economy. Core competencies and industry cluster strengths line up in a number of areas:

- Institutional strengths in the biosciences support industry activity in biopharmaceuticals and medical device-related technologies
- Institutional competencies in mathematics and computer sciences support industry presence in data processing, e-commerce, and enterprise applications
- Institutional competencies in advanced materials and applied nanotechnology match well with industry activities in advanced polymers, films, and composites

Through the application of core competency analysis to the roll-up of small clusters into larger groupings, the Brookings-Battelle process was able to identify a set of consolidated potential growth areas.

Step three: Addition of the line of sight to markets analysis to the industry cluster and core competency analyses ensures that Rhode Island's key industry identification process focuses on industries that matter. The final step in identifying Rhode Island's growth areas is to undertake a forward-looking assessment of how Rhode Island's industry drivers and growth capacities best connect to growing market opportunities and the state's ability to realize future growth.

This assessment is referred to as a line of sight to markets analysis. It involves integrating market research studies covering specific industry and technology areas in which Rhode Island has strengths, with insights from industry and economic development stakeholder interviews.

The growth areas identified have a close connection with specific industry strengths and growth capacities found in Rhode Island. Each of these dimensions are explored in the profiles below.

Five advanced industry growth areas and two opportunity industry growth areas offer Rhode Island the best chance for strengthening its economy and cultivating widely shared prosperity

Five high-value advanced industry growth areas surfaced as Rhode Island's best opportunities for expanding its advanced industry base in the coming years. These growth areas are:

- Biomedical Innovation
- IT-Software, Cyber-Physical Systems, and Data Analytics
- Defense Shipbuilding and Maritime
- Advanced Business Services
- Design, Food, and Custom Manufacturing

In addition, the Brookings-Battelle process identified two opportunity industry growth areas that produce larger numbers of accessible full-time jobs for those without college degrees. These opportunity industry growth areas are:

- Transportation, Distribution, and Logistics
- Arts, Education, Hospitality, and Tourism

Industry Growth Areas for Rhode Island by the Numbers

Advanced Industry Growth Areas

Biomedical Innovation

- 31,548 jobs in 2013
- 31% higher industry concentration than nation
- -0.2% job decline from 2009-2013

IT-Software, Cyber-Physical Systems, and Data Analytics

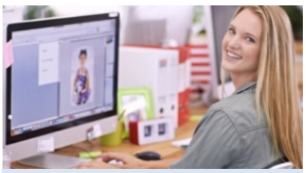
- 12,528 jobs in 2013
- 18% higher industry concentration than nation
- -3.2% job decline from 2009-2013

Defense Shipbuilding and Maritime

- 19,107 jobs in 2013
- 86% higher industry concentration than nation
- 9.1% job gains from 2009-2013

Advanced Business Services

- 34,780 jobs in 2013
- 30% higher industry concentration than nation
- 7.9% job gains from 2009-2013



Design, Food and Custom Manufacturing

- 11,045 jobs in 2013
- 128% higher industry concentration than nation
- -9.4% job decline from 2009-2013

Opportunity Industry Growth Areas

Transportation, Distribution, and Logistics

- 21,322 jobs in 2013
- 27% lower industry concentration than nation
- 5.3% job gains from 2009-2013

Arts, Education, Hospitality and Tourism

- 42,801 jobs in 2013
- 38% higher industry concentration than nation
- 5.2% job gains from 2009-2013

Taken together, these growth areas offer a range of well-documented opportunities for nurturing new advanced growth engines and supporting broader-based opportunity in Rhode Island. Some of these growth opportunities are relatively small in scale while others are much larger. Some can generate near-term gains while others represent longer-term development strategies. And as noted earlier, defense and food activities surface in several places, reflecting their multidimensional nature in the state.

These growth areas represent Rhode Island's best shot at getting its economy moving again.

What follows are detailed profiles of the seven growth areas.

WHAT IS IT?

Biomedical Innovation advances scientific knowledge of biological processes and systems in ways that are reshaping the diagnosis and treatment of medical conditions. These advances are converging with technology development in other scientific fields—including electronics, information technology, imaging, and nanosciences—to offer new insights that inform the creation of biomedical products.

Biomedical Innovation requires close connections between basic research, clinical research, and industry development. Its reach extends "from bench to bedside."

WHY IN RHODE ISLAND?

Industry strengths:

- Rhode Island has a large health and life sciences industry cluster that is highly specialized compared to the nation
    - Total employment in Rhode Island reached 31,548 jobs in 2013
    - Rhode Island has a 31 percent higher industry concentration in health and life sciences than the nation
- However, employment growth in this cluster has been flat since 2009 while growing at 4.5 percent nationally
- Particular detailed industry clusters of note include:
    - Both the biopharmaceutical and medical device industry clusters are highly specialized and growing in Rhode Island since 2009, though declining nationally
    - The hospital base is also more specialized than the nation, though it has been declining slightly in Rhode Island since 2009 while growing nationally
    - The Health and Life Sciences industry cluster stands out with 50 percent of its workforce employed in good jobs

Growth capacities across core competencies, innovative growth companies, and productivity:

- In Biomedical Innovation, Rhode Island possesses a strong alignment of industry and academic core competencies

  - Industry core competencies stand out in biopharmaceuticals involving active organic ingredients, drug delivery, and genetic engineering, as well as in medical technologies involving surgical tools, spinal and bone prosthetics, and design of medical equipment. Amgen's facility in West Greenwich has been named one of the top biologics manufacturing sites in the world

  - Academic research institutions offer a wide breadth of research strengths in Biomedical Innovation, led by neurosciences, infectious diseases, and public health. There is also strength in converging technologies applied to biomedical innovation, including sensors and imaging

- Biomedical Innovation also provides a strong presence of innovation-led emerging companies, with over 30 startups in biopharmaceuticals and medical devices in recent years. These innovation-led emerging companies include some of the leading venture-backed companies in the state such as Neurotech Pharmaceuticals ($29 million since 2009) and Mnemosyne Pharmaceuticals ($13 million). The DNA-sequencing firm had secured some $68 million before it closed this past autumn

- Productivity in Rhode Island in Biomedical Innovation slightly lags that of the nation, standing at 88 percent of the national average

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

Market opportunities in Biomedical Innovation range across pharmaceutical, medical devices, and health care informatics. A major topic that cuts across these markets is neurosciences, reflecting a particular strength of Brown University. Rhode Island has particularly strong market opportunities in:

- **Neuroscience-related therapeutics.** An opportunity area for Rhode Island is in biopharmaceuticals for psychiatric and neurodegenerative disorders. This opportunity builds upon the multidisciplinary capabilities found at Brown and its hospital network as well as emerging strengths at URI in studying brain function, pharmaceutical sciences for neurological application, and ongoing work in mood disorders, addiction, neurodegeneration, and vision. There are also multiple Rhode Island companies with products in neuroscience-related fields either for neural sensing and stimulation or biopharmaceuticals, including Afferent, Bionica, CRE Medical, Cyberkinetics, Mnemosyne, Myomics, Sention, and Tivorsan Pharmaceuticals. The market opportunity is quite significant in neuroscience-related therapeutics. Drugs for mental disorders are expected to reach $68.9 billion in 2013 globally, with an expected 2.3 percent compounded annual growth between 2013–2018.[24] Meanwhile, drugs for neurological disorders reached a global market of $11.1 billion in 2012 and are projected to see a healthy 8.5 percent compounded annual growth rate between 2012–2017, rising to a projected total market of $16.7 billion by 2017[25]

- **Medical devices for orthopedic, biosensing, and neurological applications**. Rhode Island's C.R. Bard is a market leader in comprehensive soft tissue reconstruction, delivering a growing line of mesh prosthetics, biologic implants, and fixation systems. There are also a number of emerging companies such as IlluminOss Medical, Inc., which is developing minimally invasive orthopedic systems for the stabilization and treatment of bone fractures; Biomedical Structures LLC, which provides biomedical textiles for medical devices; and CREmedical Corporation, which is advancing brain imaging to treat epilepsy. BCC Research places the orthopedics and spine devices market at $53 billion globally for 2013 and projects a rise to $77 billion by 2018—a compound annual growth rate (CAGR) of 7.5 percent. At the same time neurotechnology is a quickly evolving market in the application of electronic and engineering methods to understanding and controlling nervous system function, an area in which Brown University has been an early pioneer. Neurotech Reports, in work for Battelle, notes that the overall worldwide market for neurotechnology was $6.4 billion in 2014 and is anticipated to rise to $10.7 billion in 2018 (a 14 percent CAGR) – including major applications in neural prostheses, neuromodulation, neurorehabilitation and neurosensing[26]

- **Health care informatics and digital innovations** is another emerging area of opportunity in Biomedical Innovation in Rhode Island. Standing at the intersection of computer sciences, applied mathematics, remote sensing, and public health and health care systems, it provides opportunities for a niche focus on health care information systems. Rhode Island has a number of companies in the wellness, health monitoring, and computer health IT and apps space, including BLI Messaging, Chartwise Medical Systems, E4 Health, HealthID Profile, Insight Health Solutions, Qualitymetric, Quitbit, and ShapeUp. The U.S. market for clinical healthcare IT technologies approximated $11.2 billion in 2012 and is projected to grow substantially, to $23.5 billion by 2018 (a CAGR of 16.1 percent). Comprising both software and hardware technologies, this technology space bridges Rhode Island's platforms in Biomedical Innovation and IT-Software, Cyber-Physical Systems, and Data Analytics. Remote patient monitoring devices are expected to be a particularly fast-growing technology area[27]

WHAT ARE RHODE ISLAND'S KEY ASSETS AND BARRIERS TO GROWTH?

Assets for growth:

- Growing collaborations across Rhode Island's universities and academic hospitals involving a growing emphasis on clinical and translational research. The Brown operational plan for excellence calls for significant investments in clinical and translational research that will build strong partnerships with its academic hospital partners

- Brown plans to continue making significant investments in major research facilities and faculty in the neurosciences. Meanwhile, URI is launching its Ryan Institute for Neurosciences, which will collaborate closely with Brown on research and clinical studies

- There may be opportunities for positive spillover effects in Rhode Island from the strength of biomedical innovation taking place in the Boston area. These spillover effects can be encouraged by creating a more positive business environment for startups and emerging Health and Life Sciences companies in Rhode Island

Barriers to growth:

- Few university-industry connections exist in Rhode Island. There are few instances of established life science companies partnering with academic institutions in the state and commercialization of university research into new startups is not strong
- Lack of life science wet lab space for emerging companies is a barrier for new innovation-led life science companies
- While both the Slater Fund and Cherrystone Angel Fund are active early-stage investors in the life sciences, there is a concern that follow-on venture financing is hard to attract to Rhode Island

Advanced Industry Growth Areas

IT-Software, Cyber-Physical Systems, and Data Analytics

WHAT IS IT?

Cyber-physical systems—often referred to as the Internet of Things—represents the next frontier of the information technology revolution. It involves complex engineered systems that seamlessly integrate advanced sensing and imaging devices with cutting-edge information technologies and software applications for data management, computing algorithms and data analytics through the use of wireless technology connected through the Internet. Advances in cyber-physical systems are expected to enable adaptability, scalability, resiliency, safety, security, and usability of complex Big Data to inform real-time decisions. New smart cyber-physical systems will drive innovation and competition in sectors such as agriculture, energy, transportation, building design and automation, healthcare, and manufacturing.[28]

These advances have brought with them a heightened concern about cybersecurity given the need to protect the devices that generate information, the software that manipulates the information, and the data systems that store and eventually disseminate the information. In Rhode Island, this growth area contains a significant portion of the state's defense enterprise. Undersea technology and cybersecurity activities reside here while the state's sizable submarine building industry resides in the Defense Shipbuilding and Maritime domain.

WHY IN RHODE ISLAND?

Industry strengths:

- Rhode Island has a sizable and modestly concentrated level of jobs in IT-Software, Cyber-Physical Systems, and Data Analytics, though it is growing slowly
    - Total Rhode Island employment in IT-Software, Cyber-Physical Systems, and Data Analytics reached 12,528 jobs in 2013
    - Rhode Island has an 18 percent higher industry concentration in IT-Software, Cyber-Physical Systems, and Data Analytics compared to the nation
    - Employment growth from 2009-2013 in IT-Software, Cyber-Physical Systems, and Data Analytics was only 1.1 percent in Rhode Island, compared to 14.6 percent nationally
- Two broad industry clusters drive this growth area, but diverge in their economic performance:
    - Rhode Island has a 43 percent higher industry specialization than the nation in its broad industry cluster of Instruments, Electronics and Defense, involving over 3,088 jobs in 2013. But this broad industry cluster is in sharp decline, losing nearly 10 percent of its workforce since 2009
    - At the same time, the broad industry cluster IT-Software, Cyber-Physical Systems, and Data Analytics is growing in Rhode Island, advancing by 5.2 percent from 2009 to 2013 to reach 9,440 jobs in 2013. It has a modest 11 percent higher level of concentration than the nation, so still emerging as a specialized industry cluster

Growth capacities across core competencies, innovative growth companies and productivity:

- In IT-Software, Cyber-Physical Systems, and Data Analytics, Rhode Island has a mix of core competencies across industry and research institutions
    - Industry in Rhode Island has a cluster of patent activity in data processing, e-commerce, enterprise applications, and cybersecurity. In addition, industry in Rhode Island is patenting in the area of semiconductors and electronic components, with a focus on optical and electromagnetic sensors, fuel cells, and power conversion devices
    - Among research institutions, Brown stands out in mathematics and computer sciences. U.S. News and World Report ranks Brown University fifth in the nation in applied math and 20th in computer science among research universities. In addition, the Naval Underwater Warfare Center is a national leader in unmanned systems and brings extensive expertise in systems engineering to complex communications and electromagnetic systems

- The IT-Software, Cyber-Physical Systems, and Data Analytics growth area is the leading area for over 60 innovation-led emerging companies in Rhode Island. Among the major venture-backed companies are Swipely ($40 million) offering payment marketing services, Greenbytes ($36 million) offering data storage solutions, Utilidata ($20 million) providing power automation control systems and ShapeUp ($9 million) offering wellness software management. This is also an area for several fast growth companies that made the Inc. 5000 list, including Atrion, Carousel Industries, Gurnet Consulting, and MojoTech. Meanwhile, in semiconductors and electronic components, while there is not as a large number of emerging innovation companies, several SBIR-funded Rhode Island firms are actively involved in advanced instrumentation development for the military involving sonar-based systems, navigation systems, and radar systems

- Productivity levels found in the broad industry clusters comprising Rhode Island's IT-Software, Cyber-Physical Systems, and Data Analytics growth area lag the national average. Rhode Island reaches only 77 percent of the productivity level for Software Systems and Internet and a mere 39 percent for Instruments, Electronics, and Defense. These low productivity levels suggest an opportunity to spur more commercial-oriented products and more complex services

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

Rhode Island's core competencies suggest the state's potential to excel in specific market niches related to the IT-Software, Cyber-Physical Systems, and Data Analytics growth area.

- **IT-Software, Cyber-Physical Systems, and Data Analytics offers opportunities for Rhode Island in autonomous underwater vehicles, remote health care monitoring, environmental and energy monitoring systems, and smart grid applications.** The broader market for IT-Software, Cyber-Physical Systems, and Data Analytics is huge. McKinsey estimates the economic impact of the Internet of Things will reach between $2.7 trillion and $6.2 trillion per year by 2025, led by applications connecting devices for health care delivery and manufacturing.[29] Much of the value from cyber-physical systems will come from specific applications, so identifying and pursuing the most competitive applications will prove essential

    - **Autonomous Underwater Vehicles**. Rhode Island is well-positioned in this cluster in large part because of the Naval Underwater Warfare Center in Newport. IBISWorld reports that from 2014–2019, autonomous underwater vehicles are expected to rise at an annualized rate of 20.7 percent to $446 million. Oil and gas companies use these vehicles for pipeline inspections and mapping the ocean floor for deepwater drilling and offshore platforms. The autonomous underwater vehicles market also receives sizable amounts of defense funding[30]

    - **Remote medical device monitoring systems**. A much larger market that has already been identified for Rhode Island is remote monitoring systems for medical devices, particularly in the areas of neurotechnology, imaging, and general health and wellness.

BCC Research estimates that the global tele-home and tele-hospital market reached $19.2 billion in 2014 and is expected to increase to $43 billion in 2019, a five-year CAGR of 17.7 percent[31]

- **Environmental and energy monitoring and management systems.** Rhode Island has a number of companies and core technology competencies positioned to tap into this market, including Schneider Electric and Utilidata. One significant market is environmental controls in buildings that involve the development of systems that sense how equipment is operating and rely on real-time remote monitoring to provide prognostics on when components such as bearings are failing. BCC Research estimates that building automation systems was valued at $71.5 billion in 2011 and is expected to reach $88.2 billion by 2016, a five-year compound annual growth rate of 4.3 percent.[32] Another potential market is in smart energy grid management, a market McKinsey estimates will reach $130 billion by 2020.[33] The worldwide Smart Grid Operations Management software and services market is estimated to grow by more than 65 percent over the next five years, a CAGR of 11.1 percent. A new report published by ARC Advisory Group projects that this substantial growth will result from a concurrent wave of new technology and worldwide infrastructure spending driven by sovereign investment programs, which focus heavily on technology to improve grid reliability, efficiency, and information management capabilities

- **Rhode Island is positioned to grow in the field of Data Analytics to capture the power of Big Data in new tools development and talent development.** Brown University is planning a new Data Sciences Institute to better leverage its nationally-ranked strengths in applied math and computer sciences. This research center will provide an opportunity to develop new tools, applications, and services for advancing the field of data analytics. Wikibon estimates that the market for applications in data sciences reached $27 billion in 2014 and is expected to grow at a hefty compounded annual growth rate of 17 percent to reach $84 billion by 2026[34]

  It will be especially important for Rhode Island to focus on cultivating and attracting the talent needed to deploy new Data Analytics solutions. The need is pressing. The McKinsey Global Institute reports that the United States faces a shortage of 140,000 to 190,000 people with data analytical expertise and 1.5 million managers and analysts with the skills to understand and make decisions based on the analysis of big data.[35] Fortunately, both Brown and URI are expanding and advancing new educational offerings in Data Analytics and software development.

  Cybersecurity workforce shortages also loom large. A significant shortage of skilled cybersecurity workers has made organizations more vulnerable to attacks, which in turn increases demand for cybersecurity workers. Job openings in cybersecurity are growing twice as fast as in other IT categories.[36] Even more traditional software development jobs are experiencing shortages. The Technology Councils of North America indicate that 83 percent of

industry reported a shortage of software development professionals, mostly due to the lack of qualified local talent.[37]

What are Rhode Island's Key Assets and Barriers to Growth?

Assets for growth:

- NUWC's leadership in autonomous underwater systems for the Navy is a critical competitive advantage for Rhode Island
- Presence and growth of Advanced Business Services in Rhode Island offer a strong demand driver for cyber-skills

Barriers to growth:

- Talent generation and retention is of concern and a much more concerted effort to grow cyber-talent is needed. Rhode Island also must do more to retain its college graduates, especially those leaving Brown University with degrees in computer science and applied math
- An outward-facing signature research center in IT-Software, Cyber-Physical Systems, and Data Sciences is needed. Other states have similar efforts underway, including Indiana's Pervasive Technology Institute, North Carolina's Renaissance Computing Institute, Ohio's Supercomputing Center, and Washington State's e-Science Institute

Advanced Industry Growth Areas

Defense Shipbuilding and Maritime

What Is It?

The extensive breadth of defense shipbuilding and other maritime industry activities taking place across Rhode Island is impressive. This includes custom boat and defense submarine building, renovating, and servicing; development of advanced materials and component boat/ship systems; nautical tourism; and the preservation of coastal communities and environments. This part of the state's multidimensional defense enterprise does not include undersea technology, cyber-physical systems, or security IT, all of which reside in the IT-Software, Cyber-Physical Systems, and Data Analytics growth area discussed above.

WHY IN RHODE ISLAND?

Industry strengths:

- Rhode Island stands out as the nation's Ocean State.
    - The broad industry cluster of Marine, Materials, and Machinery, which encompasses the manufacturing components of the Defense Shipbuilding and Maritime growth area, is highly specialized, with an 86 percent higher level of concentration than the national average. This cluster has held strong through the economic recovery, growing 9.1 percent in Rhode Island compared to 4.9 percent nationally. It is also quite sizable at over 19,000 jobs
    - There are strong links with tourism in Rhode Island for boating and beach resorts and sailing regattas are an important draw for Rhode Island

Growth capacities across core competencies, innovative growth companies and productivity:

- Both industry and research institutions in Rhode Island bring core competencies in advanced materials. Industry core competency is found in advanced polymers, films, and composites, while the research institution focus on advanced materials is particularly active in applied nanotechnology
- A transformative core competency is URI's outstanding school of oceanography that includes world-class expertise in ocean mapping
- Rhode Island is a first-mover in offshore wind thanks to progressive regulations, burgeoning industry presence (including headquarters and suppliers), opportunity to build on momentum, and early-mover advantage
- Within the Marine, Materials, and Machinery broad industry cluster, productivity stands 73 percent higher than the nation and 57 percent of the jobs are good jobs. This suggests strong deployment of advanced technologies in production activities, which in turn yields high quality jobs and good career prospects for more Rhode Islanders

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

The breadth of Rhode Island's activities within the Defense Shipbuilding and Maritime growth area serves the state well. It has multiple ways to grow, including:

- **Boatbuilding and defense-related ship and submarine building**. Continued growth is expected for both boatbuilding and defense-related ship and submarine building. For boatbuilding, IBISWorld reports that in the economic recovery years of 2010–2015 there was considerable pent-up demand that generated a robust 9 percent annual growth rate. Going forward, this growth will moderate to 2.1 percent annually.[38] Despite continued pressure on defense

spending, the demands on the U.S. military suggest growth in defense-related ship and submarine building, which is expected to increase by 6.0 percent[39]

- **Oceanographic cartography.** Ocean mapping is a growing market involving positioning systems, acoustic underwater systems, non-acoustic marine geophysical systems, oceanographic system and samplers along with applications such as hydrographic/bathymetric survey, seabed feature mapping, port and harbor management, dredge operations, offshore oil and gas survey, cable/pipeline route survey, and charting. A number of factors—including an increase in maritime commerce, rapid growth in infrastructure and construction industry, and exploration of oil and gas reserves—drive demand, which is expected to increase by 6–7 percent on an annual compounded rate between 2014–2020[40]

- **Marine tourism.** The prospects for Rhode Island to expand marine-based tourism are strong. The U.S. Army Corps of Engineers reports that coastal states receive about 85 percent of tourist-related revenues in the United States. Others estimate that some 180 million Americans make 2 billion visits to ocean, gulf, and inland beaches each year—more than twice the number of visitors to all the National Park Service properties combined[41]

WHAT ARE RHODE ISLAND'S KEY ASSETS AND BARRIERS TO GROWTH?

Assets for growth:

- Highly integrated maritime economy across manufacturing, services, and research reinforces Rhode Island's competitive advantages in this growth area. For instance, because Rhode Island is a leading state in custom boatbuilding, renovation, and servicing, it attracts boat owners who in turn increase tourism in the state

- URI's most prominent area of research is ocean sciences and engineering, a program that is truly world-class. Much of the top talent across the world has attended or collaborated with URI, providing Rhode Island a strong reputation in this field

- NUWC stands as a leader in underwater systems and Electric Boat is a major builder of submarines

Barriers to growth:

- Talent retention to meet industry needs is a major concern of employers, especially for manufacturing-related activities in the Marine, Materials, and Machinery cluster

- Industrial space for expansion—including large-scale structures for both boatbuilding and composites—is hard to find in Rhode Island. It is difficult for this type of space to compete with recreational and residential development along Rhode Island's coastal communities

- Organized support mechanisms for advancing ocean shipping and military affairs are lacking. Despite federal and state officials' emphasis on defense and the ongoing efforts of the Southeastern New England Defense Industry Alliance (SENEDIA), Rhode Island—unlike other New England states—does not have the organized industry-government partnership efforts in place to help address key competitive issues and position the state for growth

- Limited presence of ocean engineering firms despite the strengths of URI. This is a surprising gap in the industry activities of the Defense Shipbuilding and Maritime growth area. Pursuing a signature industry-university shared-use facility might be needed to attract and grow ocean engineering firms to Rhode Island

WHAT IS IT?

Modern business organizations rely on back office and headquarters operations to ensure the overall functioning of their key business systems, including computing, data processing, marketing, client management, human resources, financial services, and support for development of new strategies and products. These operations base their competitiveness in large part on the application of advanced technologies, particularly those involving advanced information technology.

WHY IN RHODE ISLAND?

Industry strengths:

- Advanced Business Services is already a significant industry strength in Rhode Island that is large, specialized, and growing faster than the national trend

    - Rhode Island's Advanced Business Services industries encompasses nearly 35,000 jobs, which represents a 30 percent higher level of industry concentration in the state than found nationally

    - From 2009-2013 Rhode Island recorded a strong gain of 7.9 percent in Advanced Business Services jobs, well above the national growth rate of 4.5 percent

- Both Connecticut and Massachusetts also have a high industry specialization in Advanced Business Services, but unlike Rhode Island their clusters are not growing. This fact suggests that

that the business environment in Rhode Island is better positioned for office operations of headquarters and insurance and financial services

Growth capacities across core competencies, innovative growth companies, and productivity:

- Advanced Business Services aligns strongly with Rhode Island's core competencies in information technology, including industry efforts in data processing and university strengths in applied math and computer sciences
- Advanced Business Services also does well in other growth capacities, standing 9 percent higher than the nation in value-added per worker and employing 48 percent of its workforce in good jobs

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

For Rhode Island to become a national leader in Advanced Business Services, it will need a stronger value proposition in IT-Software, Cyber-Physical Systems, and Data Analytics.

- **Advanced Business Services growth will require and could be accelerated by IT service delivery**. The growth forecast for Advanced Business Services points toward continued strong gains in output but little by way of job creation. BLS projects a national CAGR of 3.7 percent in economic output from this growth area, well above the national average of 2.6 percent for all industries. At the same time, employment growth projections for Advanced Business Services nationally are a mere 0.7 percent each year compared to 1.0 percent annually for all national industries. These contrasting projections of output and employment indicate that increased productivity will be a key driver for Advanced Business Services. Accelerated innovation in the state's IT-Software, Cyber-Physical Systems, and Data Analytics sphere could generate important synergies and support further growth in Advanced Business Services
- **Big Data matters for Advanced Business Services growth**. Productivity and employment growth in the Advanced Business Services realm will increasingly depend on firms' ability to manage and analyze unprecedented amounts of data generated from record digitization, online transactions, social networking, and Internet searches. *Forbes* reports that 89 percent of business leaders surveyed by Salesforce believe that Big Data will revolutionize business operations by offering greater insights into customers and their needs as well as streamlining sales and customer service.[42] Rhode Island will stay competitive and continue to outpace national trends in Advanced Business Services if it can realize its potential as a leading location for Big Data. This effort ties directly to the core competencies found in industry and research institutions in data sciences, with industry having innovation strengths in data processing, e-commerce, and enterprise applications and research institutions possessing core technology competencies in mathematics and computer science. Ensuring the state's underserved populations have access to these growth opportunities will be critical in the next five years

What Are Rhode Island's Key Assets and Barriers to Growth?

Assets for growth:

- Rhode Island's economic momentum in Advanced Business Services should be celebrated and better marketed as a competitive advantage
- Strong regional opportunities for Rhode Island to pursue Advanced Business Services exist among the major corporate presences found in New England and New York
- The new Data Sciences Institute at Brown can raise Rhode Island's competitiveness in Advanced Business Services if the institute collaborates with industry

Barriers to growth:

- Rhode Island will need to offset the higher costs of doing business compared to other centers such as Atlanta and Dallas with a very positive value proposition of innovation and access to high-quality talent
- Commercial real estate development constraints cited by industry, including high property taxes and local zoning requirements, will need to be monitored and addressed
- Limited connections between universities and industry limits Rhode Island's ability to cultivate and attract high-end talent for data sciences

Advanced Industry Growth Areas

Design, Food, and Custom Manufacturing

What Is It?

Industrial design provides significant competitive advantages for companies, especially in consumer products and packaging, which prize distinctive style and usability. Driven by rapid technological developments, falling costs, and new applications for 3D printing technology, the emphasis on industrial design is intensifying in the product and service development process. Meanwhile, a burgeoning maker movement is reshaping product development by lowering the barriers to designing and manufacturing goods.

WHY IN RHODE ISLAND?

Industry strengths:

- Rhode Island stands out for its high industry specialization in the consumer product industries that comprise its Design, Food, and Custom Manufacturing growth area
    - With just over 11,000 jobs across consumer goods industries such as jewelry, furniture, textiles, toys, and food manufacturing, Rhode Island has more than double the industry concentration found nationally. (Note that restaurants reside in the Arts, Education, Hospitality, and Tourism growth area)
    - Even still, Rhode Island continues to shed jobs across industries found in this growth area. While employment at the national level was largely flat, showing a slight decline of 0.5 percent from 2009-2013, Rhode Island declined by 9.4 percent during the same period
    - Large employment losses are not inevitable for these manufacturing-related industries involved in consumer goods. From 2009-2013 Rhode Island saw 16 percent growth in perishable food production and 34 percent growth in consumer displays and signage. In addition, both textile industries and design service industries saw only slight job declines of around 2 percent during that period

Growth capacities across core competencies, innovative growth companies and productivity:

- The Design, Food, and Custom Manufacturing growth area taps into identified core competencies found in Rhode Island, including strengths in design at RISD and in culinary arts at Johnson & Wales as well as industry strengths in advanced polymers, films, and composites used in packaging
- Productivity is very high for Rhode Island industries associated with the Design, Food, and Custom Manufacturing growth area, standing 45 percent higher than the U.S. average. This fact suggests an underlying competitive edge for the state

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

Two particular opportunities for growth reflect a broad strength and a more specific market niche within the Design, Food, and Custom Manufacturing growth area.

- **The broad field of industrial design is in demand and an important driver of competitive advantage for consumer products**. IBISWorld explains: “Industrial designers are hired by manufacturers to improve the functionality, longevity and production efficiency of a range of goods. In coming years, consumers will increasingly seek highly differentiated and aesthetically pleasing products, ranging from cars to electronics to furniture, generating sustained demand for industrial designers.” IBISWorld projects industry revenue will rise at an annualized rate of

1.7 percent over the period 2014–2019.[43] While Rhode Island offers many types of consumer products for design to shape, one particular area stands out—the convergence of design and medical devices. Medical equipment manufacturers hire industrial designers to create products that are functional and simple to use. Greater expenditure on medical equipment increases demand for industrial designers and, by extension, boosts industry revenue. Demand for medical equipment manufacturing has increased nationally over the past five years and currently generates about 15.6 percent of revenue for industrial design services[44]

- **A more specific market opportunity for Rhode Island is in food manufacturing—particularly at the nexus of food and health.** Rhode Island's food manufacturing industry is already strongly positioned in the state with a 32 percent higher level of industry concentration than the nation and employment growth of 16 percent from 2009-2013, significantly exceeding national employment growth of 3.8 percent. While food manufacturing is a mature industry with modest growth projections according to BLS, it encompasses a number of fast-growing segments, particularly at the nexus of food and health. BCC Research projects that sports nutrition products will grow at a CAGR of 10 percent from 2014-2022, while nutraceuticals—an umbrella term used to describe any food product with particular health benefits—is expected to realize a 7 percent CAGR from 2014-2019.[45] By connecting Rhode Island's growing food manufacturing industry with core competencies in food and health found at Johnson & Wales, there is significant upside potential for continued strong growth. In addition, upgrading warehousing capabilities for cold storage at Rhode Island's ports could provide an additional boost to Rhode Island's food manufacturing industry

WHAT ARE RHODE ISLAND'S KEY ASSETS AND BARRIERS TO GROWTH?

Assets for growth:

- Rhode Island has a diversified base of consumer product companies serving a wide variety of markets
- RISD is a leader in design that offers through its faculty, students, and graduates an enabling strength to spur further innovation and provide competitive advantage for Rhode Island's consumer products industries
- Johnson & Wales is actively involved in advancing healthy foods and is expanding its capacities in conscious cuisine to spur innovation at the nexus of food and health as well as entrepreneurship to move those innovations to the market

Barriers to growth:

- Rhode Island needs to be more proactive in retaining design talent, including engaging RISD faculty to do creative work in the state

- Rhode Island lacks large-scale shared spaces—including large-scale maker spaces and shared facilities for food testing and production—that can attract companies and foster partnerships with individuals at RISD and Johnson & Wales

Opportunity Industry Growth Areas

Transportation, Distribution, and Logistics

WHAT IS IT?

Transportation, Distribution, and Logistics encompasses Rhode Island's multi-modal freight transportation system, which includes ocean shipping, rail shipping, and trucking. These freight transportation activities help drive the siting of warehousing and distribution centers and the demand for logistics services.

WHY IN RHODE ISLAND?

Industry strengths:

- Transportation, Distribution, and Logistics represents a large and growing industry opportunity in Rhode Island
    - Over 21,000 jobs are in Transportation, Distribution, and Logistics, despite the fact that the industry has a 27 percent lower concentration in Rhode Island than in the nation
    - Rhode Island is adding jobs in Transportation, Distribution, and Logistics and grew 5.3 percent from 2009-2013. This is slightly above the national growth rate of 4.9 percent
    - No state in New England currently specializes in Transportation, Distribution, and Logistics, suggesting an opportunity to consolidate this industry more centrally in Rhode Island in order to better serve New England and the Northeast
    - Rhode Island is the only state in New England to realize sizable job gains in Transportation, Distribution, and Logistics between 2009 and 2013. During that same period, Connecticut, Massachusetts, and Vermont saw slight declines in employment and gains in New Hampshire and Maine were under 1 percent

Growth capacities across core competencies, innovative growth companies and productivity:

- There are no core competency drivers for Transportation, Distribution, and Logistics in Rhode Island, though the state does possess assets such as its multi-modal capacities in ports, air, and highway access points
- Productivity for Rhode Island in Transportation, Distribution, and Logistics is on par with the nation, standing 3 percent higher in Rhode Island

WHAT ARE THE OPPORTUNITIES FOR RHODE ISLAND?

A closer look at Rhode Island's Transportation, Distribution, and Logistics activities in recent years suggests two growing areas whose economic momentum can continue in the future:

- **Grocery Wholesale is a growing industry activity in Rhode Island with strong growth prospects nationally**. Rhode Island saw 9.5 percent job growth from 2010-2014 in grocery wholesaling, with total employment standing at approximately 2,500 jobs. Nationally, BLS projects strong economic output growth of 3.7 percent on a compounded annual rate from 2012-2022 for grocery wholesaling. For Rhode Island, a focus on Grocery Wholesale complements the growth opportunity in food manufacturing and leverages the multi-modal distribution found in the state
- **Warehousing and Storage has made strides in Rhode Island and is expected to grow nationally**. Rhode Island posted a 26 percent gain in jobs from 2009-2013 in warehousing and storage activities, reaching over 1,300 jobs in 2013. Nationally, BLS is projecting a 3.5 percent gain in economic output on a compounded annual basis from 2012-2022. Growth in Warehousing and Storage is significant but investments in increased capacity, particularly with regard to cold storage, will be needed to keep Rhode Island competitive

WHAT ARE RHODE ISLAND'S KEY ASSETS AND BARRIERS TO GROWTH?

Assets for growth:

- Modest but nimble port facilities with intermodal connections
- Access to populous Northeastern market offers many opportunities to grow and become a major regional transportation and distribution hub

Barriers to growth:

- Few sizable developable industrial parcels needed for state-of-the-art logistics warehouse and logistics centers
- Negative public reaction to the land-intensive development needed for Transportation, Distribution, and Logistics activities to grow is a concern of those in the industry

- Rhode Island does not have research strengths found in other states to support logistics activities
- Lack of a centralizing or coordinating body to pursue broader Transportation, Distribution, and Logistics development
- Lack of specialized facilities such as cold storage for transporting food products, which is a high priority opportunity for Rhode Island in light of its growing food manufacturing activities

Opportunity Industry Growth Areas

Arts, Education, Hospitality, and Tourism

WHAT IS IT?

An opportunity growth area that brings together creative and recreational services across the industries involved in the arts, higher education, hospitality, full service restaurants, convention, tours and sightseeing, and gambling.

WHY IN RHODE ISLAND?

Industry strengths:

- Arts, Education, Hospitality, and Tourism is the largest growth area in Rhode Island and continues to add new jobs.
    - More than 40,000 jobs are found in Arts, Education, Hospitality, and Tourism in Rhode Island, which represents a 38 percent higher industry concentration than the nation
    - Only Vermont has a higher level of industry concentration at 45 percent higher than the nation, but is roughly only two-thirds the size of Rhode Island's Arts, Education, Hospitality and Tourism industry activities
    - Job growth from 2009-2013 stands at 5.2 percent in Rhode Island, which is below the national average of 8.6 percent job growth.

Growth capacities across core competencies, innovative growth companies and productivity:

- The Arts, Education, Hospitality, and Tourism growth area leverages the core competencies of Rhode Island's nationally ranked educational institutions in Rhode Island directly involved in arts and culinary sciences—RISD and Johnson & Wales

- Productivity for the Arts, Education, Hospitality, and Tourism industries in Rhode Island is 13 percent higher than the nation, suggesting a higher value of services being offered

What Are the Opportunities for Rhode Island?

As an opportunity industry the focus of growth in the Arts, Education, Hospitality and Tourism industries should be on activities that bring new wealth into the state. This growth area more broadly reflects the quality of life found in Rhode Island and so is also critical for placemaking activities in the state

- **Tourism represents a key wealth creation opportunity**. Tourism as an economic driver is already quite notable in Rhode Island. The Arts, Hospitality, and Tourism industries comprise over 31,000 jobs and recorded strong growth of 12.7 percent from 2009-2013 compared to 8.9 percent nationally. Rhode Island offers a high quality location for visitors. Providence is active through its convention center, leveraging the city's redevelopment and outstanding restaurants with the convenience of easy access by air, car, and rail. Rhode Island also offers coastal and marine-based tourism, with high quality beaches and boating opportunities.

- **Higher education is expected to make strong gains through 2022**. Rhode Island is a small state with a broad mix of higher education institutions that attract students from outside the state. The strength of higher education as an economic driver in Rhode Island is demonstrated by the fact that the state has a 158 percent higher industry concentration in private colleges and universities than the nation, with total employment of over 11,000 jobs. Furthermore, BLS projects that annual job growth in higher education will increase at a healthy 2.2 percent annually from 2013-2022.

What Are Rhode Island's Key Assets and Barriers to Growth?

Assets for growth:

- Rhode Island's beaches, boating, and historic communities such as Newport offer high value destinations

- Good air transportation is an asset for tourism

- Gathering buzz about Providence as a redeveloped urban center with high quality amenities, including excellent restaurants

- A renewed statewide focus on tourism to grow Rhode Island's economy is now in place and includes a strong branding and marketing effort

- The unique capabilities and name recognition that RISD and Johnson & Wales provide for arts and culinary sciences, respectively

Barriers to growth:

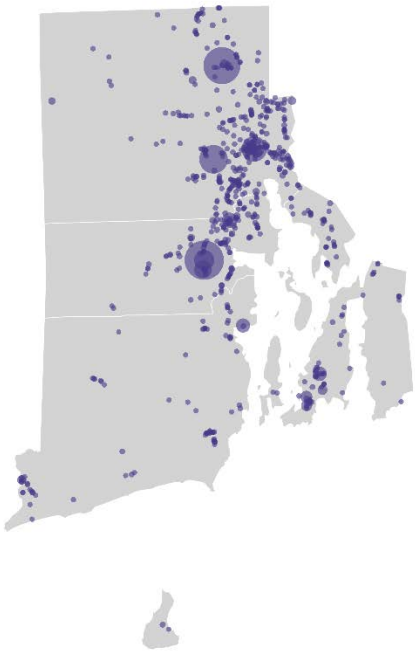
- Seasonality of coastal and marine-based tourism limits ability to attract high-end venues like a five-star hotel
- The lack of water-based passenger infrastructure across the bay and around coastal areas limits accessibility and the broader tourist experience

The industries that comprise the state's growth areas are not evenly distributed but cluster in different mixes across the state's five counties

The Ocean State's five counties comprise essentially three regional economies that represent distinct groupings of all seven growth areas identified above. These regions interact and intersect to form Rhode Island's statewide economic profile.

Advanced Business Services activity, for example, is widely distributed but clusters in the northern part of the state. Biomedical Innovation and Design, Food, and Custom Manufacturing firms are similarly dispersed but concentrate primarily in the Providence metro and nearby parts of Kent County.

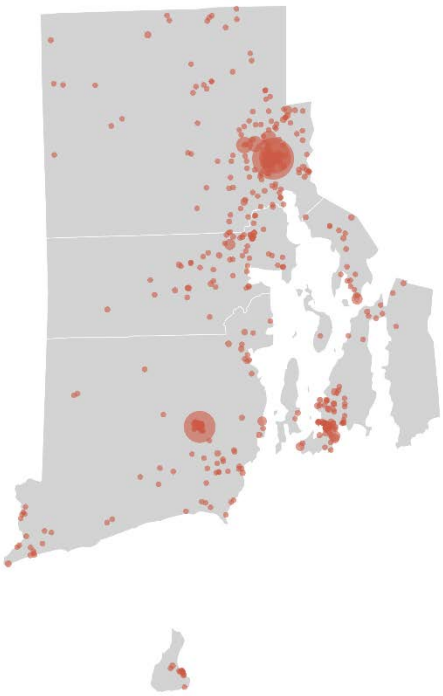
Employment in Advanced Business Services clusters in northern Rhode Island



Transportation, Distribution, and Logistics is similarly dense in northern Rhode Island, though as elsewhere establishment concentration generally tracks with population in each of the state's three regions.

IT-Software, Cyber-Physical Systems, and Data Analytics firms are also spread out across the state but the presence of software and IT firms gives Bristol and Newport counties a sizeable share of the state's firms in this growth area, while instrumentation and defense-oriented manufacturers drives IT-Software, Cyber-Physical Systems, and Data Analytics growth in the eastern part of the state.

Newport and Bristol Counties lead on employment in Arts, Education, Hospitality, and Tourism



Arts, Education, Hospitality, and Tourism is significantly oriented around the state's seashore and a remarkable concentration of museums and other amenities on Aquidneck Island, making Newport and Bristol counties leaders in this growth area.

Defense Shipbuilding and Maritime is mostly concentrated in the northern part of the state but not in line with population, meaning that total employment within the growth area remains low. Southern Washington County has almost a third of the state's employment in Defense Shipbuilding and Maritime, but that only accounts for a tenth of the state's total employment.

In general, the state's economic geography is that of a major metropolitan area and proximate surrounding and adjoining counties, with the remaining three counties having distinct specializations outside of Advanced Business Services. Northern Rhode Island's Kent and Providence counties contain

the lion's share of the state's jobs and given their proximity to the Massachusetts border share a service-oriented economy that is highly specialized in design, education, and financial services. The northern part of the state also enjoys a sizeable hospital presence and the bulk of the state's IT-Software, Cyber-Physical Systems, and Data Analytics, anchored by software and internet services activity.

Newport and Bristol, the eastern counties, are small in terms of their employment base but have a sizeable specialty in Defense Shipbuilding and Maritime through yacht construction and repair; host several private colleges and universities; and have a foothold in IT-Software, Cyber-Physical Systems, and Data Analytics as well as Design, Food, and Custom Manufacturing.

Southern Rhode Island's Washington County serves as a Shipbuilding and Maritime hub of the state.

Greater Providence and Northern Rhode Island

The bulk of Rhode Island's jobs are located in the northern part of the state, which for this analysis includes both Providence and Kent counties. These two counties share a border and proximity to Massachusetts and the Boston metropolitan area as well as a labor market and a common industrial composition. Together Providence and Kent account for over 374,000 jobs or 76 percent of the state's total employment.

Rhode Island's Advanced Business Services concentrate in Kent and Providence, where over 88 percent of the state's jobs in this growth area are located. Advanced Business Services employs 34,000 workers, more than Design, Food, and Custom Manufacturing and Arts, Education, Hospitality, and Tourism combined (despite the fact that these latter two are specialized in the region). Advanced Business Services is also the fastest growing growth area in the northern part of the state due to strengths in insurance and finance. Providence has major employers in insurers Factory Mutual and Bank of America while Lincoln is home to Amica. Kent's major employers are Metropolitan Group Properties & Casualty, United Health Care, and Beacon Mutual.

Biomedical Innovation is overrepresented in the north, where 86 percent of the state's activity is located. This growth area represents a sizeable share of the counties' employment (27,000 jobs, 7.2 percent of total employment) and includes anchor firms such as Rhode Island, Women & Infants, and Memorial Hospitals in Providence and Kent County Memorial Hospital and C.R. Bard, Inc. in Kent.

Northern Rhode Island Growth Area Profile

Growth Area	Employment 2014	Share of Total Regional Employment 2014	Location Quotient 2014	CAGR 2000–10	CAGR 2010–14
Biomedical Innovation	27,029	7.20%	1.46	1.80%	-0.30%
IT-Software, Cyber-Physical Systems, and Data Analytics	9,240	2.50%	1.07	-1.10%	0.50%
Defense Shipbuilding and Maritime	11,641	3.10%	0.88	-6.80%	0.00%
Advanced Business Services	34,042	9.10%	1.65	0.90%	0.80%
Design, Food, and Custom Manufacturing	7,115	1.90%	2.66	-8.10%	-0.90%
Transportation, Distribution, and Logistics	18,038	4.80%	0.8	-1.00%	0.50%
Arts, Education, Hospitality, and Tourism	19,854	5.30%	1.68	0.40%	0.60%
All Growth Areas	126,959	33.9%	1.30	-1.3%	0.3%
Total Employment	**374,778**	**100.0%**	**1.00**	**-0.7%**	**0.3%**

With the exception of Design, Food, and Custom Manufacturing, the state's growth areas have added jobs on average each year in northern Rhode Island since 1980. Even still, Design, Food, and Custom Manufacturing remains a key specialization in this part of the state, despite the fact that the 7,000 jobs in this growth area represent less than 2 percent of total employment in the two counties. Although northern Rhode Island firms in this growth area experienced major losses (nearly 37,000 jobs since 1980), greater losses were seen elsewhere in the United States. As a result, Providence and Kent employ people in this growth area at over two and half times the intensity of the nation as a whole, making it one of the most specialized regions in the United States for Design, Food, and Custom Manufacturing Products. Major firms in the region include Kenney Manufacturing and Clariant in Kent and Visual Creations and Packaging Concepts in Providence.

Arts, Education, Hospitality, and Tourism account for nearly 20,000 jobs in the two northern Rhode Island counties, which represents roughly 5.3 percent of total employment. The major employers in this cluster are Rhode Island's universities and colleges—Brown University, Rhode Island College, Providence College, and Johnson & Wales in Providence and the Community College of Rhode Island system, which has locations throughout the state.

Rounding out the growth area specializations in northern Rhode Island is IT-Software, Cyber-Physical Systems, and Data Analytics, where Providence and Kent counties share 7,000 jobs, representing nearly 2 percent of total employment in the region. The largest employers are the French 3D design firm Dassault Systèmes in Providence and payroll giant Automatic Data Processing (ADP) in Kent.

Eastern Rhode Island: Newport and Bristol Counties

Aquidneck Island is a prominent geographic feature of eastern Rhode Island, along with the surrounding bay and ocean that together make Newport and Bristol counties hubs of Arts, Education, Hospitality, and Tourism establishments and activity. Though this part of the state accounts for approximately 12 percent of total jobs statewide, more than one-fifth of all Arts, Education, Hospitality, and Tourism jobs are located in these two counties. Employment in Arts, Education, Hospitality, and Tourism is almost three times as concentrated here as it is nationally, accounting for nearly 10 percent of local employment (5,500 jobs). This relative concentration is driven by the presence of several private colleges and universities as well as many local museums. Salve Regina in Newport and Roger Williams University in Bristol are major employers in these two counties.

Overall Newport and Bristol do not have a significant specialization in Defense Shipbuilding and Maritime, though their strong presence in yacht construction and repair provides over 1,000 jobs (nearly 2 percent of total employment in the region and over 18 times the concentration in the nation). At the same time, eastern Rhode Island maintains a major presence in related defense activities in the IT-Software, Cyber-Physical Systems, and Data Analytics realm. Strength in this growth area is demonstrated by the presence of KVH Industries, a sea-specialized mobile satellite company in Middletown, and Raytheon in Portsmouth.

Eastern Rhode Island Growth Area Profile

Growth Area	Employment 2014	Share of Total Regional Employment 2014	Location Quotient 2014	CAGR 2000-10	CAGR 2010-14
Biomedical Innovation	1,895	3.30%	0.66	0.70%	0.50%
IT-Software, Cyber-Physical Systems, and Data Analytics	2,297	3.90%	1.71	-0.20%	-1.60%
Defense Shipbuilding and Maritime	1,693	2.90%	0.83	-5.80%	0.90%
Advanced Business Services	2,190	3.80%	0.68	2.90%	0.70%
Design, Food, and Custom Manufacturing	571	1.00%	1.38	-4.70%	-0.10%
Transportation, Distribution, and Logistics	1,021	1.80%	0.29	-0.70%	-0.80%
Arts, Education, Hospitality, and Tourism	5,578	9.60%	3.04	0.30%	0.70%
All Growth Areas	15,245	26.2%	1.00	-0.6%	0.1%
Total Employment	**58,192**	**100.0%**	**1.00**	**0.1%**	**0.0%**

Although IT-Software, Cyber-Physical Systems, and Data Analytics employs 2,300 people in the region and Design, Materials, Food, and Custom Manufacturing employs just 600, these two growth areas employ more people as a share of total employment than the United States as a whole.

Southern Rhode Island

Southern Rhode Island, which for this analysis focuses on Washington County, is the smallest of the state's three regions. Defense Shipbuilding and Maritime is strongly represented, with employment in shipbuilding alone representing 5 percent of total local employment—nearly 50 times that of the economy nationwide. With over 2,700 jobs in shipbuilding, Washington County accounts for fully half of the Defense Shipbuilding and Maritime growth area in the region. Major employers include Schnieder Electric in West Kingstown, and Coto Technology, Electric Boat, Senesco Marine, and Toray Plastics in North Kingstown.

In addition to Defense Shipbuilding and Maritime, Washington County retains strong specializations in textile production, which anchors its Design, Food, and Custom Manufacturing growth area. This despite the fact that the textile industry has been shedding jobs in the area and throughout the United States for decades, particularly since 2000. Though not a specialization in southern Rhode Island, a sizable Arts, Education, Hospitality, and Tourism cluster is anchored by the University of Rhode Island, which is another major employer in the region.

Southern Rhode Island Growth Area Profile

Growth Area	Employment 2014	Share of Total Regional Employment 2014	Location Quotient 2014	CAGR 2000-10	CAGR 2010-14
Biomedical Innovation	2,552	4.60%	0.94	2.70%	0.90%
IT-Software, Cyber-Physical Systems, and Data Analytics	1,275	2.30%	1	14.20%	1.80%
Defense Shipbuilding and Maritime	5,323	9.60%	2.74	0.10%	1.60%
Advanced Business Services	2,221	4.00%	0.73	1.50%	1.00%
Design, Food, and Custom Manufacturing	941	1.70%	2.39	-5.90%	0.50%
Transportation, Distribution, and Logistics	2,418	4.40%	0.73	3.80%	0.50%
Arts, Education, Hospitality, and Tourism	1,022	1.90%	0.59	-1.80%	1.70%
All Growth Areas	15,752	28.5%	1.09	1.1%	1.2%
Total Employment	**55,177**	**100.0%**	**1.00**	**1.1%**	**0.5%**

* * *

This detailed examination of the industries powering Rhode Island's economy reveals that the state possesses a number of promising industry development opportunities and growth areas. At the same time, the chapter suggests that the state would not be well served by an economic development strategy that relies on heavy investment in individual industry targets. Rhode Island's industries are too small and not always competitive enough to warrant that approach. Of the 33 detailed industry groupings identified, 24 contain fewer than 5,000 jobs. Particularly small are those industry groups associated with advanced industries in Rhode Island.

That said, the analysis shows that Rhode Island's intricate webs of smaller interconnected industries, when aligned with core competencies, add up to a finite set of promising growth areas that appear ripe for crosscutting support.

The next section will assess the state of the state's crosscutting growth platform.

4. Situational Assessment—Rhode Island's Competitive Position

Without a change of its economic trajectory Rhode Island will continue to see its standard of living decline, its available resources erode, and its ability to connect its diverse population to sustaining opportunities weaken.

Rhode Island needs to bend its trends and ultimately improve its industry mix.

Fortunately, Rhode Island possesses intriguing industry specializations and genuine competencies. Respected universities conducting path-breaking research, a vivid quality of place, and creative workers represent key assets. If properly aligned these could differentiate the state and result in improved economic outcomes.

How well do these assets and competencies stand up as sources of competitive advantage for Rhode Island? To find out, Brookings and Battelle conducted a detailed situational assessment of the strength of the state's basic competitiveness drivers and enablers.

In conducting this review, the study team carefully considered the unique nature of Rhode Island's intricate network of small, interconnected industry clusters in determining the most relevant sorts of drivers and enablers in the state to assess.

Along these lines, this section concludes that:

- Assessing the state's competitive situation requires assessing its standing on the elements of a crosscutting growth platform
- A platform-oriented situational assessment yields a mixed picture of the state's growth capacity
- Rhode Island should embrace a new economic development model in which the state invests in the most critical advanced industries growth drivers while systematically improving its statewide platform for growth

Assessing the state's competitive situation requires assessing its standing on the elements of a crosscutting growth platform

For many states, competitiveness is easily established by benchmarking the core needs of two or three larger industries against other jurisdictions. This narrow focus simplifies economic analysis and with limited support a handful of sizable industry clusters tied to significant and growing markets can be expected to drive economic success.

For Rhode Island the situation is not so simple.

Rhode Island's economic growth areas reflect a complicated, fine-grained industry structure made up of many small industries that lack the scale to drive economic prosperity on their own. As the last chapter concluded, 33 distinct industry clusters comprise the state's economic base and serve a highly diverse set of markets with a broad range of products and services. Of those, 24 clusters have fewer than 5,000 jobs, meaning that the state lacks large, monolithic growth engines to concentrate on. Instead, Rhode Island's key areas of growth potential are networks of interrelated small industries and clusters. As a result, benchmarking the state's competitive position is a bit more complicated.

HOW WERE PEER STATES SELECTED?

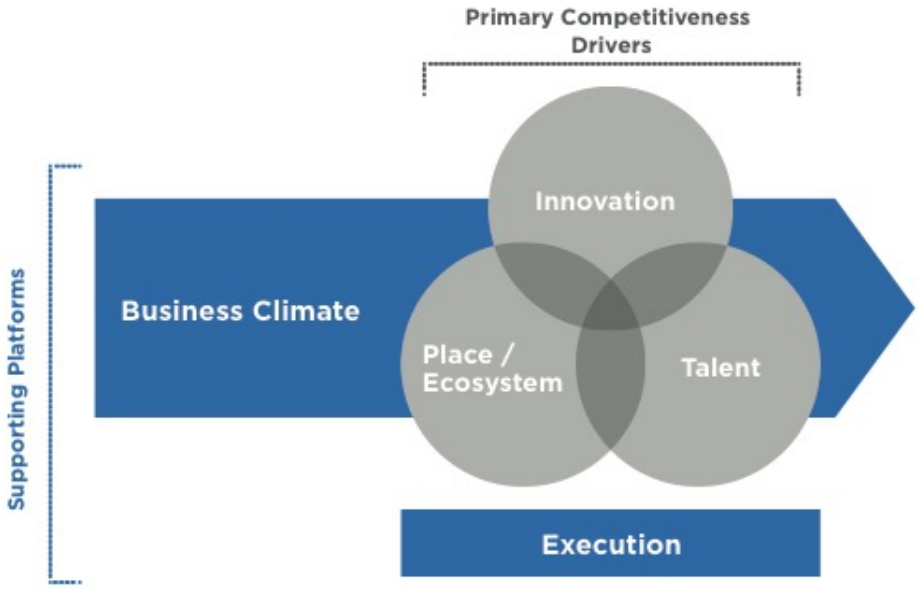
In addition to evaluating Rhode Island across several key indicators, the situational assessment compares the Ocean State against nine benchmark peer states in order to better assess Rhode Island's competitive advantages and weaknesses. The nine benchmark states are:

Connecticut	**Massachusetts**	**Oregon**
Delaware	**Minnesota**	**Pennsylvania**
Maine	**New Hampshire**	**Vermont**

In order to select appropriate peer states for this study, the Brookings-Battelle team took several quantitative factors into consideration including proximity (all New England states are included), industry composition, size, and governance structure as well as expert qualitative knowledge about technology trends and business, academic, and political environments. The peer states represent a broad array of regional players, production partners, and origins and destinations of past and future Rhode Islanders. As a result, the situational assessment offers a robust benchmarking of Rhode Island's key strengths and weaknesses in several relevant domains against similar states in the country. See appendix E for more on the findings from this benchmarking exercise.

The present analysis suggests another way to assess the state's competitive position. This method focuses on the shared inputs, resources, and assets that support many or all of the state's interconnected industries at once. In other words, the situational assessment best supports Rhode Island's strategy-setting is not one heavily focused on a few "target" industries but rather one that assesses the state's broad economic platform across indicators that measure the state's basic supportiveness for many industries.

What are the most crucial aspects to assess? Extensive economic literature and much in-state discussion pointed to a relatively short list of crosscutting sources of competitive advantage in Rhode Island.



In the foreground are three critical **competitiveness drivers** that lie at the center of any state's growth platform and anchor and support it, especially when it comes to its advanced industry base.[46] These drivers are the state's:

- **Innovation capacity**, or its ability to generate new products, services, processes, and ways of managing
- **Quality of place**, or the unique set of physical and human qualities that define the state's locales and make them attractive
- **Talent and skills**, or the collective value of the knowledge, competencies, and know-how of its workforce

Supporting these competitiveness drivers are crosscutting **supporting platforms**, none more salient in Rhode Island than the state's:

- **Business environment**

And finally, reflecting the quality of a state or region's **governance**, there is one more critical factor—the location's capacity for:

- **Business-led civic engagement**

Although many additional factors contribute to the quality of the state's growth platform, substantial economic opinion argues for focusing on a short list of competitiveness drivers, enabling factors, and governance issues when assessing the solidity of Rhode Island's platform for industry growth.

A platform-oriented situational assessment yields a mixed picture of the state's growth capacity

Results from the situational assessment depict a state with genuine strengths across its growth platform as well as areas of weakness. The sections that follow report key results of the assessment.

First are takeaways from assessment of the core competitiveness drivers: the state's innovation capacity, its quality of place, and its talent and skills base. Subsequent sections focus on key supportive platforms and governance.

INNOVATION CAPACITY

WHY IT MATTERS

Innovation capacity matters because it is the only lasting source of advantage for firms and places in a global economy.[47] As a 2012 National Research Council report declares, "The capacity to innovate is fast becoming the most important determinant of economic growth and a nation's ability to compete and prosper in the 21st century global economy."[48] More specifically, local innovation capacity is critical for providing Rhode Islanders the opportunity for a rising standard of living. As the World Economic Forum explains in its *Global Competitiveness Report*: "In the long run, standards of living can be expanded only with innovation … This requires an environment that is conducive to innovative activity, supported by both the public and the private sectors."[49] Additional evidence from the Information Technology and Innovation Foundation's 2014 *State New Economy Index* suggests that there is a strong relationship between these innovation inputs and per capita income.[50]

Given that critical link, what are the features of a dynamic innovation system? One building block of innovation capacity is the research and development (R&D) undertaken by research institutions such as universities and federal labs as well as the state's industry base. The evidence on the importance of research activities to advance economic development is overwhelming. Hundreds of empirical analyses affirm that no factor correlates more strongly with technology-oriented economic growth in a region than the presence of research universities and government-run or private-sector research centers.51

Research and development activities alone, however, do not ensure that innovations reach the marketplace. A range of commercialization activities must complement R&D work to generate economic growth. Of particular importance here is not only the ability of existing businesses to translate R&D into new product development, but the presence of entrepreneurial activities linked to broader technology development. Starting with David Birch's work and validated by the Office of Advocacy of the U.S. Small Business Administration (SBA) and further refined by studies commissioned in recent years by the Kauffman Foundation and others, it is clear that entrepreneurship is critical to translating innovations to the marketplace. A 2005 report prepared for the SBA's Office of Advocacy comparing regions with strong and weak entrepreneurial activity found that "the most entrepreneurial regions had better local economies from 1990 to 2001 compared to the least entrepreneurial. They had 125 percent higher

employment growth, 58 percent higher wage growth and 109 percent higher productivity. This general finding held individually for large, medium and small sized regions."[52]

ASSESSMENT

To assess Rhode Island's innovation capacity, the situational review compared the state's performance to the benchmark states across a set of measures reflecting the state's standing on key links of the innovation and commercialization value chain. These measures track the depth and vibrancy of the activities underway in Rhode Island for conducting R&D and translating it through commercialization, entrepreneurship, and finance into industry gains and new enterprise development.

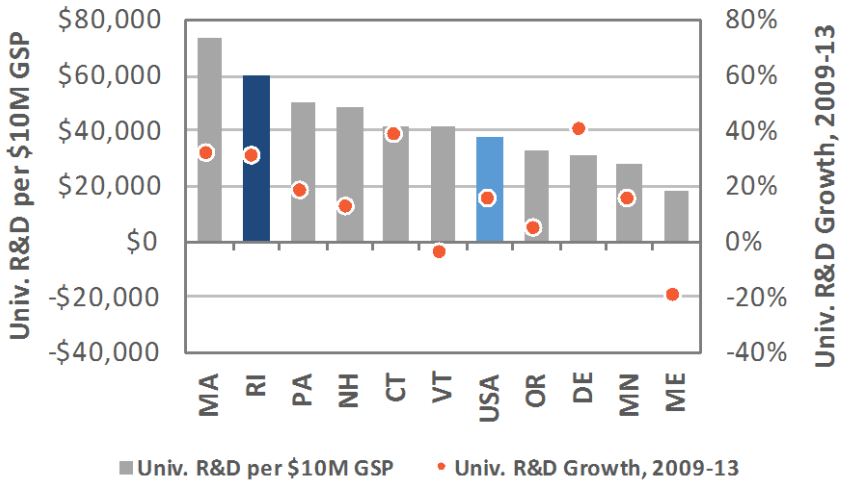
How does Rhode Island's innovation capacity stack up? Overall, the state's university research platform is quite strong but its commercialization enterprise remains uneven.

Rhode Island has amassed considerable innovation capacity through the growth of its solid university R&D base and the presence of a leading Department of Defense research center. Three takeaways stand out:

- **Rhode Island is a leading state in the size of its university R&D base relative to the size of the state's economy.** The overall research expenditures of universities in Rhode Island reached $320.9 million in 2013. This represents $60,202 in university research expenditures per $10 million of state economic output, a level that well exceeds the national average of $38,040 and trails only Massachusetts's $73,530 among the benchmark states
- **Rhode Island's university R&D activity nearly doubled the growth rate nationally.** From 2009 to 2013, Rhode Island saw its university R&D enterprise grow by 30 percent, compared to 16

Rhode Island stands as a leader in university R&D expenditures relative to the size of its economy

University R&D expenditures per $10 million of gross state product, 2013 and growth from 2009-2013



Source: Battelle analysis of National Science Foundation data

percent growth nationally. Among the benchmark states Rhode Island stood among the upper echelon of states on this metric, while many of its peers fell below the national growth rate, including Maine, Vermont, Oregon, and New Hampshire

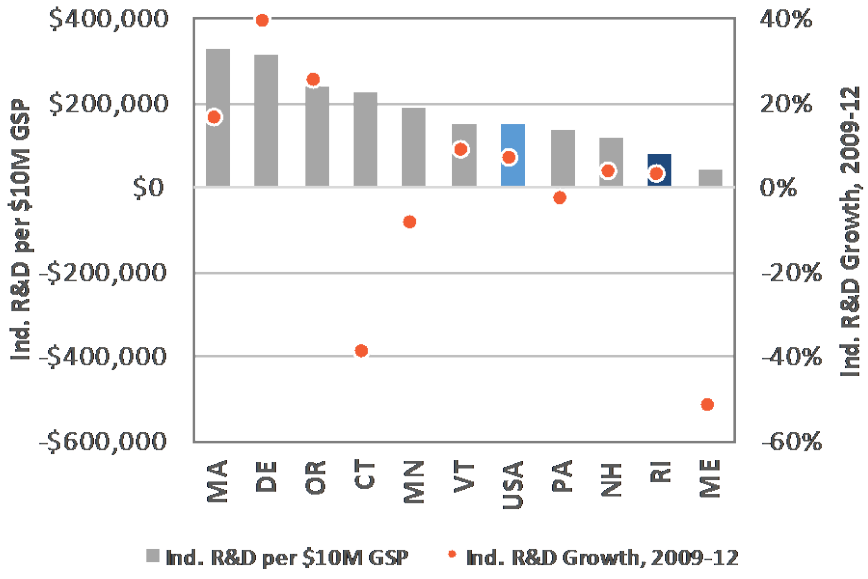
- **Rhode Island also benefits from the presence of the Newport-based NUWC, one of the nation's leading Department of Defense R&D centers.** NUWC provides research, development, test and evaluation, engineering, and analysis and assessment, as well as support services for submarines, autonomous underwater systems, and offensive and defensive undersea weapon systems. In 2014, NUWC had a funded program of approximately $934 million that supported approximately 2,693 scientists and engineers—roughly half its workforce—across its civilian and contractor workforces. This suggests that close to half of its funded program goes towards research and development activities, though no precise figure is available

Despite these research strengths, a closer examination suggests an uneven R&D enterprise in Rhode Island and low levels of commercial and entrepreneurial activity. These deficits represent clear points of weakness in the state's growth platform. Several issues merit attention:

- **Industry R&D in Rhode Island substantially lags the national average and that of benchmark states**. Despite the presence of Department of Defense activities, Rhode Island's industry R&D efforts languish at about half the national average intensity. The Rhode Island industry sector generates only $79,461 of R&D per $10 million of state economic output in 2012, compared to the national average of $149,345. Unsurprisingly, this places Rhode Island among the lowest of

Rhode Island lags the nation and peer states in industry research and development relative to the size of its economy

Industry R&D expenditures per $10 million of gross state product, 2012 and growth from 2009-2012



Source: National Science Foundation BRDIS, 2013

the benchmark states, exceeding only Maine and well off the pace of leading states that have more than $200,000 per $10 million of state economic output, including Massachusetts, Delaware, Oregon and Connecticut. While industry R&D grew 3 percent in Rhode Island from 2009 to 2012, less than half the average U.S. growth

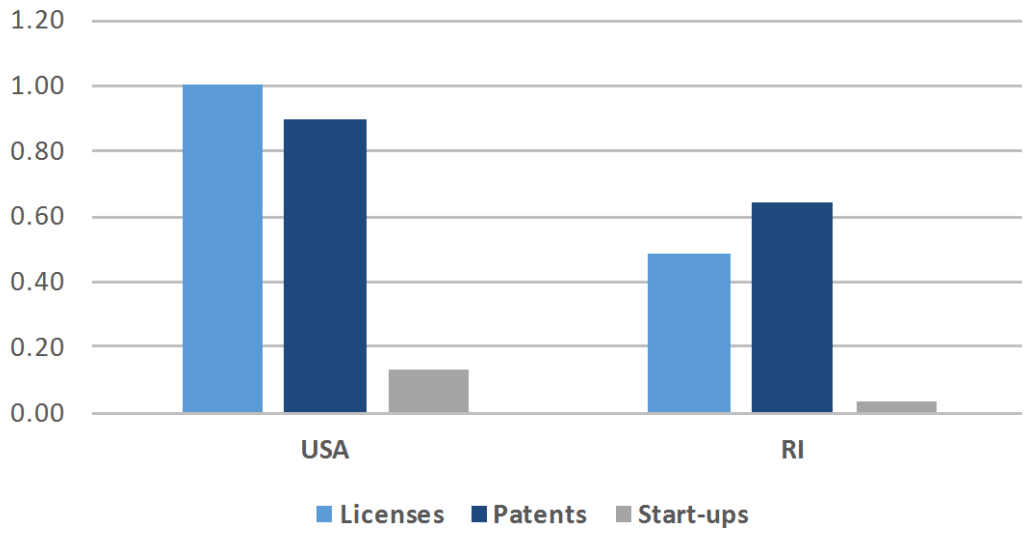
This low level of industry R&D reveals the unusually uneven nature of Rhode Island's innovation activities. Nationally industry R&D is about 400 percent larger than university research activities and among the benchmark states industry R&D exceeds university activity by 500 percent. By contrast, Rhode Island's industry R&D exceeds its university R&D by a mere 32 percent (excluding R&D at NUWC)

- **Commercialization activities across Rhode Island's research base lag top performing benchmark states and seem particularly weak across universities in the state.** Given the low level of industry R&D in Rhode Island, it is not surprising that the state ranks among the lowest of the benchmark states in patents generated. In 2014, inventors in Rhode Island generated 1.38 patents per $10 million in state economic output—a performance that ranked the Ocean State just seventh among the benchmark states

  What is surprising is how much Rhode Island trails on university technology transfer. Despite its substantial and growing base of university R&D, Rhode Island ranks last among the benchmark states on key measures of university technology transfer activities including patents per research expenditures, licenses per research expenditures, and startups per research expenditures (note: no university from Maine reported on technology transfer activities). The state's lagging performance can also be seen when compared to the average of all universities

Universities in Rhode Island lag in technology transfer activities

Licenses, patents and startups per $10 million of university research expenditures, Rhode Island and U.S. average, 2013



Source: Association of University Technology Managers Database

reporting to the Association of University Technology Managers. Rhode Island universities stand at two-thirds of the average level in patents issued per $10 million in research expenditures; half the average level in licenses issued per $10 million in research expenditures; and one-third the average level in startups per $10 million

- **Entrepreneurial activity and growth of new ventures in Rhode Island are also weak**. Rhode Island lags the nation and compares poorly to the benchmark states across a number of measures of entrepreneurial activity, ranging from the share of entrepreneurs in the population to new firm birthrates to job creation by new firms to the presence of fast-growing private companies. This low level of entrepreneurial activity might help explain part of why university technology transfer results are also low: There are fewer entrepreneurs looking to commercialize technology

Rhode Island lags the nation on measures of entrepreneurship

Rhode Island's standing in statewide entrepreneurial and new company formation and growth measures vs. the United States and benchmark states

Measure	Definition	Rhode Island	U.S.	Rhode Island ranking vs. 9 benchmark states (1st to 10th)
Entrepreneurial Activity	Kauffman Foundation's Index of Entrepreneurial Activity, Entrepreneurs Per 100,000 Population, 2013	140	280	10th
New Company Birth Rate	Average Annual Rate of New Firm Formation as a Percent of All Establishments, 2007–2012	6.5%	8.6%	8th
Job Creation by New Company Births	Average Annual Job Creation from New Firms, 2007–2012	5.63	5.74	6th
Presence of Fast-Growth Companies	Number of Companies on the Inc. 5000 List of Fastest Growing Private Companies, 2013	17	n/a	8th

The nine benchmark states are CT, MA, ME, NH, VT, DE, OR, PA, MN .
Sources: Kauffman Foundation; U.S. Census of Business Dynamics; Inc. Magazine.

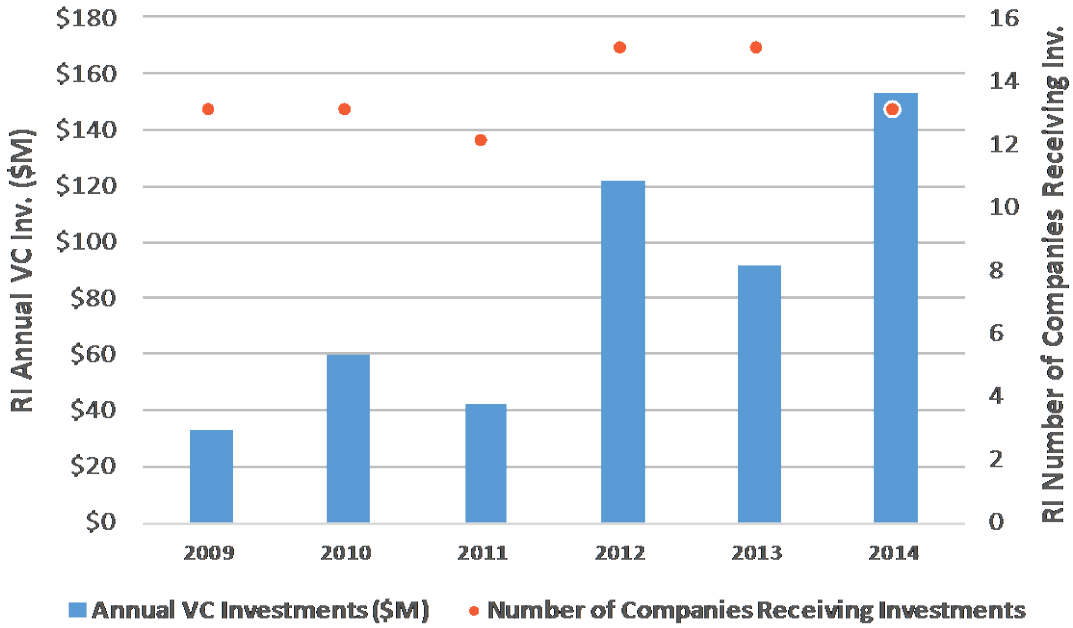
- **Further confirming the state's commercialization problem is the fact that Rhode Island startups receive well below national levels of early-stage venture capital (VC).** Only 19 percent of total VC invested in Rhode Island from 2009–2014 went to seed and early-stage investments, compared to 26 percent nationally. Among benchmark states, Rhode Island ranked seventh in its share of seed and early-stage VC investments, lagging far behind Massachusetts, which saw 43 percent of its VC flowing to seed and early-stage entities, New Hampshire 39 percent, and Minnesota 30 percent. Over the 2009–2014 period, Rhode Island had only 27 venture-backed companies funded for an average of slightly more than four per year—too few to drive major innovation-led growth

  Still, the overall level of venture investment taking place in Rhode Island is considerable. From 2009 to 2014, Rhode Island generated $505.7 million in venture capital across 45 companies. In comparison to the benchmark states relative to the size of the economy, Rhode Island fares quite well on this measure, having generated $16,338 in venture capital invested from 2009 to 2014 per $10 million in state economic output. This places Rhode Island on par with Connecticut and above all other benchmark states except Massachusetts, which maintains a leading national position with $84,924 in venture capital invested per $10 million in state economic output from 2009 to 2014

  Recent years have reflected a significant increase in the level of venture capital investments in Rhode Island, though not in the number of companies receiving it. This is consistent with the difficulty of generating high-growth new ventures, though it suggests if a top emerging innovation company located in Rhode Island, it could likely attract capital

Although venture capital investments are picking up in Rhode Island, the number of companies receiving funding is not increasing

Annual venture capital investments and number of companies receiving investments, 2009-2014



Source: Thomson One Venture Capital Database

BOTTOM LINE

Across a variety of dimensions, Rhode Island's mixed position in innovation is at once promising and in need of improvement. The state's solid and growing university and federal research enterprise provides an important base on which to grow, and the ability of some companies to secure venture funding suggests Rhode Island startups could secure funding if there were more of them. With that said, the limited investment in innovation by industries and the state's weak commercialization activities point to an urgent need for more industry research and industry-university partnerships while better leveraging the state's university and federal laboratory complex. This work will require a more focused public-private partnership to advance university and federal lab-related commercialization and engage not only the top talent in Rhode Island but also entrepreneurs outside the state.

QUALITY OF PLACE

WHY IT MATTERS

Placemaking and strengthening the business ecosystem matter because growth happens in places, most notably in metropolitan regions, where workers and firms cluster in geographic proximity to enjoy the local quality of life, find work, and profit from formal and informal knowledge transfer.[53] Places that cultivate their quality of place with a particular focus on their local industrial clusters will be well positioned to attract and retain talent while also nurturing and capturing the benefits of advanced and opportunity industry growth.[54] Places that do not cultivate such "co-location synergies" will not be so well positioned.

These imperatives may be intensifying. Since the Great Recession, the art of urban placemaking has been fusing with the practice of economic development even more than in the past. Increasingly, the "consumer city" view of the pre-crisis years—which placed quality of life issues and consumption amenities like the availability of restaurants and sidewalk life at the center of citymaking—has been merging with new insights about high-value economic activity and the behavior of technology companies and industry clusters.[55] Increasingly, cities or portions of cities are being reinvented as amenity-rich incubators to address the urgent human capital and collaboration needs of entrepreneurs and high-value advanced businesses.

Brookings' Bruce Katz has documented that a rising number of talented workers and innovative firms are choosing to congregate and co-locate in compact, amenity-rich enclaves in the cores of central cities.[56] The rise of these innovation districts presents not only a new option in urban design but a new necessity in economic development. On the design side, a growing share of metropolitan residents—beginning with the coveted millennials—is spurning long commutes and daily congestion and choosing to work and live in places that are walkable, bikeable, and connected by transit and technology.[57] These residents want urban character and convenience. On the economic side, growing numbers of marquee companies in knowledge-intensive industries are locating key facilities in cities close to other firms,

universities, and research labs so they can leverage proximity, access talented young workers, and practice open innovation even as entrepreneurs start companies in nearby collaborative spaces.[58] These companies want talent and quick access to ideas, services, and vendors.

The evolving locational preferences of workers, entrepreneurs, and companies demand a new focus on urban placemaking and business ecosystem development with a view toward how those two aspects fit together.

ASSESSMENT

Evidence on Rhode Island's quality of place and business ecosystem vitality confirms that the state has much to work with but faces several key challenges as it seeks to fuse its placemaking with state-of-the-art economic development practice. Overall, the state begins from a position of strength on these issues but must modernize its offerings:

Rhode Island has built up critical elements of a strong quality of life. Several national and international indexes rank the state highly for its general quality of life—a key factor in attracting and retaining talented workers. While the scope and content of these rankings vary and rely on multiple different economic indicators to quantify the quality of land uses, transportation options, and the overall urban environment in a given region, Rhode Island boasts numerous attractive features and tends to rank well. The recent Organization for Economic Cooperation and Development (OECD) Regional Well-Being Index, for instance, looked at housing, education, jobs, and several other factors and rated Rhode Island the 19th best state for its quality of life in 2014—with a total score of 66.9—ahead of states like California, New York, and even Hawaii.[59] Supported by an assortment of economic and cultural assets, the state also contains a wide variety of urban amenities that contribute to a rich quality of place that is crucial to attracting new firms and talent.[60] The state also rates well—12th among the 50 states—on the quality of life components of both *Forbes' 2015 Best States for Business* and *CNBC's* 2015 *Top States for Business.*[61]

Meanwhile, if amenities play a large role in defining places and attracting and retaining skilled workers, Rhode Island has a genuine economic edge. Not only has the state been lauded for its quality of life but Providence has also garnered recognition as an up-and-coming small city. Earlier this year *GQ* named Providence the "coolest" city in the nation and the year before *Architectural Digest* named it the country's best small city.[62] Providence has become famous for its restaurants, culinary scene, and "foodie" vibe, and was recently named America's second best city for "foodies" by *Travel + Leisure*.[63] In addition to supporting the creation of local "food hubs" and the expansion of related businesses through the internationally renowned Culinary Arts program at Johnson & Wales University and the state's new culinary incubator, Hope & Main, Rhode Island contains nearly 3,000 restaurants that together generate $2 billion in sales annually.[64] Rhode Island ranked second nationally among states for the density of its eating and drinking places in 2014, behind only the District of Columbia.[65] Meanwhile, more than 7,000 businesses and 65,000 jobs comprise the state's food system, contributing to the efficient production, distribution, and consumption of healthy products regionally, according to the Rhode Island Food Policy Council.[66]

The Ocean State also shines across a variety of arts-related measures, spanning performing arts, music, and other creative industries. A national economic analysis by Americans for the Arts recently found that Providence's nonprofit arts and culture organizations spent nearly $84 million in 2010 while attracting an additional $106 million in audience expenditures. This $190 million in total economic activity supported more than 4,600 jobs.[67] On a per-capita basis, Providence generated more arts activity than much larger cities such as Atlanta, Baltimore, and San Francisco.

Finally, the state's outstanding urban-rural balance (600 farms and 55 percent forest cover persists in the nation's most urbanized state), coastal attractions, Gilded Age mansions, yacht races, and historic sites continue to make it a major tourism destination. In 2013, more than 19 million tourists and visitors were attracted to Rhode Island, and spent almost $6 billion that supported over 66,000 jobs.[68] From year to year, tourism's economic impact continues to rise in importance, according to recent estimates from IHS.

Sizable opportunity industries in their own right, each of these economies contributes heavily to the state's amenity base and constitutes an important appeal to skilled residents and setting for industrial ecosystem activity.

Underlying its amenities are solid urban fundamentals. From the urban concentration and character of downtown Providence to Newport's historic charm, Rhode Island locations provide the kinds of physical settings that offer potential for developing vibrant business ecosystems and attracting high-value firms. In the capitol city, the dense concentration of university and health system anchor institutions downtown points up urban Providence County's high ranking on smart growth and walkability measures. Providence County scores a very high 144 on Smart Growth America's growth measure, thanks to its high density, street connectivity, and activity centering.[69] And the city scores 76 out of 100 on WalkScore's measure of walkability.[70] Newport and Newport County also score above average on these measures, though only slightly so. In addition, rail service to Boston and New York from stations at Westerly, Kingston, and Providence adds a legitimate quality-of-life amenity for Rhode Islanders. Taken together, these quality-of-place factors hold out potential for the state to insert itself into bigger conversations about the interplay of place and economic development.

However, the state suffers from several challenges as it weighs quality-of-place strategies and economic development. Several of these challenges are physical while others reflect the specific nature of Rhode Island's business ecosystem:

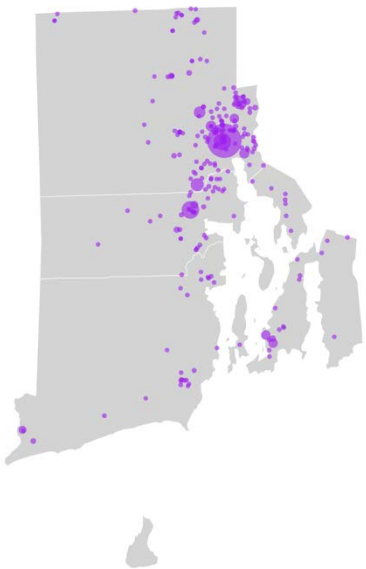
- **In terms of its quality of place, Rhode Island is neither as centered nor as connected as its small size might suggest:**
    - **Job sprawl is a problem for Rhode Island**. The Providence metro area suffers worse job sprawl than the average large metro area—which cuts against concentration and speed of movement. Currently, a below-average 22 percent of Rhode Island jobs lie within three miles of the central business district, and just 28.7 percent lie between 3 and 10 miles, also below average. That leaves effectively half of jobs between 10 and 35 miles

from the central business district—well above the national average of 43.1 percent. On this measure, metro Providence does worse than regional neighbors like Boston, Hartford, New Haven, Springfield, and Worcester.[71] Moreover, while some regions have seen a re-centering of growth in recent years, Providence and Rhode Island have continued to see a slow decentralization of employment into the periphery

- **On the economic development side of the equation, Rhode Island must consider the decentralized nature of its business ecosystem as it determines how to leverage placemaking strategies for growth.** Much of Rhode Island's technology and advanced industry business activity remains highly promising but diffuse—even splintered. Industry links to research institutions remain thin and patenting patterns point to a disparate and decentralized set of innovation networks. Similarly, while the state's proliferation of cluster-oriented organizations contributes to the vitality of the innovation ecosystem, the sheer number of small entities may complicate efforts to construct crosscutting industry platforms. The existence of so many cluster organizations is a net positive for the state but on closer inspection, and as suggested by numerous stakeholders interviewed, many of these organizations are suboptimally connected with each other and with the larger anchors of Rhode Island's economy. Finally, the diffusion is physical, as evidenced by mappings of establishment locations in several of the state's key clusters. These mappings that show that establishments in these growth areas are in several cases distributed quite widely across the state's terrain instead of being tightly clustered. While Rhode Island is not a large place, this diffusion may suggest opportunities for fostering greater clustering and the synergies that can bring

Establishments in the Biomedical Innovation growth area are spread throughout the state

Geographical Distribution of Biomedical Innovation Firms in Rhode Island



- **Finally, interviews and other evidence suggest that Rhode Island's small but decentralized innovation ecosystem is short on collaboration, translation, and prototyping spaces and similar focal points.** Currently several of the state's growth clusters lack access to the kinds of specialized facilities where new startups and emerging companies can co-locate or otherwise gain access to innovation space for applied research, prototyping, and limited production. Interviews with industry executives, intermediary organizations, and university officials point to shortages of bioscience wet lab space and a need for additional "makerspaces" to facilitate design, prototyping, and manufacture using 3D printers, digital fabrication machines, and computer-aided design (CAD) software. Interviewees also saw a need for warehouse spaces among emerging marine and materials companies. In short, instead of inventing or commercializing on their own, an array of researchers, entrepreneurs, and firms are looking for focal points, hubs, and collaboration spaces where they can connect with others in the innovation business and gain efficient access to everything from intellectual exchange and sophisticated lab equipment to legal advice

BOTTOM LINE

Globally and locally, the arts of placemaking and innovation are converging—and that could be good for Rhode Island. With its attractive urban and coastal quality of life, clustered universities, vibrant culinary and arts scenes, and walkability, the state boasts quality-of-place attributes that are increasingly valued by skilled workers and advanced businesses. The state's challenge now is to enhance those features with smart quality of place enhancements and sculpt them into a compelling offer that addresses the need for concentration and collaboration across the state's advanced industry ecosystem.

TALENT AND SKILLS

WHY IT MATTERS

Talent and skills matter because human capital—the stock of knowledge, know-how, expertise, and capacities embedded in the labor force—plays a huge role in sparking innovation, enhancing productivity, raising incomes, and driving economic growth.[72] For states, preparing, attracting, and retaining skilled workers and connecting them to employment represent crucial determinants of prosperity and broadly based opportunity. Study after study demonstrates that states with high levels of well-educated workers tend to enjoy significantly higher gains in per capita income and other economic measures.[73]

Beyond education, *technical* skills matter more and more for individual, regional, and state growth. What matters most are STEM (or increasingly STEAM, with an A for arts and design) workers.

Advanced industries are by definition technical industries, but so are many other industries as advanced technologies and the "digitization of everything" pervade the economy.[74] Roughly six of every 10

information technology workers are now employed outside of the computer and telecommunications industries, with high concentrations in finance, insurance, logistics, and manufacturing. Meanwhile, numerous established Rhode Island products and services, ranging from boats and ships, industrial machinery, and design to logistics, involve increasingly high-technology content.

Not only do STEM / STEAM workers at all pay levels earn significant wage premiums over other workers, but their concentration can also help determine regional prosperity. Brookings research shows that regional economies that mobilize the densest concentrations of STEM /STEAM workers perform the most strongly on a wide variety of economic indicators, including patenting, wages, employment rates, and job growth.[75]

In view of all this, it is critical for a state trying to build new growth engines to attend to the job-readiness of its STEAM workforce, particularly with regard to those trained in computer science, IT, and coding.

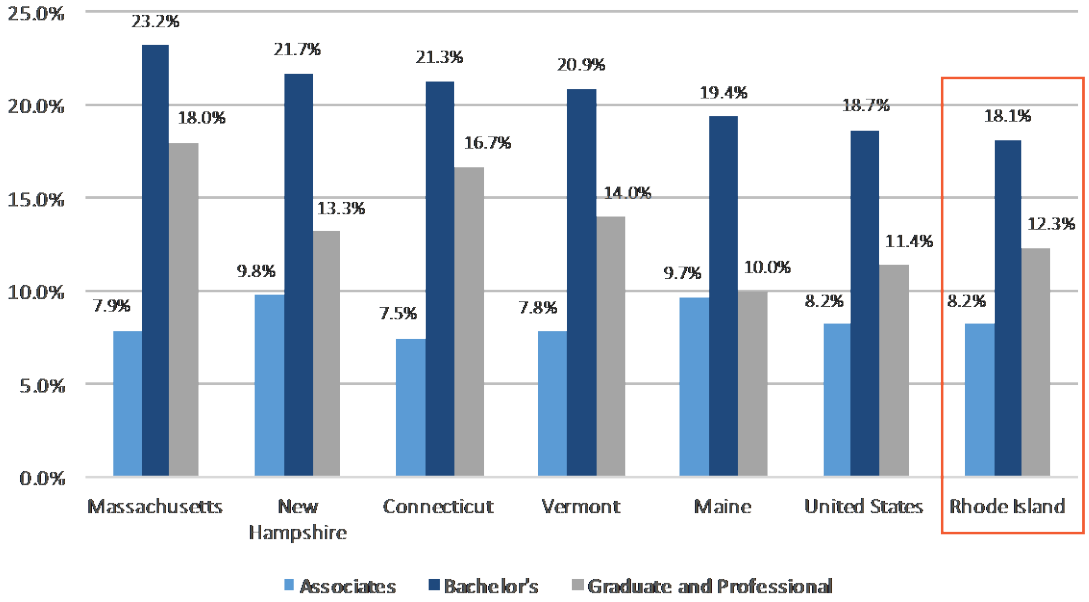
ASSESSMENT

Analysis reveals that Rhode Island today possesses a competitive workforce in several respects but will face near- and longer-term challenges in mobilizing the kinds of technical skills needed to grow its advanced industries.

Rhode Island's current working-age population—while nationally competitive—lags New England educational attainment rates. As of 2014, 57 percent of Rhode Islanders aged 25 and older attended at least some college, placing the state slightly behind the national average of 59.3 percent. However, Rhode Island slightly exceeds the education level of the nation when it comes to bachelor's and graduate/professional degree attainment, with 30.4 percent of Rhode Islanders possessing such degrees compared to 30.1 percent nationally. The state's population is slightly more educated than average at the highest levels: In 2014, 12.3 percent of Rhode Islanders possessed a graduate or professional degree in 2013, compared to 11.4 percent nationally. However, a comparison of the Rhode Island workforce to that of its New England peer states reveals that state levels of educational attainment trails that of its regional peers. Excluding Rhode Island, 63.4 percent of New Englanders has at least some college and 16.2 percent has a graduate or professional degree. Among the six states that comprise New England, Rhode Island ranks last on share of population with a bachelor's degree and fifth on number of residents with a graduate or professional degree

Bachelor's degree attainment in Rhode Island lags the United States and the rest of New England

Share of the population over 25 by postsecondary educational attainment, 2014.



Source: Brookings analysis of American Communities Survey data

Several trends suggest that Rhode Island's current workforce will be underprepared to meet skills needs and fill jobs in the coming years. Several findings bear notice:

- **On the demand side, Rhode Island has seen strong job growth in both high-skill jobs requiring at least a bachelor's degree and middle-skill jobs requiring some postsecondary credential or an associate degree**. From 2010 to 2014, Rhode Island enjoyed a strong 17 percent expansion of its high-skill jobs base compared to a nation-wide 10 percent gain—growth that ranked Rhode Island first among the benchmark states. Similarly, Rhode Island saw a healthy 6 percent growth in middle-skill jobs between 2010 and 2014—a gain that outstripped the nation's 4 percent growth and ranked Rhode Island second among the benchmark states. Such trends may already be challenging the adequacy of the state's skilled workforce

- **On the supply side, Rhode Island struggles to maintain the growth and educational attainment of its workforce.** Overall the United States recorded strong annual average growth in associate degree (3.0 percent), bachelor degree (2.4 percent), and graduate/professional degree (3.2 percent) attainment among those aged 25 and older between 2009 and 2014. Rhode Island, by contrast, did not perform so well. The state increased the share of its population with an associate degree by an average of just 0.3 percent annually between 2009 and 2014, while the share of its residents with bachelor's degrees declined at an average annual rate of -0.4 percent, and the share with graduate/professional degrees grew by only 1.3 percent per year on average.

In sum, Rhode Island's residents were barely more educated in 2014 than they were in 2009, and actually less educated in terms of the share of the population with only a bachelor's degree. These trends stands in contrast to the rest of the region, moreover. Today every other New England state has higher levels of educational attainment across all categories of postsecondary education compared to 2009 levels

Of special concern are issues surrounding the adequacy of the state's near- and longer-term production of STEAM talent. Here too, disconnects in demand and supply suggest potential workforce shortages will surface in the next few years:

- **On the demand side, analysis of employment trends in specific occupational groupings shows that a number of high- and medium-skill technical occupations associated with the state's growth areas are expanding.** Between 2010 and 2014, employment in high-STEM occupations—those associated with a high degree of knowledge in science, technology, engineering, and/or math—grew 2.4 percent in Rhode Island, nearly two and a half times the growth rate of all occupations over the same time period. By contrast, STEM occupations that require less than a bachelor's degree grew at a much slower rate (0.6 percent), which suggests that postsecondary STEM attainment in Rhode Island is particularly important at the bachelor's level and above.
    - **Computer programming and coding epitomize the trend, with thousands of openings appearing each year.** An analysis of all jobs posted online in 2013 reveals that over 3,800 jobs posted online in Rhode Island listed knowledge of at least one programming language as a skill requirement. These job postings accounted for 6.4 percent of all jobs posted in the state that year. Over half of those job postings called for programming skills in Java, SQL, and SAS. Java and SQL are often taught in traditional computer science curricula, while the statistical programming software SAS is widely used for big data applications and corporate data centers. SAS is sometimes taught in postsecondary business and economics programs, but is often taught through courses that particular companies and other training providers produce. These three languages, as well as other in-demand languages such as .NET, PHP, HTML5, and JavaScript, are often taught to web developers and IT professionals outside of traditional college or university settings

Rhode Island's high-STEM jobs have seen steady growth since 2010

Employment levels and changes by STEM and educational requirements in Rhode Island

CATEGORY	EMPLOYMENT 2010	EMPLOYMENT 2014	COMPOUND ANNUAL GROWTH RATE
All Occupations	448,150	463,930	0.9%
High-STEM Sub-BA	26,450	27,050	0.6%
High-STEM BA and Above	39,630	45,530	3.5%
Total High-STEM	**66,080**	**72,580**	**2.4%**

Source: Bureau of Labor Statistics Occupational Employment Statistics

- **On the supply side, Rhode Island struggles to maintain sufficient talent pools in technical fields relevant to its growth areas, whether for near-term hiring or through its talent pipeline.** In this regard, issues surround both the production of postsecondary certificates and degrees and basic technical education:
    - **Students in Rhode Island are under-prepared to enter STEAM careers.** Lack of proficiency makes it unlikely that students will go on to study related fields and pursue STEAM-oriented careers after completing high school.
        - Among Rhode Island 11th-graders taking the New England Common Assessment Program (NECAP) science exam in 2015, only 31.5 percent scored proficient or above
        - In 2015, likewise, just 32 percent of eighth graders and 37 percent of fourth-grade students scored at proficient levels in math on the National Assessment of Educational Progress (NAEP).[76] Though not markedly different from national averages, such scores highlight a growing math proficiency crisis in the state
        - Student engagement with computer science and coding—subjects critical for an advanced Rhode Island economy—remains low. Few schools offer coding and students tend to meet the state's technology graduation requirement with a basic computer literacy class rather than a computer science course. In 2014–2015 only 72 students in the state sat for the AP computer science exam
        - Most Rhode Islanders know little about STEAM education or the wide range of well-paying career pathways that STEAM training can open up for people with only some postsecondary training, people with advanced degrees, and everyone in between
    - **Rhode Island's STEAM degree production is not keeping pace with that of leading benchmark states**. The number of STEAM degrees as a share of postsecondary graduates in Rhode Island declined by 2.5 percentage points for associate degrees even

as it increased by 2.9 points for bachelor's degrees and 2.0 points for master's degrees. These trends placed the state ninth, tenth, and eighth, respectively, among benchmark states between 2010 and 2014 for STEAM degree attainment. This finding is particularly problematic for Rhode Island given that the number of occupations requiring STEAM degrees at the bachelor's level and higher is growing and the state produces the lowest or near the lowest share of STEAM degrees among both benchmark states and regional peers.

Rhode Island lags most benchmark states in STEAM degree production

STEAM share of all degrees awarded in Rhode Island and benchmark states, 2014

State	Associate degree	Rank	Bachelor's degree	Rank	Master's degree	Rank
CT	31.8%	8	26.7%	9	31.8%	3
DE	39.7%	3	29.0%	7	25.4%	6
MA	34.9%	7	30.1%	6	27.9%	5
ME	40.9%	2	38.1%	1	31.3%	4
MN	37.4%	6	30.2%	5	32.6%	1
NH	38.6%	4	26.7%	8	25.2%	7
OR	21.6%	10	30.8%	4	23.2%	9
PA	41.8%	1	32.4%	2	32.5%	2
RI	**29.4%**	**9**	**24.9%**	**10**	**24.1%**	**8**
VT	37.5%	5	30.9%	3	15.3%	10

Source: Integrated Postsecondary Educational Database (IPEDS)

- **With regard to computer science, it appears that the state's relatively high granting rate on degrees in this field is not growing fast enough.** The state's curriculum and student body appears relatively well oriented towards technology degrees. Among the peer states in 2014, the state ranked fourth, fourth, and second (at 9.4 percent in associate's degrees, 10.6 percent for bachelor's, and 14.2 percent for master's and above) in the shares of all degrees that its higher education institutions awarded in computer science fields. With that said, the state is not seeing as rapid growth in awards of these credentials as some of its competitors. Rhode Island ranked tenth, sixth, and seventh among benchmark states in terms of growth in its share of computer science associate, bachelor's, and master's degrees conferred, respectively

- **Stark racial, ethnic, gender, and income divides have implications for the engagement of the state's people of color and low-income communities in its advanced and**

opportunity economy. For Rhode Island's students of color and those from low-income households, math proficiency challenges are especially acute. Among eighth graders, 41 percent of white students but just 13 percent of Hispanic students, 14 percent of black students, and 15 percent of low-income students scored at proficiency on the math portion of the NAEP in 2015. Among fourth graders, 48 percent of white children were proficient, compared to 18 percent of Hispanic students, 17 percent of black students, and 21 percent of low-income students.[77] These are disturbing numbers for the state's economic future given that 30 percent of the state's PK-12 population is Hispanic or black and 46 percent are low income.[78] As Baby Boomers retire it is far from clear that the state's future workforce will be ready to fill their jobs in critical advanced industries, let alone support sector expansion

BOTTOM LINE

Rhode Island's middling-quality talent stocks are coming under stress. Adequate numbers of high- and middle-skill technical workers will be critical to replace Baby Boomer retirees and meet any additional growth in the state's emerging advanced industry sector and its opportunity industries. However, the state's training and education systems are already struggling to supply such skilled technical workers, and could face greater difficulty as demographic change continues. These challenges could have potentially disastrous effects. If the most desirable high-value technical businesses cannot find enough skilled workers in Rhode Island, they will neither come to the state or stay in it. All of which means that Rhode Island needs to make STEAM skills development an urgent priority through bold postsecondary training initiatives and improved PK-12 STEAM education as well as more effective efforts to attract and retain skilled workers. Of critical importance will be more widely disseminating basic tech skills like coding and engaging, educating, and drawing the state's young people of color and those from low-income communities into the workforce.

* * *

Overall, the state faces the challenge of supporting the emergence of new growth engines with a mixed standing on the three core competitiveness factors: innovation capacity, quality of place, and talent and skills. On all three dimensions the state has strengths to leverage as well as weaknesses to ameliorate.

At the same time, other factors matter as supporting platforms, none more important than the state's general business environment.

What follows are key takeaways from an assessment of the state's business environment.

BUSINESS ENVIRONMENT

WHY IT MATTERS

A conducive business environment is a prerequisite for promoting economic development and societal well-being. It plays an important role in structuring the economy, paving the way for innovation and competitive markets, strengthening particular industries, and ensuring the prudent use of resources.[79] At the same time, a poorly managed business environment can become an obstacle to doing business by, inhibiting growth and reinforcing citizens' skepticism of government. More specifically, research shows that an onerous business environment is associated with reduced job creation and reduced entry of new firms—with regulatory environment, startup costs, and tax burden amplifying or dampening firm entry and expansion, depending on whether they are business friendly or not.[80]

Given the critical link between business environment and economic growth, what are the features of a supportive business environment?

To begin with, firms look at the tax system when considering a move to a particular jurisdiction. Economic evidence suggests tax policy is only becoming more relevant with heightened global competition.[81] At the same time, it is important to keep in mind that low taxes alone do not spur economic growth; it is the nature and efficiency of the overall system that matters most.[82] For instance, tax credits, such as the R&D or equipment investment credits, can be successful fiscal tools to grow particular parts of a state economy.[83]

The second and perhaps even more important component of a dynamic business environment is the regulatory regime. It can be costly in terms of both time and money for businesses and workers to comply with cumbersome government regulations, which over time can stifle economic growth. The World Bank's annual *Doing Business* report notes that the efficiency and quality of regulatory environment go hand-in-hand with producing more competitive, viable firms and industries that help to grow national economies.[84] Similarly, the executives queried in KPMG's recent survey of 400 U.S. CEOs identified the regulatory environment as the single issue that can have the greatest impact on a company, followed by corporate tax reform, global economic growth, and cybersecurity.[85]

Other factors matter too. Land availability and robust transportation infrastructure remain important aspects of the business environment. Companies of all kinds locate in places with adequate supply of land and a well-integrated transportation infrastructure that reduces travel time, increases the labor pool from which companies can draw, and allows efficient access to markets. *Area Development*'s annual "Top States for Doing Business" survey notes that top-ranked states all have well-connected interstates and highways, rail lines, airports, and port shipping in addition to certified sites/shovel-ready land and other infrastructure. [86]

Nor are the stakes going down. If anything, the stakes are rising as constant, high speed innovation and change convulses industries that used to advance only incrementally. A new report from Deloitte, *Business Ecosystems Come of Age*, points out that the rules, best practices, business models, and even

the mindsets that have served organizations, business leaders, and government well for decades are all being disrupted.[87] Traditional slow-moving industries are giving way to a new breed characterized by constant innovation, new business models that tap into rapidly changing technological development, and a wide range of business players working to solve problems in fundamentally different ways. It has become more important than ever that governments and policy leaders understand today's high-speed business realities as they assess their state's business environment.

ASSESSMENT

In a state the size of Rhode Island, the business environment ought to be lean, efficient, and up-to-the-minute. Its small size should allow nimble, continuous updating of the state's business environment so as to provide entrepreneurs and companies a modern and supportive environment in which to grow.

However, Rhode Island cannot be said to have achieved such an environment.

Over the years, Rhode Island has accumulated a bad reputation for its business environment. Whether rightly or wrongly, sentiment about the state's tax and regulatory systems remains low. According to Monitor Deloitte's recent "Executive Insight and Competitiveness Survey" conducted for this report, only 28 percent of Rhode Island executives who responded agree that Rhode Island is "a good place to grow and innovate [a] business," as compared to 62 percent of respondents in Massachusetts and 64 percent nationally.[88] Deloitte's survey of Rhode Island business executives found that the cost of doing business, government responsiveness to business needs, and the available pool of skilled workforce are the top three threats in state's business environment as identified by survey respondents. Similarly, a survey of Rhode Island small business owners conducted by the Office of Regulatory Reform (ORR) in 2014 also found that 40 percent of those surveyed considered the state's regulatory system "poor" compared to that of other states. Respondents felt that the state needs to "think as a small business owner" in evaluating the impact of taxes and regulations on businesses.[89]

Nevertheless, Rhode Island has begun to make changes and is positioned to emerge as a leader on business environment reengineering. Leveraging its manageable size and vigorous new leadership Rhode Island has already demonstrated its ability to act on multiple fronts to carry off the challenge of modernizing its business environment. In recent years it has:

- Passed major pension reform legislation in 2011, which serves as a model of reform at a time when many states are struggling to rein in ballooning pension costs. The state has now finished a four-year pension overhaul without raising taxes or issuing risky pension-obligation bonds[90]
- Launched an accelerated regulatory review process in 2012 to streamline processes and reduce the regulatory impact on small businesses.[91] State agencies reviewed 1,600 regulations in 17 months and identified 250 changes to improve the state's regulatory environment. Three-quarters of those reforms have been completed, with state agencies on target to complete those that remain

- Launched a long-awaited runway extension at T.F. Green Airport that offers the potential for more transcontinental and international nonstop flights out of the state's main airport, which has ranked regularly in the top 10 nationally for its convenience and user-friendliness

- Implemented significant corporate income tax changes in 2014, reducing the levy from 9 percent to 7 percent.[92] The new Rhode Island rate is lower than that of both Massachusetts (8 percent) and Connecticut (7.5 percent)

- Repealed 30 professional licensing requirements to make it easier for residents to enter new occupations. These licenses were identified by the Office of Regulatory Reform as burdensome, duplicative, and/or unnecessary

- Began construction of the nation's first offshore wind farm. The state secured this opportunity through deft navigation of the federal and state regulatory environment; strong executive leadership; and collaborative relationships among the state agencies, Deepwater Wind, and various community stakeholders[93]

Despite this progress, Rhode Island lags its neighboring states and the rest of the country in creating an attractive environment for businesses, especially in advanced industries that offer high-wage and knowledge economy jobs. Both taxes and regulations pose problems:

- **The state's tax environment remains burdensome.** Rhode Island ranks 45th in the nation in the Tax Foundation's *2016 State Business Tax Climate Index*. [94] The index compares the states in five areas of taxation that impact business: corporate taxes, individual income taxes, sales taxes, unemployment insurance taxes, and property taxes. New Hampshire ranks seventh, Massachusetts 25th, Maine 34th, and Connecticut 44th. Reducing the corporate income tax rate from 9 percent to 7 percent last year helped Rhode Island move from 43rd to 34th on the corporate tax component of the index, but the state still ranks 44th on property tax and 49th on unemployment insurance (UI). These factors combined with others may well impede the emergence of a dynamic advanced industry growth sector in Rhode Island, given their disproportionate impact on young companies and tech-oriented firms:

    - **Rhode Island's UI system weighs especially heavily on young firms (under three years) which face a higher average UI payroll tax rate than more mature firms.** While this disparity is common, in Rhode Island the rate paid by young firms is disproportionately high compared to the national average or to its peers in New England

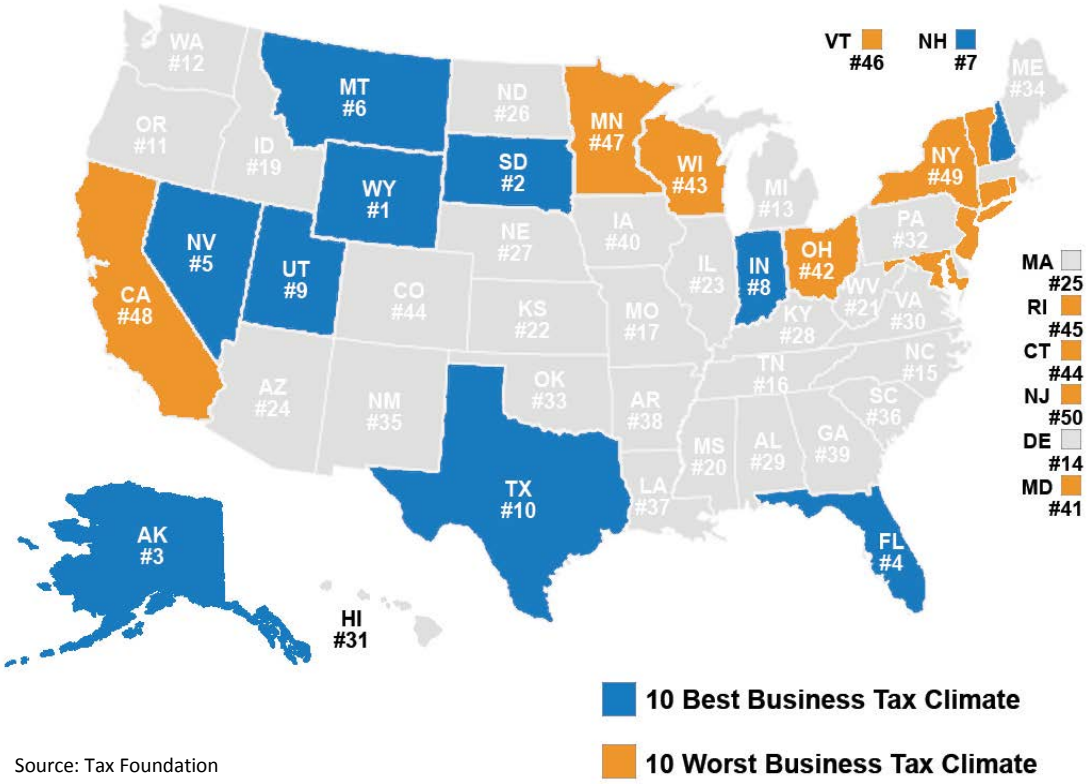
    - **The interplay of the state's high local property tax undercuts the effectiveness of its R&D tax credit.** A 2015 study of effective tax rates by the Tax Foundation and KPMG concludes that Rhode Island ranks 50th in the nation in its level of taxation for new R&D facilities.[95] Property taxes drive much of the high effective tax rate, although the structure of the state's above-average R&D tax credit is also suboptimal. The credit is weakened by the fact that it is not available as a refundable tax credit and because the

credit claimed during any year cannot exceed 50 percent of an entity's tax liability for that year

- Overall, RIPEC has concluded that taxes are one of the most significant components of the cost of doing business in Rhode Island and are an area where the state has some of the most opportunity for improvement[96]

Rhode Island ranks 45th in the nation in terms of business tax climate

2016 state business tax climate rankings



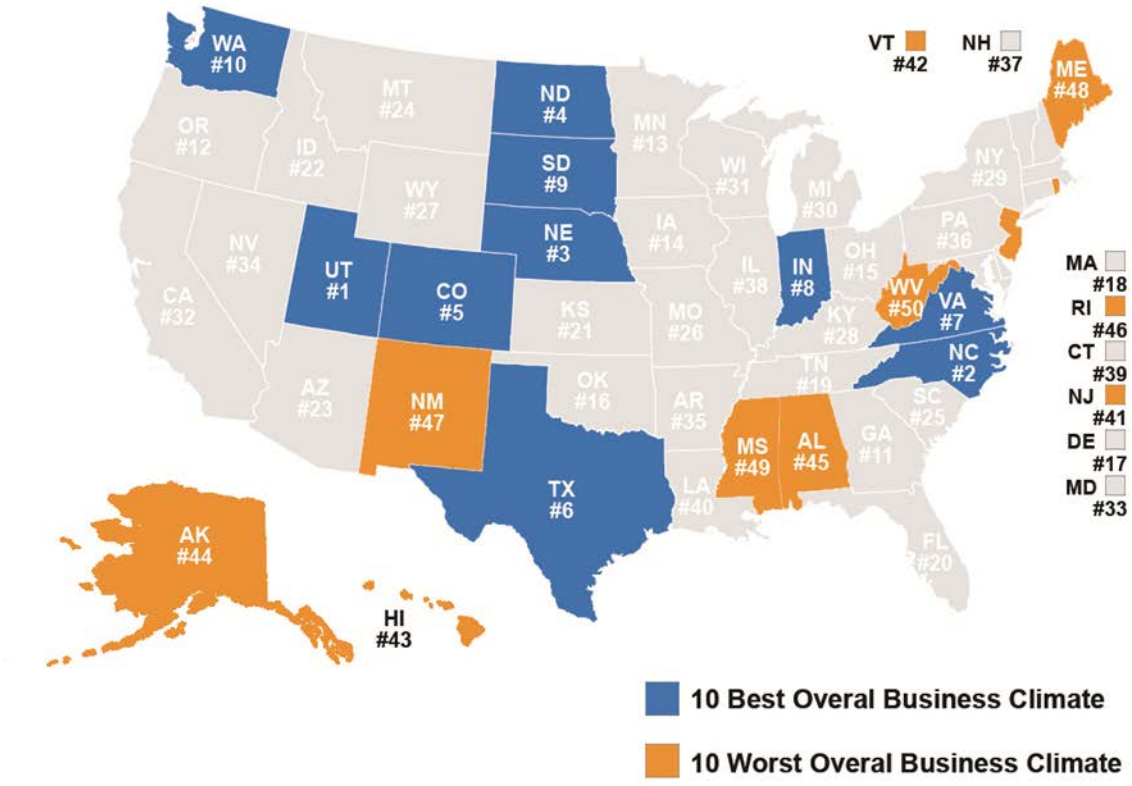
Source: Tax Foundation

- **Rhode Island's regulatory environment is also problematic.** Negative past ratings may well have become a self-fulfilling prophecy in souring business sentiments. Regardless, two well-regarded annual business climate studies by *CNBC* and *Forbes* place Rhode Island in the bottom tier of states across a wide range of business climate factors. *Forbes'* 2015 *Best States for Business* report rates Rhode Island 47th.[97] *CNBC* in its 2015 *Top States for Business* assessment ranks Rhode Island 48th overall and 45th on business friendliness—a category measuring legal and regulatory environments.[98] While recent tax and regulatory changes by Gov. Raimondo and the General Assembly may not be fully reflected in these data-driven business climate studies, the rankings consistently suggest that Rhode Island has real challenges as well as perception problems with regard to its business environment. Here too, small businesses—which will play a

large role in any Rhode Island advanced industries surge—may be bearing the brunt of the burden

Rhode Island's regulatory environment ranks low in the country

2015 Business climate rankings by Forbes



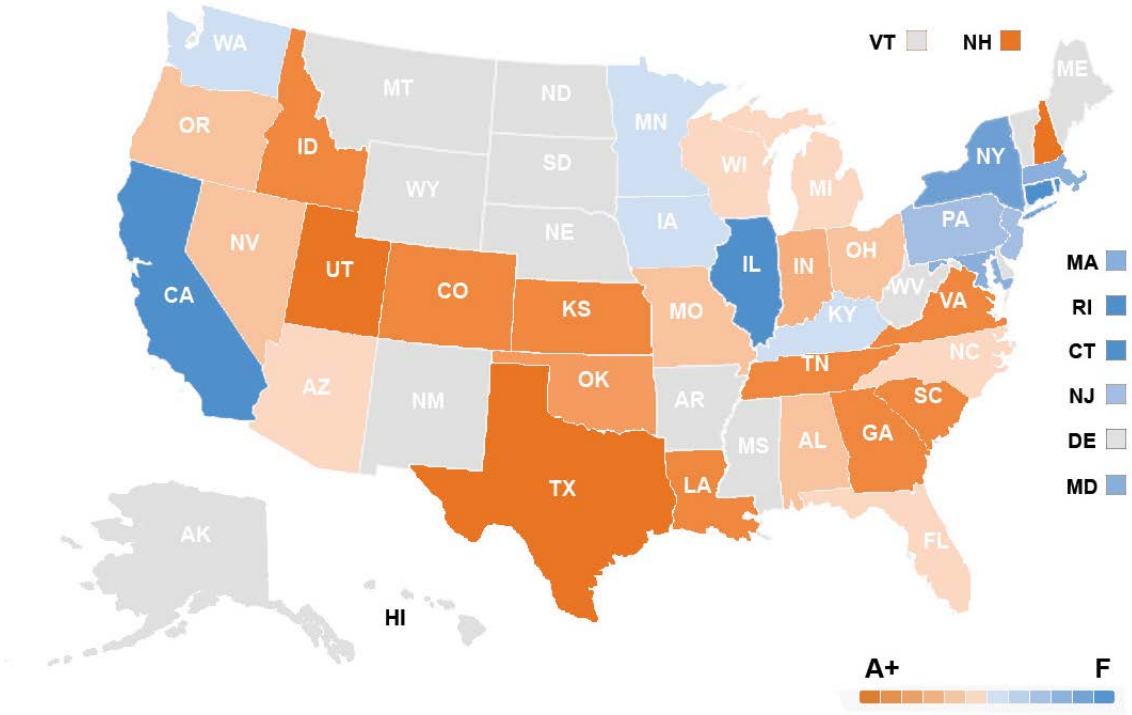
Source: Forbes' 2015 *Best States for Business*

- **Multiple ratings deem the state's regulatory environment burdensome for small businesses.** Though recent adjustments may not be reflected, neither benchmarking nor perceptions tell a positive story. In a 2014 report from the Small Business & Entrepreneurship Council measuring state tax and regulatory environments for small businesses, Rhode Island ranked 40th in the nation.[99] Surveys say much the same thing. The 2015 Thumbtack.com Small Business Friendliness Survey, conducted in partnership with the Kauffman Foundation, ranked Rhode Island dead last—36th out of the 36 states examined in a survey of 18,000 small business owners. Rhode Island received an F grade in seven of the 10 subcategories: ease of starting a business; overall regulations; employment, labor and hiring; tax code; licensing; environmental; and zoning.[100]

Similarly, the Rhode Island Office of Regulatory Reform's recent survey of Rhode Island small business owners found that 40 percent of owners considered the state's regulatory system relatively "poor," with 66 percent believing there is too much regulation, and over half believing that the benefits of regulations do not outweigh costs to comply.[101] Regulations that have been cited as particularly frustrating include local meals and beverage taxes, unemployment and disability insurance regulations, and requirements around contractor registration and construction standards

Rhode Island is not perceived as friendly to small businesses

2015 U.S. small business friendliness survey rankings



Source: Thumbtack.com

In addition, several physical infrastructure problems involving the state's land inventory and transport links undercut Rhode Island's competitiveness.

- **Rhode Island lacks readily developable land, which could prevent companies from locating in the state in future.** The shortage of premium, pad-ready, and permitted sites is a major constraining factor preventing manufacturers and other firms requiring large footprints from locating in Rhode Island. [102] While Quonset Business Park, the state's leading industrial park, has been a huge economic success, it is running out of land, with less than 300 acres available for

lease. Rhode Island needs a new land development strategy that develops sites to support existing and future demand for large facilities

- **Transportation links do not always connect travelers to jobs throughout the region.** Even though RIPTA is a relatively high-capacity transit operator, the average worker using the system can access only 22 percent of jobs in the Providence metro area within 90 minutes.[103] The Providence-Warwick metropolitan area has the highest commute time for workers who take public transit of any medium-sized metro area. Moreover, intercity passenger and commuter rail service—while increasingly popular—remains suboptimal despite being one of the state's most visible economic links to the rest of the Boston-Washington corridor. The connection between Providence and Boston ranks as one of the longest, least frequent, and most expensive commuter rail links on the East Coast. This too cuts against business proximity and hampers Rhode Island's access to Boston-area talent and investment

BOTTOM LINE

Both data- and survey-driven analyses confirm that Rhode Island's business environment remains a liability. Tax, regulatory, and sentiment dimensions all appear to weigh on the state's business dynamics, notwithstanding recent progress made by the Raimondo administration. Rhode Island now needs to continue chipping away at the state's mass of onerous tax burdens and inefficient regulations. At the same time, it needs to do what it can to accelerate the speed of business in Rhode Island by making land development and rail travel easier.

* * *

Lastly, Rhode Island's governance—the nature of its business-led civic culture—matters intensely. Governance of this sort plays a large role in determining whether a state or region can mobilize substantial resources and execute strategies for economic development.

BUSINESS-LED CIVIC ENGAGEMENT

WHY IT MATTERS

The quality of a region's governance, defined as "the way society collectively solves its problems and meets its needs," directly affects economic outcomes.[104] Studies produced by researchers at the OECD and elsewhere affirm the role that decisive governance plays in building prosperous regional economies.[105] It is becoming increasingly clear that the nature and scale of economic challenges faced by states like Rhode Island—intense global competition; an unreliable national government; the need to invest continuously in innovation, placemaking, and skills—are upping the ante and requiring new forms of collaborative governance that bring together the private, public, and civic sectors as never before.

Networks of business leaders bring a great deal to the work of regional governance. They "have a fundamental understanding of the local economy's needs, and … are personally passionate about its success."[106] They recognize the pitfalls of short-term thinking and strive to advance a long view of regional economic growth that transcends individual political administrations. They prioritize technology-based economic development, building and retaining worker talent, and transportation and physical infrastructure—all of which are essential components of a healthy economy. Perhaps most critically, they can marshal resources to invest in crosscutting interventions that bolster regional economic growth and ensure that the regional economy works for all residents.[107]

In its 2015 report on local economic leadership, to this point, OECD researchers found that business and civic leadership collaborations represent "a driving leadership force in almost all of the world's most successful cities." By engaging directly in local governance, the study found, these networks "can make a decisive difference to local economic development as a complementary actor to local government, helping to fill the gaps in the system."[108] The Federal Reserve Bank of Boston reached a similar conclusion in its study of areas coping with long-term economic decline. Of the 10 cities investigated that were able to mount a resurgence, the critical factor was not a city's industry mix, demographic composition, or geographic position but rather the ability of regional leaders to collaborate across sectors on designing and implementing a long-term vision for success.[109] These and other findings reinforce the notion that "improving local governance is conducive to economic and employment development and prosperity."[110]

ASSESSMENT

Rhode Island is fortunate to have business and civic leaders who care deeply about the state and its residents. This intense interest has sparked a broad range of civic organizations and initiatives that work to strengthen the state's economy and improve Rhode Islanders' quality of life. The election of Gov. Raimondo and the arrival of new leadership at Brown University, the Rhode Island School of Design, and the Community College of Rhode Island (CCRI) system in recent years have only reinforced regional leaders' desire to effect positive change in the state. However, despite the state's small size, Rhode

Island's leadership class has historically punched below its weight in delivering large-scale transformation initiatives in the economic development sphere.

The state possesses numerous private-sector leadership organizations that are in many ways a strength. Numerous organizations in the state seek to leverage the insights of private-sector leaders, including no fewer than 18 chambers of commerce as well as: Greater Rhode Island: Think Bigger; GrowSmartRI; Rhode Island Black Business Association; Rhode Island Commodores; Rhode Island Council of Economic Advisors; the Rhode Island Public Expenditure Council (RIPEC); and the Urban League of Rhode Island. Private-sector engagement in these various groups affirms business leaders' interest in supporting economic development efforts in the state. Recently, for example, the state's business community has actively engaged in supporting the significant economic development reinventions of the Raimondo administration.

However, despite some overlap in membership, these organizations largely operate independently with little coordination of agendas. Currently, the flaw of the Rhode Island business-leadership sphere resembles the weakness of the state's innovation ecosystem: Many of the state's mostly small intermediary organizations are largely autonomous and minimally connected with each other or with the larger anchors of Rhode Island's economy. To be sure, the Greater Providence Chamber of Commerce has consistently stressed the importance of the innovation and knowledge economy, and will continue to play an invaluable role in advancing the advanced economy. But few other organizations have the needed heft to organize substantial initiatives. As a result, the nation's smallest state lacks the ability to "go big" on key issues, unless it is through government action. The resulting atomization splinters economic development activities and inhibits Rhode Island's ability to capitalize on the insights and assets of its private-sector leaders. In this vein, a 2014 report by the Rhode Island Foundation and CommerceRI found that private-sector leaders throughout the state "expressed a need for more opportunities to connect with other stakeholders within and across sectors to leverage talent, eliminate duplication, and cross-promote good work."[111] Unfortunately, opportunities for such collaboration remain limited. Persistent fragmentation across sectors and jurisdictions continues to plague the state, as do weak connections between the private sector and institutions of higher education and a general skepticism about the public sector's ability to act effectively. Taken together, these realities significantly constrain Rhode Island's ability to formulate and execute smart, collaborative cross-sector solutions to the state's economic challenges.

Finally, the state lacks a high-level CEO council or highly engaged large-corporation CEO class. Rhode Island possesses many public-spirited top executives but in recent years has seen less engagement of top large-company executives in economic development and lacks a forum for organizing it. By contrast, many states and metropolitan areas benefit from the presence of well-organized, powerful regional business-civic organizations that are playing increasingly central roles in promoting smart economic development, prioritizing key strategies, and mobilizing money to execute them. In Rhode Island, the need for a focused and effective leadership group capable of delivering larger-scale strategic action for the good of the economy stands out.

BOTTOM LINE

Rhode Island needs to devise a way to draw its many small and disparate conversations into a larger, bolder, and more transformative one. Specifically, the state needs to increase the ability of its business and civic sector to engage decisively in order to help deliver major initiatives of broad importance to the state. Currently, the state lacks a high-level regional business-civic organization focused on driving the state's long-term growth through the delivery of a short list of transformative initiatives.

* * *

Overall, Rhode Island—like many states—possesses genuine strengths and serious weaknesses when it comes to economic growth. In each case, assets represent potential differentiators that are compromised by deficits, particularly with regard to the three key drivers of competitiveness:

- The state's **innovation capacity** is anchored by its solid university R&D base and the presence of NUWC. However, these assets' impact is undercut by a paucity of industry-sponsored research in the state and the weak commercialization activities
- Rhode Island has built up critical elements of a strong **quality of place** and a compact industrial ecosystem, anchored by its manageably scaled industry communities, distinctive cities and towns, and vibrant food and art scenes. At the same time, the innovation community remains atomized and lacks collaboration spaces and focal points
- The **talent and skills** of Rhode Island's workforce are competitive, especially for those with higher levels of education, but deepening demographic and education/training system challenges raise questions about whether the state will be able to prepare adequate numbers of younger STEM/STEAM workers to keep up with increased demand for higher-skilled workers

A similar mixed standing emerges from the situational assessment on **business environment** and **business-led civic engagement**:

- Recent tax and regulatory progress has begun to send positive signals inside and outside the state but a heavy overhang of burdensome provisions continues to earn Rhode Island negative ratings on its business environment. The state also must contend with a shortage of sizable industrial / commercial land parcels and suboptimal rail service
- Aside from the state's larger chambers, the state's proliferation of small-scale business and civic organizations reflects a valuable degree of organization but is not paired with the presence of a strong business-civic CEO organization that can mobilize money and organizing at a decisive scale. Likewise, while Greater Providence Chamber will continue to play an invaluable role in advancing the advanced economy, it will need help including from new actors and organizations

Situational assessment: Rhode Island's strengths and weaknesses on key competitiveness factors

Competitiveness Factor	Strengths	Weaknesses
Innovation Capacity	• Relative size and growth of university R&D base • NUWC • VC investment levels have grown	• Industry R&D lags the national average and that of benchmark states • Commercialization activities lag top performing benchmark states, and are particularly weak across Rhode Island's universities • Entrepreneurial activity and growth of new firms are weak • Startups receive far less early-stage VC than in benchmark states
Quality of Place	• Strong rankings on national and international quality of life indices • Solid urban fundamentals underpin attractive amenities • Providence County scores well on walkability due to high density, street connectivity, and activity centering	• Job sprawl continues • Industry links to research institutions remain thin • Patenting patterns reflect disjointed innovation networks • Some clusters lack focal points • Lack of specialized and/or shared innovation facilities for advanced industries
Talent and Skills	• Working-age population is competitive in its levels of educational attainment • Share of degrees in computer science fields is solid	• Educational attainment limited for associate and graduate degree, declining for bachelor's degrees • STEAM degree production not keeping pace with benchmark states • Digital degree attainment is not growing fast enough • PK-12 system is coming up short in preparing students for STEAM study and careers • Stark racial and ethnic divides on math proficiency foreshadow a STEAM workforce pipeline crisis
Business Environment	• Wide number of reforms in recent years to improve business environment by lowering business taxes, creating new tax incentive tools, and improving the state's regulatory regime	• Reputation as an uncompetitive business environment • Among the lowest rankings in overall business climate, tax environment, regulatory regime, small business climate • Shortage of ready-to-go industrial and commercial land parcels • Public transportation system ineffective at connecting individuals to jobs • Rail service to Boston is slow and infrequent
Business-Led Civic Engagement	• Presence of numerous private-sector leadership organizations	• Private-sector leadership organizations operate independently with little coordination of agendas • No high-level CEO council or highly engaged large-corporation CEO class

Rhode Island should embrace a new economic development model in which the state invests in the most critical advanced industries growth drivers while systematically improving its statewide platform for growth

The conclusion of the situational assessment marries the takeaways of the economic context chapter, the industry analysis, and the situational assessment. It holds that Rhode Island should invest in the development of new growth engines by investing in the most critical advanced industries growth inputs—innovation capacity, place, skills—while working to improve the state's broader platform for the growth of all industries.

The rationale for this conclusion flows from the facts. Chapter 2 revealed that the single most destructive economic dynamic of the last two decades in Rhode Island has been the erosion of the state's advanced manufacturing sector, which left the state a diminished advanced industry sector and so eroded sources of high-value output and prosperity. That finding placed the development of new growth engines through technology investments, placemaking, and skills strategies front and center.

However, the fact that the five advanced industry growth areas identified in Chapter 3 are in fact largely intricate networks of interrelated small industries and emerging clusters recommends a particular approach, namely "platform" strategies that focus on ameliorating weaknesses in the provision of key crosscutting inputs to advanced industry growth such as those enumerated in this chapter—innovation inputs, placemaking and ecosystem-building, and specialized skills. At the same time, the same logic recommends other strategies that focus on improving the broader growth platform, which includes the general business environment and the state's capacity for business-led civic engagement.

This chapter identified a short list of key crosscutting drivers of competitiveness and assessed Rhode Island's standing on each. The specific strengths and weaknesses highlighted in this assessment represent assets to be leveraged and deficits to be addressed.

5. Strategies for Rhode Island

Rhode Island needs to change the dynamic, just as its early settlers did when they embraced global trade in the 1690s and as the merchants did later when they brought large-scale industrial manufacturing to the United States. Once again, current trends are falling short of Rhode Island's historical prosperity and aspirations. The state's growth platform remains rickety. The time has come for the state to expand efforts to arrest drift by supporting the emergence of new growth engines that can produce shared opportunity for all Rhode Islanders.

Specifically, the state can bend the state's trends by upgrading its growth platform to foster the expansion of its most promising high-value clusters. Only in that way will the state have a shot at rousing itself from the disappointing realities of the past decade and improving its standard of living.

What key moves will make a difference? In order to determine the nature of the needed upgrades, Rhode Island should follow the facts and implications of the situational assessment.

As the last chapter suggested, key aspects of the state's growth platform are in particular need of renovation, ranging from its innovation enterprise and talent stores to its business environment and ability to mobilize around key initiatives.

The state's fundamental growth sources—it's innovation capacity, its placemaking, its skills base—are in need of refreshment and need strengthening. Its basic competitive environment—including its business environment, land availability, and transportation links—require upgrades. And there are gaps in the state's business-civic leadership infrastructure. And so the state needs to embrace a number of connected actions aimed at systematically upgrading the state's growth platform and catalyzing greater public-private cooperation to drive job and wage growth. To that end, this section concludes that the state and its business and civic partners should:

- Launch a **Rhode Island Innovates** initiative to invest in the core competitiveness drivers that anchor Rhode Island's growth platform—its innovation capacity, its quality of place, and its skills base
- Launch a **Rhode Island Competes** initiative to upgrade the state's supporting platforms for growth, starting with its business environment
- Ensure that **Rhode Island Acts** by strengthening its capacity for decisive business-led civic engagement

Each of these strategy initiatives consists of several sub-themes, each of which involves a number of particular action steps. Moreover, while each of the initiatives, themes, and action steps could add value individually, this array of items is intended as a comprehensive package, the value of which will be multiplied by synergies and a shared focus on expanding the state's most promising growth areas. For that reason, the significant government, private-sector, and philanthropic investments advanced here are justified by the need for urgent action at scale through an array of mutually supporting activities.

Should the state and its partners take strategic and robust action along these lines they will have a shot at catalyzing more high-value advanced industry growth and the follow-on opportunity-providing growth that comes with it.

Launch a Rhode Island Innovates initiative to invest in the core competitiveness drivers that anchor Rhode Island's growth platform—its innovation capacity, its quality of place, and its skills base

Nothing matters more to the state's future advantage than the competitiveness of the state's interrelated innovation system, placemaking, and talent base. Advanced industries are defined by their involvement in R&D, their dependence on dynamic technology ecosystems, and their reliance on skilled technical workers. Together these factors provide the state's growth platform and constitute the core drivers of advanced and opportunity industry development. Actions to stimulate the competitiveness of these inputs must stand at the center of any serious state growth strategy.

In keeping with that, Rhode Island should launch a **Rhode Island Innovates** initiative that ties together strategies for enhancing the core technology, quality of place, and skills inputs essential to spurring advanced industry expansion—and by extension growth across the whole economy. Three related sub-themes should underpin the new initiative:

- Invest in a multi-dimensional initiative to spur Rhode Island technology innovation
- Strengthen several innovation districts or neighborhoods around the state by furnishing them with place-based technology collaboration centers and strategic placemaking support
- Establish Rhode Island as a national leader in STEAM education and training with a focus on coding and other digital skills

INNOVATION CAPACITY

Launch a multi-dimensional initiative to spur Rhode Island technology innovation

PROBLEM

Rhode Island is underperforming in innovation-oriented economic development. Despite the presence of existing and emerging core technology competencies in its industries, universities, and at NUWC, the

scale and velocity of the state's industry relevant R&D, commercialization activities, and entrepreneurial enterprises remains insufficient.

More specifically, the production of knowledge capital is spotty and its commercialization remains too slight.

RESPONSE

Rhode Island needs to put in place a public-private initiative to expand the state's basic innovation enterprise with a focus on existing competencies in advanced industry growth areas, with the aim of supporting more durable, higher quality economic growth. By establishing such an initiative to **spur Rhode Island technology innovation** the state and its partners can by extension encourage related industry growth and job creation.

IMPLEMENTATION

Strengthening Rhode Island's innovation ecosystem will require significant and sustained investment as well as disciplined management of several activities.

- Over the next year, the state should launch **a three-part technology innovation initiative** to raise its overall level of R&D activities, accelerate commercialization, and boost the level of engagement between universities and industries
    - Along these lines, the state will work with universities and industries to:
        - Recruit and support the work of commercially oriented **impact faculty** in advanced industry growth area subjects. By helping to endow these faculty positions the state and its partners will at once expand the state's research base and help attract more entrepreneurial faculty
        - Support **new-product commercialization** through grants for proof-of-concept testing. The grants will allow industry or university teams to validate the commercial potential of a new technology
        - Provide **matching funds** for industry-university technology development collaborations
    - The state, research institutions, and the private sector should **augment the impact** of these efforts by investing in technology themes that align with the state's priority growth areas as well as university and NUWC investment plans and technology competencies. These plans and competencies will likely justify prioritizing investment in:
        - Biomedical sciences, with an emphasis on translational neuroscience

        - Data science, mathematics, and computational science including security applications and cyber-physical systems
        - Marine and ocean science and engineering, include extreme-environment applications
        - Design thinking and high design content products and prototyping
        - Food science, health, and wellness
    - The estimated cost for the three innovation efforts would range from $10 million to $20 million annually

- The state should also **sponsor a Rhode Island Global Innovation Challenge** to call forth, attract, and accelerate dynamic local and regional early-stage startups in key advanced industries. Similar to the well-known MassChallenge in Boston, the Rhode Island Global Innovation Challenge would connect high-impact local and regional startups—defined as having less than $500,000 in equity raised—with resources, mentoring, and accelerator services to launch and succeed in Rhode Island
    - Program elements could include a modest cash accelerator grant; office space; mentorship from a customized team offering expertise in specific technology / market / business needs; and the ability to compete for a grand award of $1 million with no equity taken
    - Estimated costs for this challenge would be moderate and would depend on the level of private contributions
- In addition, the state could link to the challenge a **Rhode Island Entrepreneurs in Residence program (RIEIR)** that would recruit talented entrepreneurs in the identified growth areas by sponsoring foreign university graduates' H-1B visa petitions. By leveraging the ability of universities and government research institutions to sponsor an unlimited number of cap-exempt H-1B visa petitions, the state and its partners could attract to and/or retain foreign entrepreneurs to set up and grow their companies in the Ocean State. In addition to visa sponsorship successful applicants could also be considered for inclusion in the Rhode Island Global Innovation Challenge and receive funding and placement in the accelerator program. The combination of the RIEIR program and the Global Innovation Challenge would create a new way to engage aspiring STEAM graduate students and entrepreneurs at the state's research institutions even as they form new companies around promising technologies, mentor other entrepreneurs, and form relationships with investors
    - Through the program, Rhode Island universities would offer selected foreign graduate students part-time work positions that would allow the majority of their time to be dedicated to developing their startup idea. Candidates would need to be STEAM- or

business-degree holders and leaders of legally registered early-stage ventures that would be headquartered in Rhode Island for the duration of the three-year H-1B visa

- Estimated costs for the residence program would be modest and could be funded through state, university, philanthropic, and/or private contributions.

Implementation of the state's public-private innovation initiative will need to be administered by a competent innovation management team—perhaps hired, overseen, and partially funded by the proposed **Partnership for Rhode Island**, a CEO- and university-president-led leadership and investment circle. An alternative model could have the CommerceRI at least temporarily run the initiative, following the model of Business Oregon's operation of that state's R&D effort, the Signature Research Institutes.

BUDGET IMPACT

Overall the proposed initiative will require moderate-to-high annual investment of state, philanthropic, and/or private funding.

ECONOMIC IMPACT

A Rhode Island technology innovation initiative would generate substantial economic returns, including increased R&D activity, commercialization, and entrepreneurialism. The presence of vibrant research and commercialization activities is also a powerful attractor of corporate sitings.

Impact example:

Since its formation in 1990, the **Georgia Research Alliance** initiative has leveraged $600 million of state funding ($24 million a year) into:

- $2.6 billion of direct federal and private investment in Georgia
- 150+ newly launched companies
- 6,000 high-skill, high-value jobs

Impact example:

Over six years, the $3 million-a-year **MassChallenge** initiative has worked with 100 startups a year at its Boston site that have generate:

- $1 billion in outside funding
- $480 million of revenue
- 4,000 jobs in Eastern Massachusetts

PLACEMAKING

Strengthen several innovation districts or neighborhoods around the state by targeting them for place-based technology collaboration centers and strategic placemaking

PROBLEM

Robust, place-based industry-university technology collaboration hubs—complemented by vibrant urban environments—are increasingly important factors in regional economic development. As yet, however, Rhode Island currently lacks such focal points. Relatedly, the state needs to do everything it can to retain talent from its strong educational institutions and augment its local talent pool in order to enable greater business attraction, entrepreneurial activity, and economic growth.

RESPONSE

Rhode Island should move to strengthen several such innovation districts or neighborhoods around the state with the development of **place-based technology development centers.** Centers should be complemented with **strategic placemaking** that will enhance their status as focal points for idea exchange and talent retention and attraction.

By linking the development of significant commercially relevant tech centers to strong placemaking Rhode Island can craft several signature physical spaces that represent the latest in tech-based economic development and increase neighborhood vibrancy for current and future residents.

IMPLEMENTATION

Anchoring several innovation districts or neighborhoods with dynamic technology development collaboration centers—and surrounding them with lively neighborhood amenities—would represent a bold bid to change the state's position in the hierarchy of New England's economic geography.

The full initiative entails **two sub-initiatives**:

- First, the state should **create one or two industry-university-laboratory tech collaboration centers** over the next year focused on promising advanced industry technology opportunities for Rhode Island. One of these centers should be located in the emerging Providence Innovation and Design District on the 1-195 lands. Another could focus and connect the ocean / undersea technologies and/or cyber technology specializations being developed on Aquidneck Island. The placement of concentrated new technology development work in urban centers adjacent to universities, existing research centers, and talent concentrations will upgrade the state's innovation enterprise, push it toward critical mass, and place the state in the vanguard of innovation practice

- To this end, the state and its partners should work with competitively selected university-industry-laboratory consortia to establish several interdisciplinary technology hubs that would:
    - Organize around advancing, deepening, and commercializing promising **Rhode Island technology competencies**, including variations and fusions of the state's strengths in the life sciences; mathematics and computational sciences; engineering; food, health, and wellness; and design and product prototyping
    - Accelerate and scale up **high-impact, use-oriented R&D** with a focus on advancing Rhode Island advanced industry competitiveness
    - Focus on **industry-university-laboratory collaboration,** with an emphasis on industry-defined problem-solving
    - House **specialized, shared-use facilities** including labs, test equipment, prototyping facilities, offices, and co-working / flex space for established and emerging companies
    - Furnish **landing sites** for new or relocating corporate labs
- To identify, shape, and empower the centers the state and its partners should utilize a carefully designed set of selection procedures, tools, and investments:
    - **Public competitions** would require joint university-industry-lab consortia to propose high-impact collaborations. The competitions could be administered by a competent innovation management entity hired and overseen by the proposed Partnership for Rhode Island. Alternatively, the competitions and project oversight could be run out of CommerceRI, with appropriate transparency and oversight
    - Consortia would be required to **match** state-provided investments with private, philanthropic, or federal funds
    - A dramatic **"pitch day"** could culminate the proposal process
    - Award decisions would be made by an **independent expert panel.** Selection criteria would include: technical and execution potential; creation of competitive advantage for Rhode Island; potential for generating economic growth; leveraging of private and federal funding
- Specific state awards to drive creation of these place-based collaboration hubs would include:
    - **State capital funding** for buildings, tenant improvements, and shared-use equipment. Matching additional investment from institutions, industry, the

federal government, and philanthropy if necessary would go towards realizing leverage requirements

- The centers would require significant capital investment to anchor significant private or philanthropic matching money

- **Priority access to existing state innovation programs**, including the state's Industry Cluster Grants, Innovation Vouchers, Innovation Network Matching Grants, and Innovate RI Small Business Fund programs

  - Use of these programs would create **no new costs**

- **Targeted Rhode Island Innovates place-based tax incentives,** including for innovation-oriented advanced industry companies locating in the I-195 corridor innovation district or another innovation neighborhood associated with a collaborative innovation center elsewhere in the state. This type of tax credit has been successfully implemented to support Pennsylvania's Keystone Innovation Zones (KIZ), which are designated areas around research universities in the state.

  - These incentives in credits or foregone near-term tax revenue would involve moderate costs over the course of a decade

- Concurrently, the state should **enhance the quality of place across Rhode Island's urban centers** to support its innovation hubs, improve talent retention and attraction, and enhance overall quality of life. Rhode Island should complement its proposed innovation activities with nimble and low-cost quality-of-place strategies in central communities to appeal to entrepreneurs, young professionals, young families, and current residents

  - The state should partner with local institutions like RISD and Johnson & Wales as well as Hope & Main's food startup ecosystem and/or other associations to:

    - Identify opportunities for and deliver **"pop-up urbanism"** showcasing the state's food, arts, and design scenes, particularly in underutilized spaces. Temporary restaurants, food-truck convergences, festivals, art shows, and markets could all make the grade. This will be of special importance in and around the I-195 lands and in Newport while longer-term development is undertaken

    - Infuse placemaking into **existing programs and investments.** To this end the state could:

      - **Incorporate placemaking into the planning of major innovation districts or neighborhoods** such as the I-195 corridor. "Live-work-play" and "mixed-use" should be central principles for developing lively urban spaces that attract and retain talent, facilitate social interaction, and

ease information exchange. Residential units should be linked to academic-innovation activities, shared facilities, commercial themes such as design-maker, arts, and food retail, and rent subsidies for related startups

- Prioritize **Main Street RI funds** towards activities that align with placemaking themes of innovation, design, food, the ocean, and mixed uses and/or the state's **Hope Communities** (Providence, Central Falls, West Warwick, Pawtucket, and Woonsocket). The state should increase the size of the Main Street RI fund or a create a complementary new placemaking fund, possibly through a recurring bond measure that provides moderate annual investment for more and/or larger-scale allocations and fund-matching

- Ensure that **statewide marketing efforts** include targeting young professionals and **branding Rhode Island's "hipness factor,"** especially with regard to food and design

- To operationalize this initiative the state should establish a minimalist but effective **operational capacity** to drive placemaking. To this end the state should:

  - Partner with a group like **Project for Public Spaces (PPS)**, a leading organization for urban placemaking, to identify key opportunities and launch low-cost "pop-up urbanism" efforts

    - Costs will be modest and vary depending on desired scale and could potentially be funded in part by PPS's "Heart of the Community" program, sponsored by Southwest Airlines.

  - Establish a state-level **New Urban Mechanics (NUM) team** to collaborate with state and local agencies to deliver ongoing civic innovation and work with entrepreneurs to pilot commercial opportunities.

    - An NUM team could be established with minimal funding for an annual operating budget combined with an annual investment fund sourced from state, local, and philanthropic funding

  - Leverage the insights of **community experts and stakeholders** by standing up a series of community-led activities at various scales, with input from PPS, the NUM team, and local stakeholders

    - One example could be to partner with Johnson & Wales, the Food Innovation Nexus, and Hope & Main's food startup ecosystem to showcase the Rhode Island food scene. The state could contribute free

or subsidized access to vacant downtown space with in-kind or financial contributions from commercial partners at **minimal cost** to state or city

BUDGET IMPACT

This two-part placemaking initiative offers serious short-, medium-, and long-term approaches that will require substantial investments over 10 years.

ECONOMIC IMPACT

Higher-cost innovation centers and low-cost "guerrilla urbanism" efforts each have attractive track records for economic impact.

Competitively awarded **technology collaboration centers**—with strong requirements for industry, federal, and/or philanthropic matching investment—have potential for generating solid economic impacts. Direct job creation would result from center construction, investment, and staffing in the near term, with growth in local companies, new startups, and the potential attraction of new companies to Rhode Island providing follow-on benefits.

Impact example:

Oregon's Signature Research Centers have generated solid returns on the state's investment. Most notably, the $21 million of state funds used to create and sustain the Oregon Nanoscience and Microtechnologies Institute (ONAMI) have generated 45 startups that together have supported 300 jobs and $560 million in total financial leverage.

Impact example:

Pennsylvania's place-based Keystone Innovation Zones (KIZ) have since their inception in 2003 awarded $103 million in tax credits to 7,000 young firms located near Pennsylvania universities. These firms went on to generate $674 million in R&D expenditures, $3.5 billion in additional funding, 1,000 product launches, and 7,500 new jobs.

Quality of place strategies also have solid economic impact potential. Direct job creation would likely result from increased business activity in local companies, new startups, and through the potential attraction of new companies to Rhode Island.

Impact example:

From 2001–13, **Portland, OR** invested in differentiating itself on both quality of life and industrial strengths, including through its "Keep Portland Weird" (2003) and "We Build Green Cities" (2012) campaigns. During this period, Portland ranked amongst the coolest and most livable cities in America and had one of the fastest growing populations of educated young people in the United States, while Oregon saw GSP outgrow U.S. GDP 62 percent vs. 22 percent.

TALENT AND SKILLS

Complement a strong statewide STEAM education and training agenda with RI Codes—a coding initiative to prepare more Rhode Islanders for careers in tech

PROBLEM

Rhode Island's economic future will be determined by the strength of its R&D and STEM-intensive advanced industries, which in turn will be influenced by the availability of a nimble and abundant technical workforce. However, the state currently lacks the education and workforce training infrastructure needed to prepare sufficient numbers of Rhode Islanders across all skill levels —including those of diverse backgrounds—for careers in tech-oriented advanced industries such as the fast-growing web development, software, and other digital fields.

This lack of high-quality STEAM and digital education and training infrastructure places a ceiling on the state's ability to grow a vibrant advanced industry sector.

RESPONSE

Rhode Island should advance a strong **statewide STEAM education and training agenda** and complement it with **RI Codes**, a state-of-the-art effort that employs short- and longer-term strategies to cultivate a strong tech workforce. By pursuing the two initiatives simultaneously the state will be able to build a diverse and deep pool of STEAM workers as well as a just-in-time cadre of tech workers to meet rising demand.

IMPLEMENTATION

Transforming the state's workforce with ubiquitous STEAM and tech education and training will be a substantial undertaking that can build on numerous admirable efforts already underway, including activities in numerous career and technical education (CTE) programs in the state, RISD, and the defense supply chain.

The full strategy entails two simultaneous initiatives:

- First, the state should move to **establish itself as a national leader in STEAM education and workforce training and development**. To a certain extent, the state has already begun to embrace STEAM. In December, Gov. Raimondo and the Rhode Island Commerce Corporation Board of Directors approved the launch of STEAM-oriented career and technical education pilot programs aligned with IBM's Pathways in Technology Early College High School program (P-TECH) in three school districts. More broadly, the proposed Governor's STEAM Council will be tasked with developing a strategic plan for integrating STEAM into PK-12, postsecondary education, and workforce training programs. Additional proposals for establishing a STEAM PK-

12 Pipeline Grant program, cultivating partnerships between the private sector and educational institutions, bringing computer science to every high school, and increasing the number of trained STEAM educators, if implemented in full, could help Rhode Island make great strides in STEAM, particularly with regard to PK-12. However, becoming the national leader in STEAM will require going beyond the activities suggested to date.

- Building on proposed actions, Rhode Island should complement a new STEAM council and other emerging initiatives with efforts that will increase the initiative's force and reach. To this end the state and its partners should:

  - **Designate a STEAM champion** in the governor's office to coordinate STEAM-related education and workforce activities and reduce fragmentation and duplicative efforts within state government. The designation of a STEAM champion would increase the value of disparate initiatives by assigning full-time responsibility to a single point person

    - Supporting a STEAM champion with 2–3 FTE support staff could be accomplished at minimal cost to the state

  - **Roll out a large-scale statewide marketing campaign** that increases awareness of and enthusiasm for STEAM education and STEAM career pathways among students, families, and educators. Utah and other states have launched marketing campaigns to educate residents, who tend to know little about STEAM education and the employment opportunities available in STEAM-intensive industries. Rhode Island similarly needs to raise public awareness of the importance of STEAM and a major marketing campaign—run through multiple channels to reach a broad range of demographics and communities—could make a difference.

    - Development and execution of a top-quality RFP and multi-channel campaign would require a minimal to moderate investment that could to be supported by the proposed Partnership for Rhode Island and/or philanthropy

  - **Invest in ongoing, high-quality professional development** for prospective and incumbent PK-12 STEAM educators. To diffuse STEAM more broadly will require more teachers with specific STEAM knowledge and training. The costs of providing ongoing, high-quality professional development for Rhode Island's STEAM educators will vary depending on the number of participants, the duration of training, equipment, and materials expenses. One model is UTeach, which recruits and prepares undergraduate STEM majors to teach in PK-12 schools

- Bringing UTeach to URI or Rhode Island College would likely require a moderate level of funding

- **Establish a STEAM Workforce Challenge grant program** to support the development, implementation, and replication of programming that meets the skill and competency needs of area industries. The competitive matching grant challenge would seed, expand, or multiply the best STEAM training initiatives in a state with numerous smart but small startup initiatives. In parallel with Real Jobs RI, a STEAM Workforce Challenge grant program would provide funds for experimentation grants and scaling grants

    - A moderate amount of state funding , when combined with a 1:1 minimum match from private-sector and/or philanthropic participants, would create a robust initiative

- **Expand the Wavemaker Fellowship** to encourage STEAM graduates of the state's colleges and universities to stay and work in Rhode Island by defraying student loan payments for up to four years. By lifting the cap on annual awards (currently $6,000) and allowing employers to apply for the program on behalf of their employees and match state* funds with private dollars this program could triple the number of young workers using the program (150 at present). An expanded fellowship program would provide an even more compelling reason for qualified STEAM grads to stay in Rhode Island

    - These changes would require a moderate increase in the state's annual budget for the Wavemaker Fellowship

- Second, the state should **launch RI Codes**, a substantial statewide coding initiative that will prepare more Rhode Islanders for careers in tech. Undertaken in conjunction with the broader STEAM education and workforce initiative, RI Codes would reinforce the state's new focus on STEAM with strategies to cultivate a strong IT, software, and tech workforce. RI Codes would include strategies that address key challenges in the immediate term while simultaneously creating the infrastructure needed to ensure a strong tech workforce in the coming decades

    - To achieve near-term impact through RI Codes, Rhode Island should move to:

        - **Provide free access to online learning platforms** like Treehouse, Thinkful, or Bloc so that anyone in Rhode Island who wants to learn coding fundamentals can do so. Free online learning represents a fast, scalable way to lower barriers to skills development for in-demand occupations. To make it work best the state and its partners should prioritize blended online platforms that include one-on-one interactions as well as web-based courses. In addition, they should select a particular provider and negotiate for volume discounts

        - Estimated costs would depend on the number of program participants and could potentially be offset by corporate and/or philanthropic donations.

    - **Make short-term tech training from high-quality providers like General Assembly available at CCRI.** Full-time or part-time immersive courses from best-in-class providers offered at CCRI could be paired with career development services and networking opportunities to create new pathways into careers in tech

        - Estimated costs for a 12-week course would require minimal funding to cover administrative expenses. Costs to the state would vary depending on the scope of offerings available, access to federal student aid, and corporate/philanthropic sponsorship. If CCRI partnered with a high-quality short-term tech training provider like General Assembly and sought participation in the new federal EQUIP program, students could use federal financial aid to cover course costs

- **Expand LaunchCode's Partnership for Real IT Jobs** to help firms create tech apprenticeships that lead to promising jobs. To meet the growing demand for work-based learning opportunities, the state should partner with more employers and work with LaunchCode to expand its current effort

    - Estimated costs would vary depending on the number of companies involved and the number of individuals served. For reference, the current initiative's **$350,000 in total funding** is expected to support over 200 individuals

- **Create a RI Codes Diversity Initiative** to cultivate a more diverse tech workforce. This essential initiative would provide sizable scholarships to encourage members of underserved communities to pursue tech training and tech-intensive careers. To make this work the state should work with the private, nonprofit, and philanthropic sectors to cultivate relationships in underrepresented communities and launch targeted marketing efforts focused on populations traditionally underrepresented in tech fields. In addition, the state should forge partnerships with national organizations like CODE2040 and Women Who Code and diversity-focused accelerators like MergeLane, which are already taking action to improve diversity in tech. Paired with an expansion of work-based learning programs like the Partnership for Real IT Jobs a strong diversity-focused tech-training outreach and scholarship program could help Rhode Island set a new standard for inclusivity in the tech workforce.

- Initial estimated costs would range from $500,000 to $1 million annually for full-time and part-time scholarships, to be reassessed in subsequent years

- At the same time, Rhode Island should embark on longer-term strategies to promote tech opportunity for Rhode Island students and ensure the state labor market is continually flush with tech talent. Moves in this direction would include steps to:

  - **Incorporate computer science into the PK-12 curriculum**. Along with the Rhode Island Department of Education, the Rhode Island Council on Elementary and Secondary Education could begin this shift by changing the half-credit in technology now required for graduation into a half-credit computer science requirement. Meanwhile, the state and its private-sector and philanthropic partners have multiple ways to help school districts identify and implement web-based and blended-learning curricula as part of a broader education platform. A partnership with an organization like Code.org or the Highlander Institute could help districts deliver new content

    - While the cost of changing state graduation requirements would be **negligible**, additional investments in curricula and related professional development will be needed to support student success. The Highlander Institute has already made inroads in providing tech education for a number of Rhode Island's school districts and would be a strong partner for this work

  - **Encourage more students who sit for the Advanced Placement (AP) computer science exam**. As the state ramps up its computer science education capabilities, it should encourage greater numbers of students to sit for the AP computer science exam so that they can leave high school with college-level tech training. The Rhode Island Department of Education, in conjunction with area school districts, may want to consider waiving the $92 fee that students must pay to register for the AP computer science exam

    - Given the low numbers of test takers the cost of waiving the test fee be minimal

BUDGET IMPACT

A combined STEAM and coding effort will require substantial investment roughly evenly divided between broader STEAM activities and IT skills development.

ECONOMIC IMPACT

STEM / STEAM workers are by definition essential to all of the state's advanced industries. Moreover, Brookings research shows that regional economies with the densest concentrations of STEM workers—

including IT workers—perform the most strongly on key economic indicators such as employment rates and growth.

Impact example:

Immersive short-term tech training programs like those offered by Flatiron School, Galvanize, and General Assembly are a relatively recent innovation, so impact metrics on outcomes are hard to come by. In addition, those who complete immersive programs are a self-selected group of individuals with high levels of motivation and resilience: The average immersive student is "31 years old [and] has 7.6 years of work experience" and a full 79 percent have at least a bachelor's degree. With those caveats in mind, the coding bootcamp intermediary Course Work found in its 2015 survey of coding bootcamp alumni that 89 percent of bootcamp graduates were able to find job placements within 120 days of completing their programs, with "respondents reporting a $18,000 average [salary] increase in their first job after attending." The 2015 Course Report survey also found that low-income alumni derived the greatest benefit in terms of increased salary. On average, low-income graduates saw "a $36,000 lift in salary…compared to a $2,000 lift in salary for high-income students.

Launch a Rhode Island Competes initiative to upgrade the state's supporting platforms for growth, starting with its business environment

Technology development initiatives, placemaking, and skills building are all top-priority, crosscutting platform strategies for driving growth. However, the effectiveness of these strategies will also be influenced by the state's business environment. A supportive business environment remains an important element of any sound platform strategy—one on which the state needs to keep working. The state has begun to make helpful adjustments, including reducing its corporate income tax last year, but there is more to be done. Along these lines, the state needs to:

- Continue improving the state's suboptimal tax and regulatory structures
- Build on success to create a statewide land assembly and site management body
- Improve Rhode Island's rail connections to Boston and beyond in order to strengthen regional economic links

TAX AND REGULATORY

Continue improving the state's suboptimal tax and regulatory structures

PROBLEM

Rhode Island continues to lag some competitor states on frequently cited assessments of its business environment, on both the tax and regulatory sides.

RESPONSE

To dispel negative perceptions and support progressive economic development, the state should continue to revise the tax code to maximize economic growth and systematically position itself as a nationally-known test bed for innovative regulatory reforms.

IMPLEMENTATION

Rhode Island should make business-oriented tax and regulatory reforms a key priority that is carried out by numerous agencies and a diverse group of local stakeholders, including municipalities. When advancing new tax reductions and launching a high-profile business environment reform campaign, the state should be bold in its overall economic vision and messaging while at the same time pursuing clear, achievable short-term goals that support growth across a wide range of firms and industries.

- When it comes to **tax interventions**, the state should prioritize the following strategies, which will create a more supportive business environment for advanced industries growth:
    - **"Plus up" Rhode Island's underperforming R&D tax credit** by raising the cap on deductions and making the credit refundable. Currently, the credit is underperforming, likely in large part because of the state's prohibitive local property tax burden. The state should explore linking credit enhancement to property tax relief for qualifying R&D-conducting companies. Improving the tax treatment of R&D in Rhode Island could not only encourage local companies to expand their innovation activities but also may induce out-of-state businesses to consider Rhode Island as a location for R&D-related activities
        - Strengthening the credit's terms and implementing a property tax abatement would require a moderate investment on the part of the state
    - **Support high-value startup formation by developing the nation's first ever A-Corp corporate designation.** Rhode Island needs to increase the number of new advanced industry companies that form and grow. To make that as easy as possible, the state should do whatever it can to reduce the drag on these early-stage firms' bottom lines.

To that end, the state should allow qualifying firms with fewer than 10 employees to: be compensated for their unemployment insurance assessments; sell unused R&D tax credits; and receive tax credits for expenditures on special advanced industry activity buildings such as wet labs or clean rooms. The A-Corp designation will provide incentives for startups and small firms to locate and grow within the state even if they are incorporated elsewhere. In addition, establishing an A-Corp designation will send a clear signal that Rhode Island is determined to support and grow its advanced industries

    - Subsidizing UI for all of these firms would require substantial investment, though the state could cap the number of A-Corp designees to preserve quality, reduce cost, and improve competition

  - **Reform the unemployment insurance payroll tax by reducing its incidence on young firms** with the goal of making Rhode Island's advanced industries—particularly young firms—more competitive. Rhode Island should at minimum reduce the maximum UI tax rate to be more consistent with that of peer New England states

    - Reforming the UI payroll tax could have a number of budgetary implications. Reforms could be revenue-neutral if the average rate that firms over three years old pay increases to compensate any reduction in rates firms younger than three years old pay Alternatively, the state could incur revenue loss by reducing rates on young firms with no subsequent offsets.

- At the same time, Rhode Island should vigorously pursue **regulatory interventions** aimed at addressing familiar bugbears and unleashing dynamism while signaling that the state is sophisticated, forward-thinking, and entrepreneurial. While there are many needed actions, the state should first focus on those immediately doable and relevant to Rhode Island's advanced industry strategy. To that end, the state should:

  - **Take Rhode Island's e-permitting pilot initiative statewide and invest in modernizing the state's municipal development regime to make it easier for businesses to start and grow.** Dealing with municipal permitting requirements, administrative requirements, turnaround time, and cost across 39 different municipalities poses a significant challenge for Rhode Island firms looking to start or expand. As such, Rhode Island should scale up its pilot e-permitting initiative to cover the remaining 29 municipalities in the state to make the initiative truly statewide and expand the program to include other types of permits. In addition, the state should push for systemic changes that would require municipalities to process permit applications within 7–10 business days; offer an express application review process for eligible projects; develop a predictable fee schedule; require municipalities to publish permitting processes online; and invest in training local inspectors to promote consistent interpretations of statewide building and fire codes. These changes would help modernize an antiquated system and addressing a

key vice in the state's reputation for cumbersome, costly, and time-consuming business regulation

- The FY2013–FY2015 budgets included $900,000 in general revenue to fund a pilot initiative in 10 municipalities. Taking the initiative statewide and creating minimum performance standards would require moderate additional investment on the part of the state

- **Reform occupational licensing requirements to make them competitive with neighboring and peer states**. Compared to other states, Rhode Island makes it more difficult and more costly for individuals to embark on new careers. Many small business owners in the state see professional licenses as their largest problem because requirements have moved far beyond their justification of protecting public safety. At minimum, Rhode Island needs to review licensing requirements across all occupations and index its degree of licensure to the requirements of neighboring states like Massachusetts and Connecticut

  - There are **no direct budget implications** of this proposal

- **Reduce or eliminate restrictions in state non-compete agreements**. Rhode Island's relatively restrictive rules on where, when, and how employees can redeploy their talents likely slow the speed of entrepreneurship and idea exchange. Given that, Rhode Island should limit the scope of the state's non-compete agreements to support worker mobility and entrepreneurship. Because all other New England states enforce such covenants, a change in non-compete rules could distinguish Rhode Island as being more hospitable for entrepreneurs. Also, given Massachusetts's numerous failed attempts to outlaw non-competes covenants, Rhode Island may as first mover have an opportunity to attract entrepreneurial technology firms from Massachusetts. Currently only three states in the nation—California, North Dakota, and Oklahoma—do not enforce non-compete covenants. If outright elimination of non-compete agreements proves too arduous, there are a number of steps the General Assembly can take to limit their scope

  - This proposal has **no direct budget implications**. The loss of fee revenue from occupational licenses would be offset by taxes from higher employment and additional transactions

BUDGET IMPACT

The tax and regulatory initiatives identified here would require substantial annual outlays.

ECONOMIC IMPACT

Identifying and removing regulatory barriers would help Rhode Island attract new industry establishments and researchers, accelerate innovation, and support lasting job creation.

Impact example:

A few of the proposals outlined above, such as A-Corp designation and the statewide e-permitting initiative, have not been implemented in other states, so solid metrics on outcomes are difficult to come by. Other proposals are recent innovations, which makes it difficult to project their economic impact. With those caveats in mind:

- Studies have shown that reducing business taxes can increase economic activity. A study of studies on the economic impact of reducing business tax incidence by the state of California Office of Legislative Affairs found that a 10 percent reduction in general taxes lead to an average 1.1 percent increase in total employment among affected firms. Rhode Island Department of Labor estimates that 3,667 firms currently pay the maximum unemployment insurance rate of 9.8 percent. A reduction of even one percent from those in the top bracket could potentially increase total employment by 1.1 percent from these firms
- Several analyses have shown that removing burdensome regulations can increase business activity. For instance, the adoption of e-permitting in Kitsap County, Washington led to a 10 percent increase in residential mechanical and plumbing permits and an 18 percent increase in commercial plumbing permit applications. The county was also able to reduce permitting lead time from a high of 26 days to a low of eight days, with an average time of 18 days. Elsewhere, Chicago's licensing and permitting reforms have dropped the average time required for zoning reviews from between seven and 14 days down to 48 hours. Not only that, by cutting the number of license categories from 117 to 49, the city saves small businesses $2 million in license fees each year that they can instead reinvest to create jobs

LAND ASSEMBLY

Build on success to prepare new sites for commercial and industrial development

PROBLEM

Rhode Island lacks an adequate inventory of developable land and as a result struggles to attract large- and medium-sized prospective employers that need high-quality commercial or industrial space. This physical constraint holds back the state's economic development, particularly in industrial sectors that offer well-paying, middle-skill jobs.

Key elements of the problem include a shortage of premium, pad-ready, and permitted sites; slow permitting processes; infrastructure gaps; and shortfalls in municipal capacity.

RESPONSE

Rhode Island should build on the success of the Quonset Business Park, which is home to thousands of jobs and major companies but now nearing capacity. To that end, the state should—either on its own or alongside local municipalities and organizations—expand its capacity to **identify and assemble parcels eligible for development**, prepare and certify them for readiness, and market them to developers.

IMPLEMENTATION

The state has multiple options for creating such a capacity, all of which would fill a vacuum in statewide land management, packaging, and marketing:

- In terms of organizational form, new capacity or a new entity to manage and package commercially relevant land parcels could be created by the CommerceRI using its existing authority. As to scope, there are many options. One approach would give the new entity or office the power to acquire land from private owners in prime locations, assemble it, prepare it, certify it as development-ready, and market it. A more modest approach would have the organization identify a comprehensive inventory of available industrial land and better manage the state's existing portfolio of properties by conducting due diligence, confirming overall site feasibility, and reducing development risk. An expanded land management activity could also provide its planning and preparation services to municipalities interested in working in close partnership with an expanded state program to develop pad-ready sites that attract companies. Many municipalities have already identified parcels of land they would like to develop but lack the capacity to prepare or manage them. Similarly, individual landowners with clear titles could apply to the program and have their sites certified as ready for a 90-day development approval. Ultimately, the new entity could become the state's one-stop shop for industrial development with a portfolio of development-ready sites
    - The new entity would:
        - **Work in close coordination with municipalities** to package, prepare, and market sites in accordance with locally-prepared master plans. Services could be provided on request to participating municipalities, purchased by localities, or provided on a competitive basis to towns proposing the most compelling opportunities. Participating municipalities must certify the zoning and land use of the site and commit to expedited municipal permitting
        - **Identify state-owned lands that could be developed**, such as the North Smithfield airfield, in order to maximize the return on state assets while preserving green space elsewhere

- **Obtain greater financing powers** aimed at more extensive real estate management and site preparation, including infrastructure investment
- **Engage in more extensive regional and national marketing activities,** such as through a SelectRhodeIsland.com website that would describe available pad-ready sites to consultants and business leaders

- In terms of operational issues, the new entity could be a **new quasi-state agency and subsidiary of CommerceRI.** Such an entity would need to:
  - **Invest in information and data resources** such as mapping software, and create a best-in-class information-rich web presence
  - **Obtain sufficient financial capacity** to buy, hold, and solve infrastructure problems

BUDGET IMPACT

Establishing such a capability would require significant investment.

ECONOMIC IMPACT

As site search timelines for companies tighten, pad-ready sites will be increasingly attractive to site selectors and their corporate clients. For companies, pad-ready sites significantly reduce development risks and related delays while simultaneously generating cost savings. By streamlining and facilitating the site-selection process in Rhode Island, the state can help stimulate regional business expansion and attract new investment.

Impact example:

Since its inception in 2012, **Tennessee's Select Tennessee Certified Sites Program** has certified 39 sites and has been instrumental in helping businesses expand and/or locate in the state. For example:

- Hankook Tire located its first U.S. manufacturing facility in Clarksville on a certified site, investing $800 million and creating 1,800 jobs
- Dot Foods, the nation's largest food redistributor, is investing $24 million at a certified site in Dyersburg in large part because much of the due diligence had already been completed in advance in order to secure Select Tennessee Certified Site status

RAIL

Improve Rhode Island's rail connections to Boston and beyond in order to strengthen regional economic links

PROBLEM

Rhode Island's congested, underdeveloped rail links struggle to provide affordable, frequent, and convenient service, which in turn limits regional economic connectivity. For daily peak commuters on MBTA rail and occasional off-peak business travelers on Amtrak, in particular, rail service between Providence and Boston ranks among the slowest, most expensive links between two dynamic neighbors on the East Coast. That inconvenience increases the mental distance between the markets and may well diminish economic opportunities.

RESPONSE

Rhode Island should **adopt a sequenced strategy to enhance rail connectivity** and maximize economic links with regional partners, starting with the near-term creation of targeted rail subsidies and an app-based Rhody Pass ticket option for occasional business travelers. Over the next several years, adding new express commuter rail service and accelerating transit hub development statewide could further bolster the economic potential of Rhode Island's infrastructure.

IMPLEMENTATION

Improving Rhode Island's rail connectivity will require a broad-based effort across numerous agencies, including RIDOT, Amtrak, and MBTA. From fare and frequency improvements to longer-term station, track, and equipment upgrades, the scope, duration, and cost of this effort will vary, though emphasis should be placed on streamlining service to and from Boston. Key goals include promoting easier travel associated with Rhode Island business development and enhancing the lifestyle attractiveness of Rhode Island through better connections with Boston and New York. Three phases of action could be staged over time, contingent on the success of preceding efforts:

- Over the next year, RIDOT should partner with Amtrak to **target new rail subsidies** and **spearhead the development of a new app-based Rhody Pass ticket option** that reduces fares and offers greater convenience to off-peak business travelers entering the state. As infrastructure capacity allows, these affordable, flexible ticket options should be extended to daily commuters coming into and out of the state in partnership with MBTA
    - When determining a precise subsidy level, these agencies should partner with a state-designated travel agent to **create the new Rhody Pass**, which will provide discounted pricing and added convenience and offers a good marketing tool for attracting more ridership and investment into the state

        - Targeted rail subsidies and a new Rhody Pass app would involve moderate annual costs

- Over the next one to two years, RIDOT, MBTA, and Amtrak should build on momentum generated by the new Rhody Pass to accelerate state-led infrastructure investments that improve speed and frequency along current rail lines. Of particular importance is the **establishment of new express commuter rail service between Providence and Boston and the expansion of intercity rail service to destinations such as T.F. Green Airport**
    - With guidance from other regional partners, such as the NEC Commission and Connecticut, the three agencies should assemble a prioritized list of upgrades needed to increase service levels, building off the state rail plan
        - Operations, equipment, track upgrades, and other improvements would require substantial investment by the state while also drawing from a pool of additional federal, state, and local funding sources.
- Over the next five to 10 years, RIDOT, RIPTA, and localities including the City of Pawtucket and the City of Providence should embark on new station improvements and transit hub developments, including a new Pawtucket/Central Falls commuter rail station.
    - Following completion of design plans and the environmental review process, state agencies should partner with local public and private stakeholders to capitalize on economic development opportunities proximate to improved stations.
        - A variety of public and private financing options ranging from ballot measures to PPPs can be mobilized finance these projects, which will require sizable levels of investment

Budget Impact

The proposed rail enhancement initiatives range from less expensive **(**fare reductions and the Rhody Pass) to moderately expensive **(**expanded and express intercity service) to substantial **(**expanded station development and in-state transit links). To ensure that funds are used judiciously, the state should start small and work its way up to larger investments

Economic Impact

Improving Rhode Island's rail connectivity through new rail subsidies and an app-based Rhody Pass ticket option would increase demand among and improve reliability and convenience for occasional business travelers coming into the state. Over time, these investments could lead to efficiency gains for daily commuters and their employers who benefit from—and increasingly demand—close proximity to one another throughout the region. Likewise, longer-term service upgrades and station improvements could attract greater numbers of riders and deliver higher property values in transit-rich neighborhoods.

Impact example:

Since its creation in 2001, Maine's state-supported **Downeaster** service has leveraged approximately $5 million in annual state operating support to:

- Offer flexible ticket options and other discounted fares, including Corporate Share Passes for businesses, to help increase ridership
- Improve mobility and attract more riders, who numbered over 500,000 in FY2014—67 percent of whom travel for business or leisure
- Bring nearly 100,000 visitors to Maine each year who contribute $29 million in economic impact, including direct spending in local businesses and service
- Spur more than $350 million in public-private development

Ensure that Rhode Island Acts by strengthening its capacity for decisive business-led civic engagement

Finally, Rhode Island needs to strengthen its ability to act decisively to implement economic development initiatives of large, crosscutting importance.

After a decade of drift and micro initiatives, Rhode Island leaders need to develop a capacity for action equal to the scale and significance of the challenges facing the state—economic restructuring; demographic change; and the need to invest seriously in technology development, placemaking, and skills training in order to foster increased growth and inclusion.

To that end, Rhode Island leaders should:

- Establish a Partnership for Rhode Island to facilitate strategic action among private-, civic-, and public-sector leaders
- Establish a small implementation unit to oversee the execution of these initiatives

EXECUTION

Establish a Partnership for Rhode Island to facilitate strategic action among private-, civic-, and public-sector leaders

PROBLEM

In other states and regions, the rigors of the present have inspired the business and civic leaders to respond cohesively and at scale. Notwithstanding its many leadership organizations, Rhode Island lacks a central high-level business-civic-university presidents' council capable of delivering large-scale strategic action for the good of the economy. This gap in governance puts Rhode Island at a disadvantage as other regions benefit from well-organized regional organizations that play increasingly large roles in prioritizing key initiatives and mobilizing resources to implement them.

RESPONSE

Rhode Island's leaders should **establish a not-for-profit Partnership for Rhode Island and affiliate Partnership Fund** focused on facilitating strategic, cross-sector collaborations that strengthen the state's economy and improve access to opportunity and quality of life for all Rhode Islanders. Creating this new organization will provide the state a focal point for big-picture direction-setting and a powerful entity for mobilizing the resources and know-how of Rhode Island's most influential firms, philanthropies, and institutions in support of economic growth. Several of the pivotal, more expensive initiatives detailed in this report would be prime candidates for Partnership engagement.

IMPLEMENTATION

Significant care should go into convening the new organization, which should bring the state's top CEOs, university presidents, and civic leaders together into a compact and effective action forum. Along these lines, partnership founders should build a big-picture organization that can embrace a systematic economic development vision and engage decisively to deliver key initiatives. The Partnership should be designed to deliver early successes as well as long-term progress, all aligned with the state's focus on supporting the emergence of stronger, bigger advanced industry growth anchors and opportunity industry sectors. Compelling interventions at scale should be the focus. Key mission and design priorities include the following:

- Above all, the Partnership for Rhode Island should work to **affirm, inform, and help execute the state's economic development strategy.** In this regard, the partnership will help set strategy for the state; support implementation; improve coordination across the private, public and civic sectors; validate Rhode Island's assets in discussions about investment and relocation; mobilize private and philanthropic resources for regional purposes; and invest in transformative strategies that seek to improve the Rhode Island economy for all residents
    - To this end the partnership will likely want to:
        - **Develop a vision** for the state's economy and the partnership's activities in conjunction with the Governor and Commerce Secretary
        - **Identify a few concrete initiatives** to inaugurate the partnership's work. One possibility might be to engage in the design and funding of the state's needed

innovation investments; another might be to support elements of Rhode Island's STEAM and coding education and training initiatives

- **Create a Partnership Fund** to invest in priority initiatives

- In terms of design and operations, the new organization should be a **non-political, high impact** organization structured to transcend political transitions and conflicts of interest. To that end, the entity should:

  - **Include the Governor and Secretary of Commerce in a non-voting, ex officio capacity**

  - **Hire a lean, efficient staff**

  - **Fund an annual operational budget** through donations provided or secured by its members. A Partnership Fund to invest in specific initiatives would require additional funding commitments from partnership members

BUDGET IMPACT

No public funds would be directed to the partnership.

ECONOMIC IMPACT

Research by both the OECD and the Federal Reserve Bank of Boston emphasizes that focused high-level and cross-sector leadership represents a leading factor in successful economic development and regional job creation. A Partnership for Rhode Island would provide such leadership by establishing a substantial coordinating body through which the efforts of private-sector, philanthropic, and academic leaders can be better focused on high-impact initiatives of statewide importance.

Development of an evergreen Partnership Fund to support strategic investments can provide more specific and tangible engagement and impacts.

Impact example:

The **Partnership for New York City** and its affiliated **Partnership Fund** work with government, labor, and the nonprofit sector to "enhance the economy and maintain New York City's position as the global center of commerce, culture and innovation." Established in 1996, the $140 million fund allows the partnership to invest in innovative firms and nonprofit initiatives. Partnership members help identify investment opportunities, which are then vetted by investment evaluation teams. The fund also administers programs that provide specific support for activities in financial services technology, digital health, fashion tech, biomedical, and seed-stage firms.

To date, the fund has invested $141 million in 178 New York City-based ventures that have generated 10,000+ new full-time jobs. Forty-eight percent of the investment dollars flowed to

Harlem and other boroughs outside Manhattan. Graduates of the fund's FinTech Innovation Lab and Digital Health Accelerator have raised $240 million post-program.

EXECUTION

Establish a small implementation unit to oversee the execution of these initiatives

PROBLEM

Rhode Island state government, after several decades of drift, makes do with limited capacity for executing modern economic development initiatives, even as it rebuilds new capacity.

RESPONSE

State government should **establish a small implementation unit** focused on setting a new standard of high-quality execution focused on efficiently and effectively moving the state's new economic development agenda beyond recommendations and toward measurable results.

IMPLEMENTATION

Given the multi-track set of interrelated initiatives associated with the emerging strategy, establishing a central point person or unit to maintain focus over time, drive progress, align what should be aligned, and ensure initiatives are delivered across the government would help the state successfully deliver on its new economic development strategy.

- Above all, the implementation unit would work to **provide high quality project management, build high-performance collaborations,** and **maintain pace and prioritization** on the core initiatives of the "ReStart" strategy**.** In this regard, the action unit will optimize execution while also building new and lasting capacities in government
    - In terms of design and operation, the new organization could be established either in CommerceRI or in the governor's office and would need only a small but experienced process management staff

BUDGET IMPACT

Support would be needed for single dynamic point person and very small team.

ECONOMIC IMPACT

Given the sizable investments being considered, a focused point person or "ReStart" champion to improve execution could deliver significant economic value.

STRATEGIES AND ACTIONS FOR ADVANCING RHODE ISLAND'S ECONOMY

Rhode Island Innovates

Rhode Island Innovates

$ = Low cost: < $1m/yr	$$ = Moderate cost: $1 m - $5 m/yr	$$$ = High cost: $10m +/yr

Launch a multi-dimensional initiative to spur Rhode Island technology innovation

Recruit and support impact faculty at Rhode Island universities	$$$
Support proof-of-concept grants for new advanced-industry products	$
Prioritize matching funds for industry-university technology development	No budget implications
Support a Rhode Island Global Innovation Challenge	$$
Create a Rhode Island Entrepreneurs in Residence Program	$$

Strengthen several innovation districts or neighborhoods around the state by targeting them for place-based technology collaboration centers and strategic placemaking

Create one or two industry-university-laboratory tech collaboration centers	$$$
Offer priority access to collaborative innovation centers to a range of state innovation programs	No budget implications
Targeted Rhode Island Innovates! place-based tax incentives	$$
Incorporate placemaking into the planning of major innovation districts or neighborhoods	No budget implications
Bolster Main Street RI program to support enhanced placemaking	$$
Ensure state marketing targets young professionals and brands "hipness," especially with regard to food and design	No budget implications
Partner to deliver "pop-up" urbanism	$
Establish a state-level New Urban Mechanics (NUM) team	$

Complement a strong statewide STEAM education and training agenda with RI Codes—a coding initiative to prepare more Rhode Islanders for careers in tech

Designate a STEAM Champion	$
Roll out a large-scale statewide marketing campaign	$ - $$
Invest in ongoing, high-quality professional development by bringing UTeach to URI and/or Rhode Island College	$
Establish a STEAM Workforce Challenge grant program	$$
Scale up Wavemaker	$$
Provide free access to online learning platforms like Treehouse, Thinkful, or Bloc to teach coding skills	$$
Make short-term tech training available at CCRI	Negligible funding required (administrative support)
Expand LaunchCode's Partnership for Real IT Jobs to help firms create tech apprenticeships that lead to promising jobs	$
Create an RI Diversity Initiative to cultivate a more diverse tech workforce	$
Incorporate computer science into the P-12 curriculum	Negligible funding required
Encourage more students to sit for the Advanced Placement computer science exam	$

Rhode Island Competes

Continue improving the state's suboptimal tax and regulatory structures

"Plus up" Rhode Island's underperforming R&D tax credit by raising the cap on deductions and making the credit refundable	$$
Reform the unemployment insurance payroll tax by reducing its incidence on young firms	Revenue neutral
Create the nation's first-ever "A-Corp" corporate designation	$$
Modernize permitting regulations and processes to make it easier for businesses to start and grow	No budget implications

Take Rhode Island's e-permitting initiative statewide to cover all municipalities and permit types	$$
Reform occupational licensing requirements to make them competitive with neighboring and peer states	No budget implications
Reduce or eliminate restrictions of the state's non-compete agreements	No budget implications

Build on success to create a statewide land assembly and site management body

Assemble and prepare more pad-ready commercial-industrial building sites	$$$

Improve Rhode Island's rail connections to Boston and beyond to strengthen regional economic links

Target new rail subsidies and spearhead the development of a new app-based "Rhody Pass" ticket option	$$
Establish new express commuter rail service between Providence and Boston and expand intercity rail service	$$$
Drive new station improvements and transit hub developments, highlighted by a new Pawtucket/Central Falls commuter rail station	$$$

Rhode Island Acts

Develop a Partnership for Rhode Island

Establish a Partnership for Rhode Island to facilitate strategic action among private, civic, and public sector leaders	No budget implications
Create a small implementation unit to oversee implementation of the new strategy	$

* * *

A few final notes are in order.

First, although no formal cost-benefit analysis has been carried out for "Rhode Island Innovates" given the difficulty of extrapolating impacts and outcomes for the sorts of recommendations advanced here, it is appropriate to consider not just the costs of the initiatives recommended but also their **potential impacts.** To be sure, the study team did not set out to design a near-term stimulus plan. Rather, "Rhode Island Innovates" is intended as a medium- to long-term strategy for improving the competitiveness and quality of the state's basic growth drivers. Nevertheless, the study team has remained highly focused on recommendations that would deliver solid impact of different kinds. And on this point, even extremely conservative informal assessments suggest that implementation of the recommendations advanced here could appreciably accelerate output and job growth in Rhode Island over time—perhaps enough to move the state up a quintile or two in the state growth ranks. In any event, the study team believes that implementation of the government, private, and philanthropic investments proposed here would generate increased output, employment, and tax revenue.

Second, it should be observed that while any of the activities proposed could add value in isolation, the array of items presented in this report is intended as a **package**. The interlocking proposals of "Rhode Island Innovates" will have the greatest positive impact if pursued together. Scholarship suggests that the impact of the various actions will be multiplied by the kinds of synergies and spillovers that occur in dense local economies and between, especially, innovation, place, and talent dynamics. Significant literature indicates, for example, that the effectiveness of R&D investments and general innovation activity can be increased by the spatial clustering of investigators, service providers, institutions, suppliers, and relevant businesses—meaning that focused "placemaking" can accelerate innovation. Similarly, metropolitan economic performance has been shown to vary with local STEM/STEAM worker concentrations—which suggests that STEAM education and tech training combined with attraction and retention efforts may well support advanced industry development. To that extend, the interlocking proposals of "Rhode Island Innovates" will be most impactful if pursued together.

Finally, while the report recommends significant state-government outlays, it also proposes a new degree of **partnership** across the public, private, civic, and philanthropic sectors. Quite simply, the nature and scale of the economic challenges facing Rhode Island—intensive global competition; an unreliable national government; persistent budgetary stress; the need to invest continuously in innovation, quality places, and skills development—require a new kind of collaborative governance that unites the private, public, and civic sectors. No one sector has the capacity or expertise to design, finance, execute, and sustain initiatives with the potential to set the state on a more prosperous trajectory. For that reason, this agenda envisions a new style of robust, multi-sector, collaborative problem-solving for Rhode Island:

- **State government,** in partnership with the private sector, local intermediaries, and third-party experts, should lead on several initiatives including: innovation activities such as the design of competitions for the industry-university-laboratory tech collaboration centers; STEAM and coding initiatives; and business environment reforms related to tax, regulatory affairs, land development, and rail

- The **private sector** can lead and/or contribute on multiple fronts, including by helping to provide resources to support impact faculty and creating a Global Innovation Challenge and the Rhode Island Entrepreneurs in Residence Program; supporting STEAM and coding initiatives, several of which will be delivered by private intermediaries; and helping mobilize business community support for key initiatives

- **Philanthropy and the civic sector** should also lead and/or contribute on multiple fronts, including the recruitment and support of impact faculty; the support of placemaking activities and "pop-up urbanism"; and in the testing and scale-up of critical STEAM and coding initiatives

In short, "Rhode Island Innovates" positions state government as a catalyst and leader of co-developed problem-solving rather than as an owner of actions. Such co-development of bold solutions will be a challenge in an often splintered, stovepiped state like Rhode Island, but the effort will be well worth it.

Strong actions are needed to locate large new sources of growth in the state, just as they were when Moses Brown and Samuel Slater triggered the state's shift from farm to factory.

Certainly the task is large, but the fact remains that Rhode Island has done it before.

Appendix A: Stakeholders Consulted

Economic Development Planning Council

Peter Alviti

Russell Carey

Michael DiBiase

Donald Grebien

Cliff Grimm

Rich Horan

Juana Horton

Scott Jensen

John Kennedy

Elizabeth Lynn

Macky McCleary

Stefan Pryor

Jim Purcell

Mike Sabitoni

Barbara Schoenfeld

John Simmons

Neil Steinberg

David Sullivan

Dale Venturini

Ken Wagner

Laurie White

Rhode Island Foundation Industry Cluster Group

Shannon Brawley

Lisa Carnevale

Christian Cowan

David Dadekian

Carmen Diaz-Jusino

Maeve Donohue

Molly Donohue Magee

Erin Donovan-Boyle

John Gregory

Wendy Mackie

Bill McCourt

Leo Pollock

Lisa Raiola

Shawn Rubin

Laurie Stroll

Dale Venturini

Laurie White

Other stakeholders consulted

David Allard

Babette Allina

Andy Altman

Alden Anderson

Peter Andruskiewicz

Rob Atkinson

Denise Barge

Randall Barko

Theresa Baus

Lenette Boisselle

Michael Beckerman

John J. Bowen

Peter Bowman

Josh Brumberger

Mary Burke

Harold “Skip” Burns

Dennis Burton

Neil Callahan

Claudia Cardozo

Sherri Carello

Sherri Carrera

Paul Carroll

Russell Carey

Lisa Carnevale

Paul Carroll

David Cedrone

Ugar Cetintemel

Joe Codega

Christian Cowan

Mike Cullen

Beth Cunha

Donna Cupelo

Jessica David

Adriana Dawson

David Dedekian

Donald DeHayes

Linda Descano

Scott DePasquale

Paul DeRoche

Carmen Diaz-Jusino

Robert DiMuccio

Maeve Donohue

Erin Donovan-Boyle

Dave Dooley

Jonathan Duffy

Lewis Duncan

Stephen Eaves

Jack Elias

Maureen Ewing

Tim Ferguson

Katharine Flynn

Ray Fogarty

Bill Foulkes

John Flaherty

Adrienne Gagnon

Kevin Gallagher

Dick Galvin

Peter Garino

Armeather Gibbs

Scott Gibbs

Carol Giuriceo

Erik Godwin

Marian Gold

Brian Goldberg

Donald Grebien

John Gregory

Jeff Grybowski

Ryan Hanley

John Harthorne

William Hatfield

Hope Hopkins

Richard Horan

Theodore Howell

Lisa Hsu

Mark Huang

Meghan Hughes

Melissa Husband

Scott Jensen

Larry Kanarak

Colin Kane

Karriem Kansten

Martin Keen

Jason Kelly

Steve King

Tom Kowalczyk

Rajiv Kumar

Christopher Lanen

E. Paul Larrat

Linda Larsen

Larry Larson

Deborah Linnell

Diane Lipscombe

Richard Locke

Joe Luca

Teresa Lynch

Amanda Lynch

Cayla Mackey

Wendy Mackie

Molly Magee

Bill McCourt

Robert Mancini

David Markert

Frederick Mason

Jack Maytum

Macky McCleary

Bill McCourt

Peter McNally

Marcus Mitchell

Eugene Monteiro

Jeffrey Morgan

Matt Murray

Danny Musher

J.-M. Napolitano

Diane Nobles

Thomas Oasha

Ron O'Hanley

Tolulope Olasanoye

Fred Ordoñez

Ken Orenstein

Robert Padgette

Nitin Padture

Derrick Pelletier

Geoffrey Peterson

Aidan Petrie

Lee Pichette

Belinda Philippe

Jill Pipher

Clint Plummer

Yahaira (Jay) Placencia

Stefan Pryor

Gina Raimondo

Kelly Ramirez

Lisa Ranglin

Benjamin Raphael

Richard Rhodes III

Ray Rickman

Elizabeth Roberts

Mim Runey

Bjorn Sandstede

Matthew Santacroce

David Savitz

Jennifer Schwall

Cynthia Scott

Shawn Selleck

Chris Semonelli

Kathie Shields

John Simmons

Christine Smith

Mary Ann Snider

Sam Solomon

Rosanne Somerson

Gerald Sonnenfeld

Thorne Sparkman

Steven Strauss

Carol Strohecker

Laurie Stroll

Shivan Subramaniam

Robert Suglia

Richard Talipsky

Allan Tear

Todd Thomas

Marcel Valois

Archbold van Beuren

Barbara van Beuren

Michael Van Leesten

Dale Venturini

Ken Wagner

Rob Walker

Raymond Watson

Peter Weber

Dean Weinberg

Edward White

Laurie White

Cap Willey

Sheri Wills

Juan Wilson

Melissa Withers

Kate Wittels

Scott Wolf

Pauline Yoder

Appendix B: Variables Used in Analysis of Industry Connections in Rhode Island

The table below explains the six variables used to assess industry clusters found in Rhode Island using advanced data analytic approaches:

Similarity Measure	Description	What it Measures
Geographic Colocation	Average density of distances between pairs of NAICS industry establishments via GIS coordinates	Any similarities in the way industries choose to locate their establishments within the state based on some shared resource – access to employees, transportation/shipping availability, natural resources, etc.
Industry Attributes	Similarity between industries based on a 2013 snapshot of their employment, establishments, wages, and relative concentration (LQs)	Any similarities in natural divisions in the structure of the RI economy between groupings with unique sets of attributes, for example distinct groups of highly specialized/high wage industries
Employment Growth Trends	Pairwise correlation of employment growth trends since 2000	Any similarities in the way industry employment growth or decline patterns have closely matched growth or decline in other industries
Labor Occupational Makeup	Pairwise correlation of occupational employment proportions of industries (3-digit NAICS level)	Any similarities in the ways industries share specific occupational talent bases or require similar kinds of employee skills
Regional Supply Chain	Proportions of supply inputs (measured in $ by source NAICS industry) to local industries provided by local industries	Any similarities in the regional supplier connections between industries as measured from input-output accounts
Innovation Focus	Pairwise correlation of patent class holdings for in-state industries	Any similarities in innovative focus between in-state industries in terms of the types of patent classes retained by companies in certain NAICS codes

Appendix C: Rhode Island High Impact Good Jobs

Good jobs with employment of 100 or more in 2014, growth from 2010 to 2014 and expected job openings of at least 25 percent annually of total jobs in 2014

Occupations	RI Occupational Employment 2014	Change in Occupational Employment, 2010–14	Forecasted Annual Job Openings* as Share of 2014 Occupational Employment
All Occupations	**463,930**	**3.5**	**32**
General and operations managers	6,390	38.9	41
First-Line supervisors of office and administrative support workers	6,060	7.6	31
Maintenance and repair workers, general	4,230	7.4	37
Financial managers	2,910	13.2	34
First-Line supervisors of production and operating workers	2,630	30.2	30
Electricians	2,010	32.2	55
Business operations specialists, all other	1,850	16.4	37
Sales representatives, services, all other	1,810	123.5	35
Network and computer systems administrators	1,680	61.5	34
Computer user support specialists	1,670	n/a	52
First-Line Supervisors of Construction Trades and Extraction Workers	1,540	32.8	68
Inspectors, testers, sorters, samplers, and weighers	1,500	7.1	36
Medical and health services managers	1,470	32.4	41
Machinists	1,300	15.0	49
Welders, cutters, solderers, and brazers	1,210	22.2	58
Insurance sales agents	1,170	8.3	29
Paralegals and legal assistants	1,120	64.7	53
Claims adjusters, examiners, and investigators	1,050	10.5	34
Loan officers	940	14.6	32
Payroll and timekeeping clerks	710	9.2	35
Property, real estate, and community association managers	670	36.7	34
Industrial machinery mechanics	620	12.7	44
Compliance officers	580	23.4	29
Dispatchers, except police, fire, and ambulance	540	5.9	25
First-Line supervisors of helpers, laborers, and material movers, hand	480	37.1	34
Construction managers	460	35.3	50

Occupations	RI Occupational Employment 2014	Change in Occupational Employment, 2010–14	Forecasted Annual Job Openings* as Share of 2014 Occupational Employment
Computer-controlled machine tool operators, metal and plastic	450	60.7	55
Industrial production managers	440	7.3	33
Mobile heavy equipment mechanics, except engines	430	207.1	29
Meeting, convention, and event planners	390	116.7	70
Respiratory therapists	390	14.7	48
Web developers	340	n/a	55
Health technologists and technicians, all other	340	21.4	54
Tool and die makers	320	3.2	43
Health educators	310	40.9	26
Computer network architects	300	n/a	36
Weighers, measurers, checkers, and samplers, recordkeeping	300	233.3	29
Transportation, storage, and distribution managers	260	8.3	32
Biological technicians	230	187.5	31
Credit counselors	210	162.5	58
Credit analysts	200	11.1	35
Information security analysts	180	n/a	64
Extruding, forming, pressing, and compacting machine setters, operators	180	28.6	40
Opticians, dispensing	170	41.7	30
Chemical technicians	150	7.1	37
Aircraft mechanics and service technicians	130	44.4	40
Audio and video equipment technicians	120	20.0	37
Metal-refining furnace operators and tenders	100	150.0	72

Source: Rhode Island Labor Market Information Office

* Job openings represent both growth in employment for an occupation and need for replacement workers due to retirement and job changes

Appendix D: Details on Broad Industry Clusters

This table is provided in landscape format on the following several pages.

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
Total Private Sector		**397,364**	**34780**	**-4.9**	**2.4**	**1.00**	**-1.1**	**5.4**
Advanced Business Services		**35,232**	**1,791**	**-1.7%**	**7.9%**	**1.30**	**-0.4%**	**4.5%**
Corporate Headquarters/Managing Offices		11,330	276	19.9%	23.0%	1.54	13.4%	12.5%
551111	Offices of bank holding companies	36	8	88.3%	255.3%	0.63	-11.8%	-5.7%
551112	Offices of other holding companies	644	21	123.7%	74.2%	2.59	-8.2%	1.2%
551114	Managing offices	10,650	247	16.5%	20.6%	1.51	14.6%	13.1%
Finance and Insurance		**23,902**	**1,515**	**-9.4%**	**2.0%**	**1.22**	**-4.7%**	**1.8%**
522110	Commercial Banking	6,413	205	-21.8%	-12.1%	1.39	-2.7%	0.0%
522120	Savings Institutions	589	43	-16.2%	0.2%	0.97	-23.8%	-9.7%
522130	Credit Unions	961	64	-3.9%	3.4%	1.16	4.4%	2.5%
522190	Other depository credit intermediation	0	0	-100.0%	N/A	0.00	-35.9%	-13.8%
522210	Credit card issuing	31	2	-65.7%	-52.8%	0.09	-12.9%	-2.6%
522220	Sales Financing	147	18	-28.7%	-3.2%	0.49	-23.3%	-7.1%
522291	Consumer lending	41	8	-58.2%	-8.9%	0.12	-19.5%	-2.7%
522292	Real Estate Credit	861	68	-32.3%	31.1%	1.10	-26.0%	7.4%
522293	International trade financing	0	0	N/A	N/A	0.00	-14.7%	-12.5%
522294	Secondary market financing	4	3	-66.7%	0.0%	0.06	8.8%	2.6%
522298	All Other Nondepository Credit Intermediation	105	26	-63.9%	-52.5%	0.45	13.5%	15.7%
522310	Mortgage and Nonmortgage Loan Brokers	427	60	-69.1%	8.7%	1.60	-36.9%	10.9%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	129	31	34.4%	21.7%	0.30	12.8%	11.8%
522390	Other Activities Related to Credit Intermediation	93	16	25.7%	52.5%	0.29	-6.2%	3.2%
523110	Investment Banking and Securities Dealing	198	17	-78.4%	-73.1%	0.39	-23.2%	-9.6%
523120	Securities Brokerage	2,719	75	91.7%	67.5%	2.81	-9.0%	-3.8%
523130	Commodity Contracts Dealing	554	2	914.3%	1572.3%	11.86	17.8%	4.6%
523140	Commodity contracts brokerage	0	0	N/A	-100.0%	0.00	-16.4%	-12.3%
523210	Securities and commodity exchanges	6	1	-71.9%	-36.2%	0.26	-18.6%	-9.3%
523910	Miscellaneous intermediation	42	13	33.8%	-10.7%	0.46	6.7%	5.1%
523920	Portfolio Management	357	78	-4.3%	11.2%	0.58	34.6%	30.6%
523930	Investment Advice	1,002	95	16.8%	36.3%	1.71	27.0%	26.2%
523991	Trust, fiduciary, and custody activities	26	8	-88.0%	-94.9%	0.36	-10.4%	7.8%
523999	Miscellaneous Financial Investment Activities	73	6	-52.8%	187.6%	0.82	9.5%	2.7%
524113	Direct Life Insurance Carriers	815	36	-43.5%	-6.4%	0.88	-10.5%	-8.8%
524114	Direct Health and Medical Insurance Carriers	1,397	13	16.6%	-10.0%	1.11	1.0%	-1.8%
524126	Direct Property and Casualty Insurance Carriers	2,869	57	4.2%	1.4%	1.74	-3.6%	-1.3%
524127	Direct title insurance carriers	41	7	-47.0%	-21.1%	0.20	-27.5%	4.9%
524128	Other direct insurance carriers	4	5	-58.8%	277.4%	0.09	0.2%	2.6%
524210	Insurance Agencies and Brokerages	2,015	405	-7.4%	-2.4%	0.86	-1.2%	2.2%
524291	Claims Adjusting	129	39	-32.5%	-11.0%	0.68	3.1%	5.5%
524292	Third Party Administration of Insurance and Pension Funds	1,292	64	85.9%	29.3%	2.31	25.0%	22.6%
524298	All Other Insurance Related Activities	562	50	56.1%	51.1%	2.37	28.5%	27.8%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
Arts, Education, and Tourism		**42,801**	**1,734**	**4.3%**	**5.2%**	**1.38**	**6.5%**	**8.6%**
Arts, Hospitality and Tourism		**31,502**	**1,669**	**7.3%**	**12.7%**	**1.18**	**5.6%**	**8.9%**
487110	Scenic and sightseeing transportation, land	44	7	-16.2%	3.9%	1.03	16.6%	19.1%
487210	Scenic and sightseeing transportation, water	121	38	-38.9%	-30.5%	2.36	-4.8%	6.2%
487990	Scenic and sightseeing transportation, other	1	1	N/A	-90.5%	0.06	1.9%	17.0%
561510	Travel agencies	230	62	-20.7%	-2.5%	0.79	-21.6%	-5.5%
561520	Tour operators	474	9	160.1%	453.8%	5.15	-11.1%	6.3%
561591	Convention and visitors bureaus	62	4	66.5%	5.1%	2.10	-4.4%	-1.7%
561599	All other travel arrangement services	1,165	23	-11.8%	-10.6%	4.36	-8.3%	4.4%
561920	Convention and trade show organizers	369	32	255.1%	379.6%	2.24	-8.0%	7.6%
711110	Theater companies and dinner theaters	497	20	29.4%	14.8%	2.30	0.5%	3.4%
711120	Dance companies	63	5	-0.9%	2.3%	1.75	14.9%	11.0%
711130	Musical groups and artists	178	16	-39.5%	-35.5%	1.49	-13.8%	-4.9%
711190	Other performing arts companies	4	1	-67.0%	-63.7%	0.15	13.9%	6.5%
711211	Sports teams and clubs	190	5	12.0%	37.5%	0.70	16.3%	11.3%
711219	Other spectator sports	24	7	-79.3%	-71.9%	0.31	-11.4%	-3.5%
711310	Promoters with facilities	180	7	245.9%	150.0%	0.62	25.6%	16.9%
712110	Museums	540	24	-4.3%	11.6%	1.87	9.3%	10.1%
712120	Historical sites	139	12	-8.6%	8.6%	2.56	13.1%	15.9%
712130	Zoos and botanical gardens	100	1	75.3%	25.8%	0.80	15.4%	13.9%
712190	Nature parks and other similar institutions	4	5	-91.6%	-73.1%	0.15	16.7%	9.9%
713110	Amusement and theme parks	35	4	-96.8%	-89.4%	0.06	17.1%	12.4%
713290	Other gambling industries	1,274	4	419.1%	95.4%	8.31	-3.8%	-7.1%
713930	Marinas	736	73	12.7%	14.5%	6.54	-1.9%	6.8%
713990	All other amusement and recreation industries	651	69	17.9%	25.0%	1.33	8.3%	11.2%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
721110	Hotels and motels, except casino hotels	3,991	122	7.8%	13.0%	0.76	0.2%	6.0%
721191	Bed-and-breakfast inns	175	42	-4.9%	9.4%	3.15	-5.6%	8.1%
721199	All other traveler accommodation	14	5	588.2%	16.7%	0.32	25.1%	25.8%
721211	RV parks and campgrounds	65	16	12.1%	0.0%	0.69	2.2%	6.5%
721214	Recreational and vacation camps	18	6	-47.1%	-33.3%	0.17	8.8%	11.0%
722110	Full-service restaurants	20,157	1,049	7.6%	10.5%	1.17	7.9%	10.2%
Private Colleges & Universities		11,300	65	-3.4%	-11.2%	2.58	12.6%	6.7%
611210	Junior colleges	575	3	201.8%	-18.6%	3.71	5.0%	-3.4%
611310	Colleges and universities	10,725	62	-6.8%	-10.7%	2.54	13.0%	7.1%
Health and Life Sciences		**31,548**	**420**	**-2.4%**	**-0.2%**	**1.31**	**8.0%**	**4.5%**
Hospitals & Healthcare Centers		**27,279**	**177**	**-1.0%**	**-1.3%**	**1.41**	**9.1%**	**5.0%**
621420	Outpatient mental health centers	1,606	54	-12.0%	2.0%	2.31	20.3%	15.2%
621491	HMO medical centers	45	3	-48.4%	-32.9%	0.10	63.1%	63.3%
621492	Kidney dialysis centers	301	11	39.0%	64.3%	0.82	29.6%	16.5%
621493	Freestanding emergency medical centers	447	21	0.4%	3.5%	1.14	38.6%	24.6%
621498	All other outpatient care centers	923	22	366.2%	104.7%	2.20	34.2%	24.2%
621512	Diagnostic imaging centers	438	40	-26.9%	-9.3%	1.83	4.2%	1.8%
622110	General medical and surgical hospitals	18,152	12	-0.9%	-1.3%	1.16	5.8%	2.4%
622210	Psychiatric and substance abuse hospitals	742	3	-43.6%	-66.6%	2.02	9.0%	4.2%
622310	Other hospitals	4,625	11	1.5%	20.6%	6.37	21.0%	7.3%
Pharmaceutical		**1,448**	**12**	**-24.9%**	**3.8%**	**1.48**	**-6.0%**	**-2.4%**
325411	Medicinal and botanical manufacturing	0	0	N/A	N/A	0.00	-15.8%	0.4%
325412	Pharmaceutical preparation manufacturing	1,320	11	-28.4%	0.3%	1.81	-9.2%	-5.1%
325413	In-vitro diagnostic substance manufacturing	128	1	260.5%	96.4%	1.61	27.3%	16.2%
325414	Other biological product manufacturing	0	0	-100.0%	-100.0%	0.00	8.9%	4.5%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
R&D and Medical Labs		**1,190**	**163**	**23.2%**	**7.0%**	**0.45**	**10.7%**	**6.5%**
541711	Research and development in biotechnology	130	25	58.5%	-20.0%	0.26	5.2%	1.8%
541712	Other physical and biological research	501	97	30.1%	22.8%	0.33	8.5%	4.5%
621511	Medical laboratories	559	41	12.0%	3.1%	0.90	22.1%	16.4%
Surgical and Medical Device Manufacturing		**1,631**	**68**	**-12.8%**	**10.5%**	**1.29**	**-1.0%**	**-1.4%**
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	193	8	-58.1%	-0.5%	0.98	-7.6%	-5.9%
339112	Surgical and Medical Instrument Manufacturing	673	5	26.9%	55.8%	1.62	6.4%	2.0%
339113	Surgical Appliance and Supplies Manufacturing	430	16	25.0%	25.0%	1.23	1.6%	0.5%
339114	Dental equipment and supplies manufacturing	17	2	-64.9%	173.2%	0.31	3.9%	4.5%
339115	Ophthalmic Goods Manufacturing	204	11	-38.1%	-51.6%	2.15	-11.0%	-9.7%
339116	Dental Laboratories	114	26	-27.5%	44.9%	0.73	-10.0%	-4.7%
Instruments, Electronics, and Defense		**12,528**	**1,460**	**7.6%**	**1.1%**	**1.18**	**13.5%**	**14.6%**
Electronics		**841**	**20**	**11.0%**	**-3.2%**	**0.64**	**-11.9%**	**-1.1%**
334119	Other Computer Peripheral Equipment Manufacturing	73	2	-41.7%	-66.7%	0.47	0.9%	12.6%
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	228	4	389.9%	13.4%	1.11	-12.7%	-13.1%
334413	Semiconductor and Related Device Manufacturing	97	2	-44.2%	-42.2%	0.15	-14.0%	0.5%
334415	Electronic Resistor Manufacturing	179	2	124.3%	91.3%	12.18	-20.1%	-5.2%
334417	Electronic Connector Manufacturing	149	6	56.6%	147.0%	2.25	-4.2%	7.8%
334419	Other Electronic Component Manufacturing	113	4	-52.1%	-9.6%	0.54	-14.0%	-4.0%
Instruments		**2,247**	**26**	**-12.5%**	**-11.9%**	**2.65**	**-12.6%**	**-6.9%**
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	812	7	-45.8%	-41.6%	1.81	-18.2%	-15.2%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	566	2	322.0%	79.3%	8.60	-19.9%	-1.1%
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	783	13	-10.0%	0.6%	3.66	-3.6%	4.7%
334516	Analytical Laboratory Instrument Manufacturing	86	4	34.7%	28.7%	0.73	1.2%	8.1%
Computer Systems and Software		**6,662**	**1,212**	**17.7%**	**11.0%**	**0.97**	**24.5%**	**20.4%**
511210	Software publishers	991	130	5.0%	11.2%	0.95	17.7%	16.2%
541511	Custom computer programming services	1,285	335	55.0%	28.6%	0.49	24.5%	20.6%
541512	Computer systems design services	4,161	726	15.6%	7.4%	1.48	31.2%	24.7%
541519	Other computer related services	225	21	-21.3%	-6.3%	0.60	1.5%	2.7%
Data Processing, Facilities and Internet		**2,778**	**202**	**4.5%**	**-6.4%**	**1.71**	**15.2%**	**20.3%**
518210	Data processing, hosting and related services	2,625	130	3.9%	-7.6%	2.81	-1.8%	8.0%
519130	Internet publishing and web search portals	115	56	82.5%	134.7%	0.23	96.3%	71.6%
541513	Computer facilities management services	38	16	-44.1%	-51.9%	0.20	-6.1%	-1.4%
Design, Consumer Products and Food Processing		**11,045**	**648**	**-23.9%**	**-9.4%**	**2.28**	**-15.2%**	**-0.5%**
Design Services		**226**	**114**	**-30.2%**	**-1.9%**	**0.72**	**-10.5%**	**-0.7%**
541420	Industrial design services	42	24	-67.4%	-36.4%	0.86	3.8%	16.3%
541430	Graphic Design Services	161	75	-13.4%	2.5%	0.74	-16.1%	-3.7%
541490	Other specialized design services	23	15	155.6%	208.4%	0.46	5.7%	-1.2%
Displays		**924**	**36**	**-16.6%**	**33.7%**	**2.35**	**-21.3%**	**-2.1%**
337215	Showcase, Partition, Shelving, and Locker Manufacturing	627	13	-19.2%	44.4%	4.05	-29.4%	-6.7%
339950	Sign Manufacturing	297	23	-10.5%	15.6%	1.25	-14.9%	1.0%
Furniture		**571**	**49**	**-38.2%**	**-37.7%**	**0.73**	**-35.3%**	**-6.8%**
337110	Wood Kitchen Cabinet and Countertop	72	23	-69.2%	-39.6%	0.20	-39.3%	-9.6%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
	Manufacturing							
337121	Upholstered Household Furniture Manufacturing	52	1	-78.5%	28.8%	0.28	-27.1%	1.5%
337122	Nonupholstered Wood Household Furniture Manufacturing	50	12	-30.6%	8.7%	0.38	-40.9%	-12.3%
337212	Custom Architectural Woodwork and Millwork Manufacturing	118	12	-64.4%	-72.4%	1.92	-13.2%	5.9%
337920	Blind and Shade Manufacturing	279	1	499.0%	-1.9%	6.47	-37.9%	-14.3%
Jewelry		**3,578**	**176**	**-45.3%**	**-22.6%**	**30.12**	**-25.3%**	**-5.4%**
339911	Jewelry (except Costume) Manufacturing	848	28	-72.4%	-62.9%	11.92	-25.5%	-4.3%
339912	Silverware and Hollowware Manufacturing	65	3	-21.1%	118.1%	12.37	-17.0%	0.3%
339913	Jewelers' Material and Lapidary Work Manufacturing	760	44	-40.1%	92.1%	96.88	-41.7%	-20.7%
339914	Costume Jewelry and Novelty Manufacturing	1,843	96	-11.6%	-2.8%	113.50	-26.9%	-9.2%
339993	Fastener, Button, Needle, and Pin Manufacturing	61	5	66.7%	334.0%	3.34	-15.0%	0.5%
Perishable Foods Manufacturing and Processing		**2,934**	**152**	**21.5%**	**16.0%**	**1.32**	**1.8%**	**3.8%**
311330	Confectionery Manufacturing from Purchased Chocolate	99	10	51.5%	49.2%	0.93	-15.7%	-5.3%
311511	Fluid Milk Manufacturing	89	4	-14.9%	-12.1%	0.48	-4.6%	-2.6%
311513	Cheese Manufacturing	51	3	67.6%	42.5%	0.34	10.8%	8.1%
311520	Ice Cream and Frozen Dessert Manufacturing	57	8	19.5%	-22.3%	0.79	4.2%	0.7%
311612	Meat Processed from Carcasses	408	9	146.6%	79.1%	1.04	1.0%	1.5%
311712	Fresh and Frozen Seafood Processing	180	10	-31.9%	7.1%	1.51	-1.1%	2.5%
311811	Retail Bakeries	688	65	14.2%	-0.4%	2.67	10.4%	14.8%
311812	Commercial Bakeries	745	24	1.5%	-0.8%	1.69	-4.1%	-2.3%
311821	Cookie and Cracker Manufacturing	76	4	982.7%	742.1%	0.65	3.0%	5.3%
311920	Coffee and Tea Manufacturing	112	4	100.3%	20.4%	1.76	25.2%	26.6%
311942	Spice and Extract Manufacturing	67	1	351.1%	1120.1%	0.87	13.5%	12.7%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
311991	Perishable Prepared Food Manufacturing	300	9	3.8%	7.8%	2.32	12.6%	7.8%
311999	All Other Miscellaneous Food Manufacturing	62	1	87.4%	122.9%	0.62	2.9%	11.3%
Primary and Secondary Textile Mills		**2,360**	**87**	**7.8%**	**-2.4%**	**4.37**	**-27.1%**	**-7.9%**
313112	Yarn Texturizing, Throwing, and Twisting Mills	61	4	1.0%	-38.0%	2.49	-22.8%	1.6%
313221	Narrow Fabric Mills	891	17	569.4%	30.3%	34.20	-20.6%	10.5%
313230	Nonwoven Fabric Mills	122	3	362.0%	-44.3%	2.82	-14.6%	5.8%
313249	Other Knit Fabric and Lace Mills	198	5	-54.5%	-34.6%	14.72	-39.0%	-6.9%
313311	Broadwoven Fabric Finishing Mills	227	7	-66.7%	-38.4%	4.59	-40.7%	-20.2%
313312	Textile and Fabric Finishing (except Broadwoven Fabric) Mills	103	4	-52.5%	56.6%	2.43	-36.9%	-17.2%
313320	Fabric Coating Mills	309	2	100.5%	-18.5%	11.21	-13.9%	12.3%
314110	Carpet and Rug Mills	104	5	-44.0%	-14.0%	0.95	-32.6%	-17.0%
314121	Curtain and Drapery Mills	58	11	16.4%	24.6%	1.99	-41.5%	-19.1%
314912	Canvas and Related Product Mills	86	15	-38.9%	56.4%	1.37	-19.0%	-3.2%
314999	All Other Miscellaneous Textile Product Mills	201	14	88.1%	157.5%	1.79	-14.4%	-0.6%
Toys and Novelty Goods		**453**	**34**	**-55.3%**	**-42.0%**	**0.93**	**-17.4%**	**2.9%**
339920	Sporting and Athletic Goods Manufacturing	55	7	-14.8%	-15.9%	0.37	-18.4%	-1.4%
339932	Game, Toy, and Children's Vehicle Manufacturing	63	6	22.7%	-54.2%	1.90	-32.5%	-11.1%
339941	Pen and Mechanical Pencil Manufacturing	124	2	-65.1%	-53.3%	12.16	-50.4%	-18.9%
339991	Gasket, Packing, and Sealing Device Manufacturing	90	4	-77.4%	-57.4%	0.85	-13.5%	12.3%
339999	All Other Miscellaneous Manufacturing	121	15	-16.0%	18.6%	0.65	-12.3%	6.2%
Marine, Materials and Machinery		**19,107**	**626**	**-4.1%**	**9.1%**	**1.86**	**-13.0%**	**4.9%**
Fabricated Metal Products		**5,259**	**237**	**-18.1%**	**2.6%**	**1.40**	**-8.0%**	**9.9%**
332112	Nonferrous Forging	51	1	2724.2%	145.0%	2.11	-3.9%	11.4%
332116	Metal Stamping	486	21	-18.9%	-7.4%	2.70	-10.4%	10.8%

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		Employment	Establishments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
332212	Hand and Edge Tool Manufacturing	213	5	-15.3%	39.8%	2.45	-27.4%	-9.8%
332312	Fabricated Structural Metal Manufacturing	88	8	69.2%	-27.8%	0.29	-14.0%	-0.8%
332313	Plate Work Manufacturing	67	7	41.1%	1217.3%	0.40	-5.9%	7.4%
332321	Metal Window and Door Manufacturing	242	6	-20.1%	-4.0%	1.31	-31.0%	-4.9%
332322	Sheet Metal Work Manufacturing	114	12	-23.5%	8.6%	0.33	-9.6%	6.5%
332420	Metal Tank (Heavy Gauge) Manufacturing	409	2	128.2%	-39.0%	3.29	12.6%	24.8%
332439	Other Metal Container Manufacturing	396	7	-40.3%	305.1%	7.01	-21.7%	0.3%
332618	Other Fabricated Wire Product Manufacturing	54	3	-91.7%	-83.2%	0.56	-32.2%	-9.8%
332710	Machine Shops	441	53	-29.6%	-9.1%	0.44	4.3%	19.8%
332721	Precision Turned Product Manufacturing	555	21	-17.7%	12.6%	3.93	-5.0%	23.1%
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	254	6	67.8%	98.6%	1.84	-8.1%	9.2%
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	316	22	0.8%	10.6%	1.64	-2.9%	12.7%
332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	747	35	-23.5%	6.7%	3.41	-13.6%	10.3%
332911	Industrial Valve Manufacturing	215	3	423.8%	5949.4%	2.24	5.6%	12.0%
332912	Fluid Power Valve and Hose Fitting Manufacturing	156	3	-10.4%	31.7%	1.18	4.1%	20.0%
332919	Other Metal Valve and Pipe Fitting Manufacturing	81	2	-15.7%	-49.2%	1.42	-18.8%	-3.9%
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	373	19	-21.1%	-22.1%	1.79	-10.2%	7.4%
Glass and Stone Products		**494**	**40**	**7.4%**	**9.1%**	**0.74**	**-25.6%**	**-3.8%**
327212	Other Pressed and Blown Glass and Glassware Manufacturing	105	7	-5.7%	-10.3%	1.91	-27.8%	-6.6%
327215	Glass Product Manufacturing Made of Purchased Glass	51	8	-54.1%	117.2%	0.36	-19.2%	1.5%
327320	Ready-Mix Concrete Manufacturing	85	8	4.2%	-27.3%	0.29	-32.0%	-10.0%
327910	Abrasive Product Manufacturing	85	2	762.1%	99.8%	2.44	-9.9%	8.8%

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327991	Cut Stone and Stone Product Manufacturing	103	14	-29.5%	-14.2%	1.15	-19.8%	6.9%
327993	Mineral Wool Manufacturing	65	1	N/A	96.7%	1.15	-17.5%	-1.2%
Industrial Machinery Manufacturing		**1,425**	**90**	**22.7%**	**31.0%**	**1.51**	**-9.3%**	**8.1%**
333293	Printing Machinery and Equipment Manufacturing	84	4	21.9%	23.7%	3.00	-37.9%	-25.5%
333298	All Other Industrial Machinery Manufacturing	224	16	78.1%	100.3%	2.00	0.4%	13.0%
333314	Optical Instrument and Lens Manufacturing	73	1	132.8%	90.4%	1.05	-13.0%	-10.2%
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	455	4	270.4%	57.9%	8.24	-15.7%	-6.4%
333511	Industrial Mold Manufacturing	88	16	-48.2%	-5.4%	0.68	-8.4%	15.1%
333512	Machine Tool (Metal Cutting Types) Manufacturing	107	13	-10.3%	252.2%	1.14	-7.1%	12.7%
333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	129	19	-49.0%	-9.2%	0.56	-8.2%	13.8%
333515	Cutting Tool and Machine Tool Accessory Manufacturing	184	14	-8.9%	-26.7%	2.07	-6.0%	18.0%
333999	All Other Miscellaneous General Purpose Machinery Manufacturing	81	4	19.1%	24.6%	0.59	-9.4%	8.2%
Metals Refining and Metalworking		**1,560**	**56**	**0.7%**	**21.1%**	**3.02**	**-14.9%**	**7.1%**
331221	Rolled Steel Shape Manufacturing	72	2	-52.9%	311.7%	0.99	-13.4%	5.5%
331419	Primary Smelting and Refining of Nonferrous Metal (except Copper and Aluminum)	467	6	106.7%	97.0%	17.30	2.5%	5.0%
331421	Copper Rolling, Drawing, and Extruding	247	6	-9.9%	-30.0%	5.83	-18.9%	7.4%
331422	Copper Wire (except Mechanical) Drawing	103	3	-16.0%	82.1%	1.85	-17.0%	5.1%
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	243	11	-1.8%	3.5%	5.18	-6.6%	6.9%
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)	98	7	-13.0%	43.7%	2.62	10.2%	18.0%
331511	Iron Foundries	84	2	-33.8%	-13.3%	0.58	-23.2%	5.6%

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331512	Steel Investment Foundries	61	2	809.9%	667.1%	1.46	-10.3%	4.8%
331522	Nonferrous (except Aluminum) Die-Casting Foundries	128	5	-24.3%	-5.2%	5.80	-26.0%	19.2%
331528	Other Nonferrous Foundries (except Die-Casting)	57	12	-48.4%	-29.3%	2.26	-7.3%	6.2%
Packaging		**1,608**	**52**	**-3.9%**	**1.5%**	**1.34**	**-22.2%**	**-4.3%**
321114	Wood Preservation	64	3	93.0%	30.5%	2.06	-21.1%	-3.3%
321911	Wood Window and Door Manufacturing	183	1	86.3%	-14.9%	1.20	-40.7%	-14.3%
321918	Other Millwork (including Flooring)	89	11	-52.4%	9.9%	0.72	-38.0%	-8.2%
321920	Wood Container and Pallet Manufacturing	120	5	-17.2%	0.0%	0.62	-6.9%	8.3%
321999	All Other Miscellaneous Wood Product Manufacturing	57	6	-20.7%	-35.9%	0.81	-22.2%	0.9%
322211	Corrugated and Solid Fiber Box Manufacturing	57	3	-45.4%	-49.9%	0.18	-17.5%	-4.2%
322212	Folding Paperboard Box Manufacturing	177	6	-4.3%	58.0%	1.85	-16.3%	-9.0%
322213	Setup Paperboard Box Manufacturing	94	5	-55.2%	-47.1%	7.57	-20.6%	-7.1%
322221	Coated and Laminated Packaging Paper Manufacturing	99	2	10.8%	48.9%	2.05	-14.5%	-7.7%
322222	Coated and Laminated Paper Manufacturing	163	5	-51.0%	-45.6%	1.66	-15.5%	-4.7%
322299	All Other Converted Paper Product Manufacturing	506	5	132.7%	93.8%	9.04	-6.5%	1.8%
Plastic Laminates and Films Manufacturing		**2,534**	**54**	**-0.4%**	**11.0%**	**1.81**	**-12.2%**	**6.8%**
326112	Plastics Packaging Film and Sheet (including Laminated) Manufacturing	647	2	345.4%	31.0%	11.34	47.3%	40.3%
326113	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing	153	4	-62.2%	14.3%	1.13	-18.9%	-1.6%
326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing	248	3	-59.1%	731.1%	4.17	-14.6%	5.2%
326150	Urethane and Other Foam Product (except Polystyrene) Manufacturing	205	6	81.4%	72.3%	1.84	-7.8%	8.0%
326199	All Other Plastics Product Manufacturing	1,132	35	-2.8%	-20.6%	1.20	-13.9%	6.3%

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326299	All Other Rubber Product Manufacturing	150	4	36.6%	83.4%	1.68	-8.9%	8.5%
Ship Building		**3,755**	**46**	**5.7%**	**16.9%**	**5.79**	**-17.7%**	**2.0%**
336211	Motor Vehicle Body Manufacturing	80	3	23.1%	79.4%	0.43	-17.8%	3.2%
336611	Ship Building and Repairing	2,060	9	65.2%	181.9%	5.81	0.8%	-0.7%
336612	Boatbuilding	1,615	34	-27.9%	-33.7%	14.85	-48.3%	9.5%
Specialty Chemicals and Resins Manufacturing		**1,388**	**27**	**-5.4%**	**9.6%**	**2.22**	**-10.5%**	**0.6%**
325199	All Other Basic Organic Chemical Manufacturing	90	4	69.4%	301.9%	0.73	2.3%	4.8%
325211	Plastics Material and Resin Manufacturing	133	8	-59.2%	-26.1%	0.68	-9.0%	2.2%
325212	Synthetic Rubber Manufacturing	63	1	151.0%	352.4%	1.68	-18.5%	-2.9%
325520	Adhesive Manufacturing	81	3	219.3%	15.7%	1.16	-6.0%	4.5%
325611	Soap and Other Detergent Manufacturing	254	2	53.6%	3.5%	2.96	0.2%	-0.4%
325991	Custom Compounding of Purchased Resins	561	6	2.0%	17.9%	9.55	-16.1%	9.1%
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing	205	3	-36.5%	-20.7%	3.67	-37.0%	-18.6%
Wiring and Related Products		**1,083**	**24**	**-0.8%**	**-10.8%**	**2.19**	**-8.2%**	**3.4%**
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	135	6	-28.6%	0.7%	1.91	-15.4%	1.9%
335314	Relay and Industrial Control Manufacturing	55	1	91.3%	23.7%	0.33	-2.4%	3.8%
335929	Other Communication and Energy Wire Manufacturing	385	3	132.6%	65.3%	8.51	-4.4%	9.1%
335931	Current-Carrying Wiring Device Manufacturing	140	7	-59.4%	-54.0%	1.25	-17.9%	0.0%
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	368	7	1.1%	-26.1%	3.69	-0.9%	5.4%
Software Systems and Internet Services		**9,440**	**1,414**	**13.5%**	**5.2%**	**1.11**	**22.6%**	**20.4%**
Computer Systems and Software		**6,662**	**1,212**	**17.7%**	**11.0%**	**0.97**	**24.5%**	**20.4%**
511210	Software publishers	991	130	5.0%	11.2%	0.95	17.7%	16.2%

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541511	Custom computer programming services	1,285	335	55.0%	28.6%	0.49	24.5%	20.6%
541512	Computer systems design services	4,161	726	15.6%	7.4%	1.48	31.2%	24.7%
541519	Other computer related services	225	21	-21.3%	-6.3%	0.60	1.5%	2.7%
Data Processing, Facilities and Internet		**2,778**	**202**	**4.5%**	**-6.4%**	**1.71**	**15.2%**	**20.3%**
518210	Data processing, hosting and related services	2,625	130	3.9%	-7.6%	2.81	-1.8%	8.0%
519130	Internet publishing and web search portals	115	56	82.5%	134.7%	0.23	96.3%	71.6%
541513	Computer facilities management services	38	16	-44.1%	-51.9%	0.20	-6.1%	-1.4%
Transportation, Shipping, and Logistics		**21,322**	**3,404**	**-1.7%**	**5.3%**	**0.73**	**-3.1%**	**4.9%**
Freight Transportation		**2,293**	**298**	**0.1%**	**12.4%**	**0.46**	**-4.7%**	**8.5%**
481112	Scheduled freight air transportation	3	1	-66.9%	-17.8%	0.06	0.1%	17.3%
483111	Deep sea freight transportation	14	1	N/A	N/A	0.36	-0.5%	-0.5%
483113	Coastal and Great Lakes freight transport.	29	1	37.5%	-24.8%	0.71	11.6%	8.2%
484110	General Freight Trucking, Local	448	86	-1.3%	25.0%	0.56	-4.0%	11.6%
484121	General freight trucking, long-distance TL	243	34	-33.4%	-6.5%	0.14	-8.7%	3.4%
484122	General Freight Trucking, Long-Distance, Less Than Truckload	639	30	26.8%	25.8%	0.83	-4.7%	10.2%
484210	Used household and office goods moving	450	40	-11.2%	7.9%	1.38	-7.1%	10.7%
484220	Other specialized trucking, local	291	80	8.2%	16.9%	0.39	1.7%	13.0%
484230	Other specialized trucking, long-distance	140	23	0.6%	-10.0%	0.32	2.5%	15.6%
488310	Port and harbor operations	36	2	55.4%	-27.9%	0.53	-16.8%	-6.8%
Logistics Support Services		**1,027**	**137**	**-1.2%**	**-5.8%**	**0.61**	**-3.6%**	**5.0%**
425110	Business to business electronic markets	37	12	-21.3%	-24.5%	0.29	-33.5%	-17.7%
488320	Marine cargo handling	123	2	58.4%	94.3%	0.76	0.0%	12.8%
488330	Navigational services to shipping	63	7	-1.5%	-7.4%	0.98	-12.8%	-5.9%
488390	Other support activities for water transport.	49	6	103.0%	-15.7%	1.54	-8.8%	-5.6%

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488510	Freight transportation arrangement	231	49	-5.7%	-12.2%	0.35	1.4%	9.9%
488991	Packing and crating	22	7	-26.8%	-17.8%	0.35	-12.4%	3.3%
488999	All other support activities for transport.	0	0	N/A	N/A	0.00	14.4%	22.7%
541614	Process and logistics consulting services	230	46	-13.2%	-19.6%	0.66	16.7%	9.1%
561910	Packaging and labeling services	272	8	-5.3%	-1.6%	1.51	-18.3%	-1.6%
Warehousing		**1,351**	**33**	**10.4%**	**26.0%**	**0.54**	**7.5%**	**11.4%**
493110	General warehousing and storage	902	20	-7.6%	4.0%	0.42	8.2%	12.8%
493120	Refrigerated warehousing and storage	0	0	-100.0%	-100.0%	0.00	7.0%	5.6%
493130	Farm product warehousing and storage	0	0	N/A	N/A	0.00	3.2%	14.2%
493190	Other warehousing and storage	449	13	103.3%	122.1%	2.87	0.5%	0.8%
Wholesale Distribution		**16,652**	**2,936**	**-2.9%**	**3.8%**	**0.83**	**-3.9%**	**3.3%**
423110	Motor vehicle merchant wholesalers	159	23	-34.5%	17.3%	0.40	-12.3%	-3.2%
423120	New motor vehicle parts merchant wholesalers	379	43	-10.8%	2.2%	0.66	-5.0%	8.6%
423130	Tire and tube merchant wholesalers	4	2	-86.4%	-59.2%	0.04	11.1%	15.4%
423140	Used motor vehicle parts merchant wholesalers	248	24	31.0%	16.4%	3.00	-2.5%	1.4%
423210	Furniture merchant wholesalers	45	10	-52.6%	-30.2%	0.29	-5.5%	8.0%
423220	Home Furnishing Merchant Wholesalers	258	13	-11.3%	6.6%	1.33	-18.8%	-2.1%
423310	Lumber and wood merchant wholesalers	163	17	-42.4%	-25.9%	0.51	-31.4%	-7.4%
423320	Masonry material merchant wholesalers	139	20	-31.5%	-20.1%	0.83	-24.2%	-6.6%
423330	Roofing and siding merchant wholesalers	78	8	-20.8%	-39.1%	0.74	-12.3%	2.6%
423390	Other const. material merchant wholesalers	20	7	-56.1%	33.3%	0.24	-19.5%	3.4%
423410	Photographic equip. merchant wholesalers	1	3	-93.1%	-88.6%	0.02	-4.4%	2.4%
423420	Office equipment merchant wholesalers	300	24	-22.5%	-2.6%	0.91	-14.5%	-9.0%
423430	Computer and software merchant wholesalers	209	27	-13.3%	17.4%	0.26	-8.5%	1.8%
423440	Other commercial equip. merchant wholesalers	172	22	-35.3%	-18.5%	0.98	-3.4%	4.5%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
423450	Medical equipment merchant wholesalers	677	66	7.0%	0.3%	1.01	1.7%	2.1%
423460	Ophthalmic goods merchant wholesalers	74	3	-10.8%	-6.9%	1.08	-2.4%	4.4%
423490	Other professional equip. merchant wholesalers	76	12	5.6%	28.8%	0.79	3.6%	6.9%
423510	Metal merchant wholesalers	192	16	21.5%	0.3%	0.45	-6.2%	8.1%
423520	Coal and other mineral merchant wholesalers	0	0	N/A	N/A	0.00	-4.2%	-3.6%
423610	Elec. equip. and wiring merchant wholesalers	847	37	2.9%	1.8%	1.62	-2.8%	5.6%
423620	Electric appliance merchant wholesalers	60	7	-53.1%	1.7%	0.62	-13.8%	-2.9%
423690	Other electronic parts merchant wholesalers	162	24	-20.2%	-1.8%	0.32	-15.0%	-5.8%
423710	Hardware merchant wholesalers	137	22	-12.7%	30.5%	0.51	-7.5%	2.6%
423720	Plumbing equip. merchant wholesalers	422	46	5.8%	6.3%	1.45	-16.0%	-3.1%
423730	HVAC equip. merchant wholesalers	75	10	13.6%	21.0%	0.37	-7.7%	0.1%
423740	Refrigeration equip. merchant wholesalers	25	5	-44.4%	-32.4%	0.60	-13.5%	-2.2%
423810	Construction equipment merchant wholesalers	22	8	-67.2%	-56.9%	0.08	-11.4%	2.8%
423820	Farm and garden equip. merchant wholesalers	30	6	-14.3%	-25.0%	0.08	1.5%	4.1%
423830	Industrial machinery merchant wholesalers	509	81	-37.7%	-27.7%	0.47	-5.1%	5.9%
423840	Industrial supplies merchant wholesalers	103	22	-8.8%	21.2%	0.35	7.2%	13.3%
423850	Service estab. equip. merchant wholesalers	207	29	-18.2%	-15.2%	1.09	-14.7%	-7.8%
423860	Other transport. goods merchant wholesalers	19	6	35.7%	58.3%	0.16	-2.8%	-0.3%
423910	Sporting goods merchant wholesalers	205	26	-19.0%	71.6%	1.17	-1.1%	8.2%
423920	Toy and hobby goods merchant wholesalers	61	9	-35.8%	-63.6%	0.85	-14.7%	-6.6%
423930	Recyclable material merchant wholesalers	404	26	-10.6%	4.7%	0.98	5.6%	15.3%
423940	Jewelry merchant wholesalers	1,628	81	45.9%	46.4%	10.28	0.9%	12.1%
423990	All other durable goods merchant wholesalers	323	30	100.6%	25.2%	1.31	1.9%	9.8%
424110	Printing and writing paper merch. whls.	4	4	-86.1%	-84.0%	0.09	-25.1%	-14.3%
424120	Office supplies merchant wholesalers	179	15	22.5%	42.6%	0.98	-21.1%	-10.7%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
424130	Industrial paper merchant wholesalers	152	17	-24.8%	5.6%	0.75	-11.4%	-2.0%
424210	Druggists' goods merchant wholesalers	460	63	-14.7%	-12.9%	0.69	-11.3%	-4.0%
424310	Piece goods merchant wholesalers	99	12	94.1%	175.2%	1.21	-7.6%	2.0%
424320	Men's and boys' clothing merchant wholesalers	19	3	-53.5%	1739.4%	0.21	-20.5%	-7.3%
424330	Women's and children's clothing merch. whls.	38	8	-74.9%	-77.1%	0.15	4.3%	14.8%
424340	Footwear merchant wholesalers	38	9	-13.6%	-5.0%	0.49	-20.7%	-14.2%
424410	General line grocery merchant wholesalers	675	24	141.1%	146.4%	0.82	3.4%	2.2%
424420	Packaged frozen food merchant wholesalers	92	13	-2.1%	0.0%	0.96	-7.3%	-5.0%
424430	Dairy product merchant wholesalers	23	9	-50.5%	-33.5%	0.16	2.6%	3.6%
424440	Poultry product merchant wholesalers	12	3	-40.9%	-60.8%	0.32	-8.5%	-2.0%
424450	Confectionery merchant wholesalers	185	7	25.5%	19.8%	1.00	5.4%	7.9%
424460	Fish and seafood merchant wholesalers	178	37	-1.8%	-5.3%	2.17	0.8%	3.8%
424470	Meat and meat product merchant wholesalers	177	11	-24.4%	-4.3%	1.34	2.6%	3.4%
424480	Fruit and vegetable merchant wholesalers	136	11	41.7%	3.8%	0.44	10.2%	9.1%
424490	Other grocery product merchant wholesalers	707	44	13.7%	24.7%	0.94	-3.9%	-0.7%
424510	Grain and field bean merchant wholesalers	5	1	N/A	514.4%	0.03	8.2%	2.7%
424520	Livestock merchant wholesalers	0	0	N/A	N/A	0.00	-10.6%	-8.4%
424590	Other farm product raw material merch. whls.	5	1	3.1%	125.6%	0.16	-4.4%	3.2%
424610	Plastics materials merchant wholesalers	138	11	-16.7%	131.4%	1.87	-11.0%	2.7%
424690	Other chemicals merchant wholesalers	504	35	0.4%	-9.8%	1.35	-0.9%	3.0%
424710	Petroleum bulk stations and terminals	56	2	-7.6%	-32.2%	0.52	-4.1%	-3.7%
424720	Other petroleum merchant wholesalers	176	17	-44.6%	-11.9%	0.78	-6.5%	-0.5%
424810	Beer and ale merchant wholesalers	152	9	-10.1%	-5.7%	0.42	11.1%	7.8%
424820	Wine and spirit merchant wholesalers	264	13	10.0%	41.3%	0.97	19.8%	14.2%
424910	Farm Supplies Merchant Wholesalers	60	9	27.7%	-9.1%	0.15	2.7%	3.6%

Cluster/ Component/ NAICS Digit	NAICS Description	Rhode Island Cluster Data, 2013		Rhode Island Employment Metrics			U.S. Employment Metrics	
		Employ-ment	Establish-ments	Percent Change 07-13	Percent Change 09-13	2013 LQ	Percent Change 07-13	Percent Change 09-13
424920	Book and periodical merchant wholesalers	69	19	-24.2%	-25.8%	0.44	-19.9%	-18.0%
424930	Nursery and florist merchant wholesalersv	121	5	-26.2%	-6.9%	0.82	-19.7%	-4.7%
424940	Tobacco and tobacco product merch. whls.	41	7	13.9%	32.3%	0.48	-9.4%	-1.9%
424950	Paint and supplies merchant wholesalers	39	8	34.5%	56.0%	0.56	-22.4%	-12.4%
424990	Other Miscellaneous Nondurable Goods Merchant Wholesalers	224	34	-40.4%	-37.3%	0.75	-6.4%	7.8%
425120	Wholesale trade agents and brokers	3,191	1,660	4.2%	-1.9%	1.06	9.9%	12.3%

Appendix E: Complete Benchmark Rankings

Innovation Capacity	Source	RI	CT	DE	ME	MA	MN	NH	OR	PA	VT
Cumulative VC Inv per $10M Cumulative GSP, 2009-14	Thomson One Venture Capital Database	3	2	8	9	1	6	4	5	7	6
Early & Seed VC as share of total inv, 2009-14	Thomson One Venture Capital Database	7	5	6	8	1	3	2	10	4	9
Per $10M GSP, 2012	Thomson One Venture Capital Database	9	4	2	10	1	5	8	3	7	6
% Change, 2009-12	Thomson One Venture Capital Database	6	9	1	10	3	8	5	2	7	4
Univ. R&D Per $10M GSP, 2013	National Science Foundation R&D Expenditures Database	2	5	8	10	1	9	4	7	3	6
% Change 2009-13	National Science Foundation R&D Expenditures Database	4	2	1	10	3	6	7	8	5	9
Number of Invented Patents per $100M GSP, 2014	Thomson Innovation	7	6	8	10	3	4	2	5	9	1
% Change, 2009-14	Thomson Innovation	4	6	9	2	1	3	5	8	7	10
Start-Ups per $10M Research Expenditures, 2013	Association of University Technology Managers Database	9	2	6	NA	8	5	7	4	3	1
Patents Issued Per $10M Research Expenditures, 2013	Association of University Technology Managers Database	9	4	5	NA	1	8	3	7	6	2
Licenses Issued Per $10M Research Expenditures, 2013	Association of University Technology Managers Database	9	4	8	NA	7	5	2	1	3	6
Avg. Annual Rate of New Firm Formation as Percent of All Firms, 2007-12	IMPLAN	8	9	2	4	5	3	5	1	7	10
Average Annual Job Creation per new firm, 2007-12	IMPLAN	6	2	1	10	7	3	5	9	3	8
Number of Companies on the Inc. 5000, 2014	Inc. 5000	8	5	7	9	2	3	6	4	1	10
Entrepreneurs Per 100K people, 2013	Kauffman Index of Entrepreneurial Activity	10	2	2	1	5	9	7	6	7	4

Quality of Place	Source	RI	CT	DE	ME	MA	MN	NH	OR	PA	VT
Regional Well-Being Score	OECD Well Being Index	8	7	9	5	4	2	1	6	10	3
Restaurant Density	National Restaurant Association	1	7	8	3	5	9	4	2	7	6
Quality of Life	CNBC 2015 Top States for Business, Quality of Life	8	7	9	4	6	2	3	5	10	1
Pedestrian Danger Index	Smart Growth America, Dangerous by Design 2014	7	9	10	4	3	5	2	8	6	1

Business Environment	Source	RI	CT	DE	ME	MA	MN	NH	OR	PA	VT
State Business Tax Climate Index Score	Tax Foundation	8	7	3	6	4	10	1	2	5	9
America's Top States for Business Score	CNBC	10	5	6	9	2	1	4	3	7	8
Small Business Policy Index	Small Business & Entrepreneurship Council	5	6	4	7	3	10	1	8	2	9
2015 Small Business Friendliness Ranking	Thumbtack.com	7	6	NA	NA	5	3	1	2	4	NA

Talent and Skills	Source	RI	CT	DE	ME	MA	MN	NH	OR	PA	VT
Averaged freshman graduation rate for public secondary schools, 2009-10	National Center for Education Statistics (NCES)	7	10	9	5	6	2	3	8	4	1
Percent of Black 9th- to 12th-graders who dropped out, 2009-10	National Center for Education Statistics (NCES)	9	10	5	6	7	4	2	8	3	1
Percent of Hispanic 9th- to 12th-graders who dropped out, 2009-10	National Center for Education Statistics (NCES)	8	9	4	6	10	3	2	5	7	1
Percentage of public school students in programs for English language learners, 2012-13	National Center for Education Statistics (NCES)	7	5	6	3	9	8	2	10	4	1
Average math scores, grade 4, 2015	National Center for Education Statistics (NCES)	9	7	8	6	1	2	3	10	5	4
Average reading scores, grade 4, 2015	National Center for Education Statistics (NCES)	6	4	7	8	1	9	2	10	5	3
Average math scores, grade 8, 2015	National Center for Education Statistics (NCES)	9	6	10	5	1	2	3	8	7	4
Average reading scores, grade 8, 2015	National Center for Education Statistics (NCES)	9	4	10	7	2	5	1	8	6	3
2010-2014 STEM Percentage Point Changes , Associate's degree	Brookings Analysis of IPEDS	9	1	4	5	7	8	3	10	6	2
2010-2014 STEM Percentage Point Changes , Bachelor's degree	Brookings Analysis of IPEDS	10	6	1	5	3	4	2	9	7	8
2010-2014 STEM Percentage Point Changes , Master's degree	Brookings Analysis of IPEDS	8	7	2	5	3	1	6	10	4	9
2010-2014 Computer Science Percentage Point Changes , Associate's degree	Brookings Analysis of IPEDS	10	3	9	4	1	7	2	5	6	8
2010-2014 Computer Science Percentage Point Changes , Bachelor's degree	Brookings Analysis of IPEDS	6	3	1	5	7	8	2	9	4	10
2010-2014 Computer Science Percentage Point Changes , Master's degree	Brookings Analysis of IPEDS	7	10	3	2	4	6	5	8	1	9

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