Review of Targeted Technology Sectors and Industry Clusters

December 2023

PREPARED FOR:

Maine Technology Institute
8 Venture Ave
Brunswick, ME 04011

camoin associates

www.camoinassociates.com

CONTENTS

EXECUTIVE SUMMARY

Purpose

Resolution LD 1318 of the 131st Maine Legislature requires MTI to evaluate the effectiveness and relevancy of the targeted technology sectors and the industry clusters that have developed within those sectors to determine whether the laws governing the sectors and clusters should be amended. The Maine Technology Institute has engaged Camoin Associates to conduct this evaluation, including the facilitation of public input, to produce a report that will be delivered to the Joint Standing Committee on Innovation, Development, and Economic Advancement and Business.

The following report details the findings of this evaluation. Based on a combination of quantitative measurements of the seven tech sectors as well as qualitative data gathered through public input and focus groups, this report provides recommendations regarding the future of Maine's technology sectors and clusters.

The Technology Sectors

MTI 's seven target technology sectors were identified in 1999 under Maine Statute Title 5, Part 19, Chapter 407, §15301. Within the statute, the seven targeted technologies are broadly defined and listed below. These broad definitions have provided MTI with unique opportunities and challenges in regard to how the institution supports the State's innovation economy.


Biotechnology


Forest Products & Agriculture


Environmental Technologies


Marine Technology & Aquaculture


Composites & Advanced Materials


Information Technology


Precision Manufacturing

Key Findings

1. Since the initiation of the targeted sectors, Maine's economy and industry sectors have changed dramatically. This is driven primarily by global changes in technology and innovation. For example, when this work was established, artificial intelligence and nano technology were concepts but had little to no applications. Additionally, the advancement of computing capacity and increased access have made technology ubiquitous across all of the sectors.
2. Based on the changes in the economy, defining and measuring sectors remains imperfect. It is important to note that *technology sectors* are different from *industry sectors*, and this is evident in Maine's body of work around these sectors.[1]

[1] Please see page 20 for detailed information on the distinction.

3. Current targeted sectors are still economically relevant in Maine's economy. They are represented and serviced by multiple organizations across the state including industry associations, research initiatives, workforce development, and more.
4. The sectors themselves are highly connected and experience crossover due to NAICS codes, necessary industry work, and skillsets. For example, there is Precision Manufacturing within Forest Products & Agriculture and there is IT within all of the industry sectors. Due to industry crossover, it is hard to measure and understand each sector in isolation.
5. The naming and description of industry sectors have not been prohibitive in economic development work to the community, specifically MTI. While MTI categorizes activity within the sectors, their criteria for awards is based on other factors including innovation, use of technology, and market and financial potentials.
6. The current target sectors are not prohibitive, meaning that new technologies relating to any given industry could reasonably be considered for funding by MTI under the current structure. For instance, the use of IT in sectors like retail, outdoor recreation, or healthcare services would be considered a potential viable candidate for funding. Furthermore, there are trends and topics that are not specifically named in the targeted sectors like outdoor recreation, tourism, and hospitality as well as FoodTech, MedTech, FinTech, InsurTech but were identified through the data collection and stakeholder engagement process. Ultimately, much of Maine's economy is grounded in climate and natural resources that influence all of the industry sectors.
7. Stakeholders were primarily concerned about the inclusivity of the current target sectors because they identified them as relevant but may not be broad enough to include emerging opportunities.
8. Stakeholders identified several emerging sectors in Maine and while these emerging sectors may or may not fall under the current industry sectors, stakeholders raised a potential idea that creates a new "catch-all" sector called "Emerging Technologies" to expand investment opportunities.

Recommendations

Based on the key findings, MTI and the Maine Legislature may consider the following options regarding the best way to nurture future growth and innovation in the state. Each recommendation has associated impacts that are listed in the Recommendations Section of this report.

1. Maintain the Status Quo | MTI will continue to support the current seven technology sectors as they are worded: Biotechnology, Composites & Advanced Materials, Environmental Technologies, Forest Products & Agriculture, Information Technology, Marine Technology & Aquaculture, and Precision

Manufacturing. This approach continues the current system in place to fund businesses and innovative ideas without changing anything that MTI is currently doing.

2. Adopt a Hybrid Approach | MTI will continue to support the seven technology sectors using the current broad definitions and add *Emerging Technologies* as the eighth target sector. This approach includes maintaining MTI's current funding criteria but might add additional evaluation guidelines for an Emerging Technologies sector.

3. Discontinue the Target Sectors Approach | MTI will focus solely on supporting businesses and ideas that are innovative and have a technological component. This approach includes creating a new evaluation criteria framework for funding decision making.

CONTEXT

Overview of MTI's Operations

Maine Technology Institute (MTI) was established in 1999 by the State legislature. Under Maine Statute, MTI was created to:

> *"encourage, promote, stimulate, and support research and development activity leading to the commercialization of new products and services in the State's technology-intensive industrial sectors to enhance the competitive position of those sectors and increase the likelihood that one or more of the sectors will support clusters of industrial activity and to create new jobs for Maine people. The institute is one element of the State's economic development strategy and will contribute to the long-term development of a statewide research, development, and product deployment infrastructure."*[2]

Nearly 25 years later, the Institute's trajectory is still in line with its original mission. MTI manages the State's research and development (R&D) incentive program and provides funding for innovative businesses related to the seven target technology sectors. Since its founding, MTI has invested over $365 million in nearly 3,800 projects across Maine's 16 counties. MTI funding has also generated over $2.2 billion in private sector matching funds.

The Technology Sectors

MTI's seven target technology sectors were identified in 1999 under Maine Statue Title 5, Part 19, Chapter 407, §15301.[3] Within the statute, the seven targeted technologies are broadly defined. These broad definitions have provided MTI with unique opportunities and challenges in regard to how the institution supports the State's innovation economy.

[2] https://www.mainelegislature.org/legis/statutes/5/title5sec15302.html

[3] The seven targeted technologies identified in Title 5, Chapter 407 are additionally tied in statute to the Maine Economic Improvement Fund, as defined in Maine Statute Title 10, Part 2, Chapter 107-C, §947. Therefore, in addition to the Maine Technology Institute, any changes to the targeted technology sectors would have cascading impacts on MEIF and university-based research and development.

By leaving the seven target technology sectors open for interpretation, the Maine Legislature provided MTI with discretion when evaluating proposals and deciding which projects receive funding. Additionally, the broad definitions have allowed the sectors to remain relevant throughout the last 20+ years.

The non-specific sector definitions have also created challenges for MTI. The innovation sectors cut across and overlap with each other and with many other industries in the state. This overlap creates challenges when attempting to measure the progress and impact of MTI's efforts using traditional North American Industry Classification System (NAICS) based industry assessments. Additionally, these sectors are considered and used by multiple economic business development stakeholders throughout the state when considering their own programs, initiatives, and plans. This includes state agencies, service providers, and industry associations.

Historical Context

Figure 1 below gives a brief historical overview of MTI's context within the wider context of Maine's historical innovation economy developments and activity. In 1997, the Maine Science and Technology Foundation identified the original five target technology areas following analysis that showed Maine's poor performance nationally on R&D funding, causing cascading impacts to the science and technology pipeline in the state.[4] As a result, the Maine Economic Improvement Fund (MEIF) was created to support R&D in the 5 target areas within the University of Maine System (UMS).

In 1999, these five target areas were expanded to seven within statute. Along with these expanded target technologies, the Maine Technology Institute was established to leverage public-private partnerships, support commercialization, enhance the competitive position of the seven targeted technologies, and create high-wage jobs for Maine people.[5]

Since MTI began operations in 2000, Maine's innovation ecosystem has expanded dramatically, with innovation becoming the focus of numerous strategic plans, initiatives, and organizations throughout the state. Both MEIF and MTI, as well as the seven technology sectors that drive their operations, have become critical tools for the state's economic development and innovation expansion. In sections 3 and 4, overviews on Maine's key documents and research about science and technology and other key players in the innovation ecosystem are provided in greater detail.

[4] https://legislature.maine.gov/doc/2277/

[5] http://lldc.mainelegislature.org/Open/Rpts/t174_3_m3_1999.pdf

Figure 1: Major Events and Developments Related to MTI

REVIEW OF EXISTING LITERATURE

Over the past 25 years, Maine has seen numerous reports and strategic plans published that relate to the state's science and technology ecosystem. These reports represent the culmination of a wealth of expertise and research as well as decades of work to promote Maine's technology and innovation expansion. As recommendations for the future of the state's technology sectors are formed, it is critical to document this historical literature such that future strategy works synergistically alongside past efforts. The following section provides a review of this literature as it relates to MTI and the technology sectors.

Battelle 2014 Review of Maine's Innovation Ecosystem & Prospects for Technology-Intensive Clusters[6]

In 2014, nonprofit independent research and development organization Battelle Memorial Institute provided MTI a comprehensive assessment on the performance and evolution of Maine's technology sectors, identifying gaps and weaknesses in the innovation ecosystem. While the study focused on the seven tech sectors, the research identified thirteen "refined" technology sectors. Eleven of the thirteen detailed tech sectors map closely to the targeted technology sectors. Two detailed sectors, Defense Technology and Engineering & Scientific/Technical Services were identified as more cross-cutting. Overall, **Engineering and Scientific/Technical Services was identified as a new cluster to support several industries in Maine.**

The report also identified detailed product/service market growth opportunities within the 13 detailed clusters, including:

- Aquaculture
- Electronic Components
- Engineering Services
- Enterprise and Data Hosting Services
- Financial Transaction Processing & Telemarketing
- Functional Foods
- Molecular-based Diagnostics & Genomics
- Remediation and Environmental Consulting
- Turbines for Energy Production
- Wireless Sensor Networks

Comprehensive Evaluation of Maine's R&D and Economic Development Incentive and Investment Programs[7]

The first Comprehensive Evaluation was completed in 2001 under the Maine Science and Technology Foundation. Subsequent updates to this evaluation were completed within the Department of Economic and Community Development (DECD) . The following summaries detail the most recent 15 years of evaluations.

Early Evaluations, 2008-2014

In 2008, DECD developed a Comprehensive Economic Development Evaluation Plan as well as a comprehensive inventory of Maine's economic development funding and programs. Following this work, Maine's first Comprehensive Economic Development Evaluation was submitted to the Office of Innovation in early 2009. The findings of early iterations of this evaluation and corresponding case studies in 2008, 2010, 2011, and 2014 include the following:

- Maine's incentive programs and investments are both effective and generate economic benefits that would not have occurred without state efforts. However, Maine significantly lagged R&D relative to other

[6] http://www.mainetechnology.org/docs/Full_Report-Maine-Innovation-Ecosystem_final5.pdf

[7] https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/January%202016%20Comprehensive%20Evaluation%20of%20Maines%20Incentive%20and%20Investment.pdf

peer states, in particular R&D performed by private industry.

- Over time, Maine made advancements in academic and non-profit R&D
- R&D in early years lacked collaborative connections between institutions and private sector, which led to the creation of more collaborative programs and ties to clusters

Recent Evaluations, 2016-2018

As part of the ongoing evaluation, in 2016 and 2018, the Maine Department of Economic and Community Development published the two most recent Comprehensive Evaluations of State Investment in Economic Development. This included an evaluation of MTI as well as other incentive-granting organizations and programs in Maine. Several key implications were found regarding MTI's operations, including the following:

- MTI is the focal point of Maine's R&D incentives. Its operations are true to its mission and legislative mandate, and its efforts encourage growth in an active, collaborative, and hands-on way
- MTI Development Loans effectively improve the innovation/R&D environment in Maine and provide a positive financial return on investment

Findings specifically about seven technology sectors:

- It may be more beneficial to focus on all growing sectors and all successful businesses rather than focusing on seven specific sectors. This strategy may enhance economic diversity and provide more resilience to changing global demand, ensuring the state is using money to the greatest positive effect.
- **Expanding Biotech and Life Sciences would provide a more robust starting point** to compete with the Boston area life science cluster and would make it easier for the state to grow the industry.

Maine Innovation Economy Action Plans

Maine's first Science and Technology Plan was published in 1997 under the auspices of the Maine Science and Technology Foundation. Later, The Maine Innovation Economy Advisory Board (MIEAB) was established in 2007 in an effort to bring together Maine's R&D activities across the public, private, and higher education sectors. MIEAB oversaw the first Maine Innovation Economy Action Plan (MIEAP) in 2010, an extension of the earlier Science & Technology plans. The following summaries detail the findings of the two most recent MIEAPs from 2017 and 2023, which build upon previous plans.

2017[8]:

The 2017 strategy suggested a combination approach involving A) growing R&D capacity, B) increasing human capital, and C) cultivating entrepreneurship and innovation within enterprises. The Maine Technology Institute plays a key role in the plan's strategies, acting as a lead and supporting organization for increasing R&D in academic, non-profit, and for-profit private institutions as well as acting as a critical facilitator of innovation funding. **The strategy calls for continued support for the seven technology sectors, applying a stronger focus on technology that intersects sectors and on high-performance clusters within and between the targeted sectors.**

2023[9]:

This plan expands on previous action plans and lays out a vision for a "resilient, innovation-driven economy that creates opportunities for all Maine people," including strategies to increase R&D, strengthen pathways to commercialization, prepare the innovation workforce, promote resilience to

[8] https://www.mainetechnology.org/wp-content/uploads/2018/08/MSTP_16pp_E_EB-EDITS-updated.pdf
[9] https://umaine.edu/mieab/wp-content/uploads/sites/686/2023/11/Maine-Innovation-Economy-Action-Plan.pdf

climate change, and strengthen the state's R&D ecosystem.

The plan specifically supports and advances the technology sectors and lays out research, enterprise, workforce, and climate change objectives for each. Notably, it separates these goals into two categories, detailed below. Heritage industries correspond directly to established target sectors, while the high-growth industries identified in the plan represent intersecting activities that combine elements of the technology sectors in new and creative ways.

1) Heritage Industries: Agriculture, Aquaculture & Marine Fisheries, and Forestry & Forest Products

2) High-growth target sectors: Aerospace, Artificial Intelligence, Advanced Building Products, Algae and Algal Products, Biochemicals, Biomanufacturing, Biomedicine and Engineering Advances, Healthy Aging, Offshore Wind, and Tidal Energy

Maine Economic Development Strategy 2020-2029[10]

Published in late 2019, this was Maine's first ten-year economic development strategy in more than two decades. The report identifies talent and innovation as the two key drivers of economic growth and proposes various actions to attract, retain, and develop a skilled and diverse workforce, as well as promote innovation across sectors and regions. Additionally, the plan sets three quantitative goals for 2030: 1) grow the average annual wage by 10%, 2) attract 75,000 people to Maine's talent pool, and 3) increase value added per worker by 10%.

The strategy does not specifically address the seven technology sectors in Maine. Instead, it identifies four thematic areas where Maine has current strengths, growing global demand, and potential for job creation:

- Food and Marine
- Forest Products
- Making and Manufacturing
- Technical Services

Three of the four named thematic areas correspond to MTI's technology sectors, either loosely or directly. Forest Products as well as Making and Manufacturing directly relate to existing technology sectors. Food and Marine relates to the Aquaculture and Marine Technology sector, though the addition of food tech lies outside the traditional bounds of existing sectors. **The fourth thematic area, Technical Services, is not currently represented within the technology sectors.** This could encompass a wide array of services that serve the other thematic areas and provide cross-cutting technological development.

Maine Climate Action Plan: Maine Won't Wait (2020)

Created by Maine's Climate Council, the 2020 plan addresses the state's strategy to combat climate change and make Maine more resilient to the changing climate. Several recommendations related to existing technology sectors are present within the report, including:

- Advancement of policies that protect Maine's natural resource-based industries, including new wood products such as Mass Timber, Wood Fiber Insulation, locally produced biofuels, nano-cellulosic materials, and more.
- Promote and provide financial support to sustainable agricultural practices and in-state food systems, including reducing food waste. This includes a goal for 20% of institutional food purchases to be sourced from Maine-grown food by 2025.
- Support for Maine's fishing and aquaculture businesses as they transition activities to meet the changing ocean ecosystem

[10] https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/DECD_120919_sm.pdf

- Investment and support for clean energy innovation, climate-ready infrastructure, and more, correspond strongly with MTI's Environmental Technology sector.

TARGETED SECTORS THROUGHOUT MAINE'S ECONOMY

Existing target sectors and definitions

Many organizations and efforts throughout Maine have targeted sectors. The following section compares MTI's seven targeted technology sectors to the targeted sectors being used by other organizations and initiatives throughout the state to identify gaps within the innovation ecosystem.

Multi-Sector Initiatives

Maine Department of Economic and Community Development (DECD): Maine Economic Development Strategy 2020-2029

In 2019 DECD produced *Maine Economic Development Strategy 2020-2029: A focus on Talent and Innovation*. The report outlines Maine's challenges, opportunities, goals, and strategies for economic growth during the next 10 years. As part of the strategy, DECD identified Food/Marine, Forest Products, Technical Services, and Making/Manufacturing as "theme areas" that align with the State's industrial assets, are supported by growing global demand, and have the potential for job creation. Overall, the report highlights seven strategies to support economic growth in the state:

1. Growing local talent
2. Attracting new talent
3. Promoting innovation in Maine's four theme areas
    i. Food/Marine
    ii. Forest Products
    iii. Technical Services
    iv. Making and Manufacturing
4. Building Connections
5. Providing Supporting Infrastructure
6. Maintaining Stable and Predictable Business Rules
7. Promote Hubs of Excellence

To read the complete Economic Development Strategy see: https://www.maine.gov/decd/sites/maine.gov.decd/files/inline-files/DECD_120919_sm.pdf

Department of Economic and Community Development (DECD)-Domestic Trade Pilot Program

The Domestic Trade Pilot Program was initiated by Maine DECD. Funded through 2021's Maine Jobs and Recovery Plan, this pilot program is designed to assist pandemic-affected businesses by helping to increase their national sales. After analyzing the macroeconomic conditions, assessing COVID-19 impacts, and aggregating industry data from studies conducted by Camoin Associates', the Domestic Trade Pilot Program identified 11 target industries to support:

1. Agriculture: Food and Beverage
2. Clean Energy
3. Construction
4. Forestry
5. Information Technology
6. Life Sciences
7. Logistics-Transportation and Warehousing
8. Manufacturing and Industry
9. Seafood and Aquaculture
10. Outdoor Recreation
11. Retail: Purveyors of goods of all types

Businesses that fall within these target industries are eligible to apply for domestic trade grants and to

receive other state-sponsored resources. For more on the Domestic Trade Pilot Program see: https://www.maine.gov/decd/domestic-trade

FocusMaine

FocusMaine is an economic organization that works to create quality jobs in Maine by investing in three of the state's globally competitive and high-potential fields: (1) agriculture, (2) aquaculture, and (3) biopharmaceuticals. The organization supports business growth by developing programs and identifying the workforce skills "needed to accelerate the growth of Maine's food economy and bioeconomy."[11] According to their 2022 Annual Report, FocusMaine and its partners:

- Supported the creation of more than 215 jobs in the food economy and bioeconomy
- Provided technical assistance and programs to 50 food and 17 life sciences companies
- Secured over $11.5 million in new funding
- Enrolled 367 interns, co-ops, and apprentices in the Maine Career Catalyst program

FocusMaine works with nonprofits and private sector leaders to deliver training and implement programs. To learn more about FocusMaine see A catalyst to grow select signature industries (focusmaine.org)

Maine Center for Entrepreneurs (MCE)

MCE was founded in 1997 and provides training, mentoring, and networking opportunities for entrepreneurs across the State of Maine. Currently, MCE has a network of more than 250 mentors and provides hands-on training, tools, and connections to entrepreneurs. Additionally, MCE offers a variety of sector-related, targeted programs and services to accelerate business growth, including:

1. FoodTech Maine Program-Supports companies that use technology, innovation, and/or science to improve the traditional food, agriculture, and aquaculture ecosystem.
2. Bio Startup Program- Equips entrepreneurs in Maine's biotech, digital health, life sciences, and medical device sectors with tools and resources to expedite business growth.
3. Food Accelerator Programs-
   i. **Cultivator** is designed to help established food, beverage, and agriculture companies "scale up" their businesses
   ii. **Market Share** helps existing companies expand into new markets

For more on MCE, see About MCE - Maine Center for Entrepreneurs (mced.biz)

Individual Sector Initiatives

In addition to the multi-sector initiatives discussed above, Maine has multiple industry-specific initiatives that use a target sector approach to support growth and development in their industry of interest.

Bioscience Association of Maine (BioME)

BioME is a trade organization that promotes the growth and support of the life science industry. The association aims to advance economic growth within Maine through its involvement in life sciences advocacy, education, economic development, workforce development, and by attracting out-of-state business. In their 2022 *State of the Industry Report*, BioME identified 29 industries that make up Maine's life sciences industry. All 29 industries are related to one of the following:

- Life Sciences
- Manufacturing
- Health Care and Social Assistance
- Wholesale trade
- Professional, Scientific, and Technical Services

For more on BioME follow this link: https://biomaine.org/

Seafood Economic Accelerator for Maine (SEAMaine)

SEAMaine is an industry-led initiative designed to support Maine's seafood-related businesses. Funded by the U.S. Department of Commerce Economic Development Administration (EDA), with match funding from MTI and FocusMaine, SEAMaine is

[11] FocusMaine-Annual-Report-2022-7.pdf

focused on market and workforce development, and greater resiliency in Maine's seafood economy. SEAMaine supports innovative businesses related to

- Commercial Fishing
- Aquaculture
- Seafood Economy

For more information on SEAMaine see: https://www.seamaine.org/

Maine Aquaculture Innovation Center (MAIC)

MAIC was established in 1988 to promote sustainable aquaculture opportunities in Maine. It sponsors and facilitates R&D projects, invests in aquaculture capacity, increases public awareness related to sustainable aquaculture practices, and supports strategic alliances for research, technology transfer, and commercialization. MAIC aims to foster innovation, sustainability, and growth within Maine's aquaculture sector and improve the State's economic and environmental well-being. More information on MAIC can be found at https://www.maineaquaculture.org/

Maine Aquaculture Association (MAA)

MAA represents the Maine aquaculture industry at the state and federal level. MAA supports aquaculture including fin fish, shellfish, and sea vegetables. Since 1978, MAA has supported sustainable business practices, promoting aquaculture's benefits in local food systems, and preserving Maine's working waterfront heritage. The industry's economic impact has almost tripled since 2007, providing jobs, food security, and diversification opportunities. To learn more about MAA see https://maineaqua.org/

Maine Marine Trades Association (MMTA)

MMTA was established in 1966 to promote growth and cooperation in the marine industry in Maine. The association focuses on education, best practices, and environmental protection related to the marine industry. MMTA provides programs and services, including workplace safety and environmental compliance training. It also advocates for the industry with regulatory agencies and the legislature. By working with the government, MMTA believes it can provide positive outcomes for its members, employees, customers, and communities.

Forest Opportunity Roadmap / Maine (FOR/Maine)

Created with support from the EDA and US Dept. of Agriculture, the FOR/Maine initiative is a coordinated effort to drive growth and innovation in the forest products industry. The initiative is a collaboration between industries, communities, governments, academics, and non-profits. FOR/Maine supports growth in the sector by identifying new markets and technological opportunities with the goal of revitalizing the forest economy in Maine. Additionally, FOR/Maine is supporting growth in the forest products sector through workforce development and retention strategies. The initiative has identified several subsectors that are essential to the success of Maine's forest economy. These subsectors include:

- Harvesting and logging
- Wood products manufacturing
- Pulp and paper manufacturing
- Transportation
- Other small or emerging industries
    - Nanocellulose
    - Bioeconomy

To learn more about FOR/Maine see: https://formaine.org/

Maine Forest Products Council

Founded in 1961, MFPC represents and advocates for the diverse interests within Maine's forest products industry. The MFPC represents a variety of stakeholders, including landowners, loggers, paper mills, tree farmers, foresters, and more. The organization advocates for the sustainable use of Maine's forest resources and represents their members' interests at the State and Federal levels. For more about MFPC see https://maineforest.org/about/

Environmental & Energy Technology Council of Maine (E2TECH)

E2Tech is a member-based organization focused on increasing clean energy innovation in Maine. Since 2002, E2Tech has managed research projects for federal and state agencies and supported

technological developments at more than 200 US and Maine-based companies. As an environmentally focused business hub, E2Tech aims to expand Maine's economy through its support of:

- Renewable energy
- Clean technology

E2Tech supports its members by providing educational forums, partnership opportunities and mentoring. For more on E2Tech see: https://www.e2tech.org/

Manufacturers Association of Maine (MAME)

MAME is a non-profit organization with more than 200 members. The organization supports all types of manufacturing in Maine by "offering members value-added services such as legislative advocacy, scholarship programs, career connections for students and job seekers and networking opportunities and events".[12] According to MAME, Maine plays a vital role in military and defense, aerospace, metal, paper, marine/boat building, semi-conductor, wood, textile, aquaculture, biotech, medical device, electronics, wireless communications, plastics, composites and bio-plastics, and food and beverage manufacturing. More information on MAME is available by following the link: https://mainemfg.com/about/

Maine Composites Alliance (MCA)

MCA is a non-profit organization of composite businesses in Maine. The organization aims to promote the state's composite industry on the national and international stage. Through their work, MCA provides opportunities for commercial ventures, product development, education, and access to world-class testing laboratories. More information about MCA is available at https://www.mainecompositesalliance.org/about/

[NOTE: there are likely other initiatives that are involved in supporting and serving Maine's economy, however in this report, we focus on those that are most directly tied to MTI's targeted sectors]

[12] https://mainemfg.com/business-services/

TARGETED SECTOR INITIATIVES THAT ALIGN WITH MTI'S TARGET SECTORS

Organization	Sector Name						
Maine Technology Institute	- Biotechnology	- Environmental Technologies	- Forest Products & Agriculture	- Information Technology	- Marine Technology & Aquaculture	- Composite & Advanced Materials	- Precision Manufacturing
Maine Department of Economic and Community Development - 10-Year State Plan			- Food/Marine - Forest Products		- Food/Marine		- Making & Manufacturing
FocusMaine	- Biopharmaceutical		-Agriculture		-Aquaculture		
Maine Center for Entrepreneurs [1]	- Bio Startup Program						
Maine Department of Economic and Community Development - Domestic Trade	- Life Sciences	- Clean Energy	- Agriculture: Food & Beverage - Forestry	- Information Technology	- Seafood & Aquaculture		- Manufacturing & Industry
Bioscience Association of Maine[2]	- Life Sciences						-Manufacturing
Seafood Economic Accelerator for					- Commercial Fishing - Aquaculture - Seafood Economy		
Forest Opportunity Roadmap / Maine[3]	- Nanocellulose - Bioeconomy (small/emerging industries)					- Harvesting & Logging	- Pulp & Paper Manufacturing
Environmental & Energy Technology Council of Maine		- Renewable Energy - Clean Technology					
Manufacturers Association of Maine							- Manufacturing
Maine Marine Trades Association					- Marine Trade		
Maine Aquaculture Innovation Center					- Aquaculture		
Maine Aquaculture Association					- Aquaculture		
Maine Forest Products Council[4]						- Logging - Paper Mills - Tree Farming - Forestry	
Maine Composites Alliance					- Marine		- Industrial Industries

NOTES: 1. MCE supports business across all sectors but has specific programs related to Biotechnology and Agriculture 2. BioMaine works across multiple industries to promote growth specifically related to Biosciences. 3. FOR/Maine works across multiple industries to promote growth specifically in the forest products sector. 4. MFPC works across multiple industries to promote growth specifically related to the forest products sector.

OTHER TARGET SECTORS SUPPORTED BY OUTSIDE INITIATIVES

Organization	Professional Services	Construction	Transportation Warehousing & Logistics	Outdoor Recreation & Tourism	Retail & Trade	Medical & Health Services	Automotive & Aerospace	Emerging Sector: Food Technology	Emerging Sector: Finance & Insurance Technology
	Sector Name								
Maine Department of Economic and Community Development - 10-Year State Plan	- Technical Services								
Maine Center for Entrepreneurs[1]								- FoodTech Maine - Food Accelerator Programs	
Maine Department of Economic and Community Development - Domestic Trade		- Construction	-Transportation & Warehousing	- Outdoor Recreation	- Retail: Purveyors of Goods of all Types				
Bioscience Association of Maine [2]	- Professional Scientific & Technical Services				- Wholesale Trade	-Health Care & Social Assistance			
Forest Opportunity Roadmap / Maine[3]			-Transportation						
Maine Forest Products Council[4]	- Banks - Lawyers - Insurance Providers		- Trucking						
Maine Composites Alliance		- Architecture					- Automotive - Aerospace		

NOTES: 1. MCE supports business across all sectors but has specific programs related to Biotechnology and Agriculture 2. BioMaine works across multiple industries to promote growth specifically related to Biosciences. 3. FOR/Maine works across multiple industries to promote growth specifically in the forest products sector. 4. MFPC works across multiple industries to promote growth specifically related to the forest products sector.

EXISTING INNOVATION ACTIVITY IN MAINE

The following section will examine the existing innovation activity in Maine through venture capital funding and patents in Maine. This will include activity for all sectors in the state to identify whether there are gaps in MTI's existing technology sectors.

Venture Capital Funding

In the most recent five years from 2018-2023 through November 15, 94 venture capital transactions have funded just under $330 million in capital to Maine companies. 47 organizations in Maine received funding of over $1 million in funding. The table to the right details the top industries associated with companies receiving venture capital in Maine in the last five years. Many of the organizations receiving venture capital funding are also MTI-funded businesses.

Much of the venture capital funding that took place in the last five years occurred within industries that are closely related to Maine's technology sectors. Health Care, Veterinary, Renewable Energy, Biotechnology, and Geospatial together rank as the top five industries associated with VC funding, which relate to the Biotechnology, Environmental Technology, and Information Technology Sectors. Other intersectional industries such as Biomass Energy, AgTech, Sustainable Building Material, and Food & Beverage are present among the most VC-funded industries in Maine since 2018.

Analysis of venture capital funding also indicates several key gaps that are not directly served by MTI's current technology sectors. While these

Top 30 Industries Associated with Companies Receiving Venture Capital in Maine, 2018-2023

Industry	Total VC Funding	Number of Deals	Related to MTI Sectors
Health Care	$40,593,515	9	✔
Veterinary	$40,000,000	1	✔
Renewable Energy	$29,423,264	4	✔
Biotechnology	$25,042,173	4	✔
Geospatial	$20,600,000	4	✔
Hospitality	$17,500,000	1	
FinTech	$16,095,000	6	
Food and Beverage	$13,179,045	12	✔
Real Estate	$11,458,000	1	
Information Technology	$9,410,705	3	✔
AgTech	$9,365,003	4	✔
Life Science	$8,977,500	2	✔
Environmental Consulting	$7,143,362	1	✔
Power Generation	$6,656,000	2	✔
Outdoor Recreation	$6,580,000	3	
Industrial Equipment	$5,999,996	1	✔
Cyber Security	$5,350,000	2	✔
Biomass Energy	$5,158,317	1	✔
Seaweed/Kelp	$5,136,183	2	✔
Aquaculture	$4,708,750	2	✔
Pharmacuetical Research	$4,000,000	1	✔
Child Care	$3,932,500	3	
Retail	$3,847,000	3	
Consulting	$3,780,000	1	
Cannabis	$3,563,427	2	
InsurTech	$3,500,000	1	
Sustainable Building Material	$3,300,000	2	✔
EdTech	$3,191,869	3	
Analytics	$3,000,000	2	✔
Software	$2,100,000	1	✔

Source: Crunchbase, Camoin Associates

technologies may be able to fit within the seven tech sectors, they do not cleanly or directly fit within the named technologies. These industries include:

- Hospitality
- FinTech
- Real Estate
- Outdoor Recreation
- Childcare
- Retail
- Consulting
- Cannabis
- InsurTech
- EdTech

While these industries represent gaps, they may not all necessarily represent areas into which MTI is recommended to expand scope.

Patents

From 2016-2020, 389 patents were awarded to owners in Maine. 35.6% of all patents were awarded to businesses that fall clearly within the seven technology sectors, while 64.4% of patents were awarded to businesses that fall either outside the seven technology sectors or are loosely connected, but not directly related.

The following tables detail total patent awards during the five years from 2016-2020.

Patents Awarded to Maine Owners - Categories Related to MTI Sectors (2016-2020)

Category	Patents	Share of Total
Biotechnology	24	6.2%
Computer Technology	22	5.7%
Medical Technology	22	5.6%
Electrical Machinery, Apparatus, Energy	14	3.7%
Analysis of Biological Materials	13	3.4%
IT Methods for Management	11	2.9%
Surface Technology, Coating	9	2.4%
Pharmaceuticals	8	2.1%
Semiconductors	6	1.5%
Basic Materials Chemistry	6	1.4%
Food Chemistry	1	0.3%
Materials, Metallurgy	1	0.3%
Microstrucural Technology and Nanotechnology	0	0.1%
Environmental Technology	0	0.0%
Total, Related to MTI Sectors	**138**	**35.6%**

Source: National Center for Science and Engineering Statistics, USPTO; Camoin Associates

Patents Awarded to Maine Owners - Categories Related to MTI Sectors (2016-2020)

Category	Patents	Share of Total
Other Special Machines	28	7.3%
Transport	27	7.0%
Civil Engineering	22	5.8%
Measurement	20	5.3%
Engines, Pumps, Turbines	19	4.8%
Other Consumer Goods	17	4.4%
Furniture, Games	16	4.0%
Mechanical Elements	12	3.2%
Chemical Engineering	12	3.0%
Control	11	2.8%
Digital Communications	10	2.7%
Handling	10	2.6%
Textile and Paper Machines	10	2.6%
Thermal Processes and Apparatus	9	2.2%
Machine Tools	8	1.9%
Audio-Visual Technology	5	1.4%
Organic Fine Chemistry	5	1.2%
Macromolecular Chemistry, Polymers	3	0.8%
Optics	3	0.7%
Telecommunications	2	0.4%
Basic Communication Processes	2	0.4%
Unassigned Under WIPO Classification	0	0.0%
Total	**250**	**64.4%**

Source: National Center for Science and Engineering Statistics, USPTO; Camoin Associates

Patent activity suggests that there may be areas of innovation within Maine that are not captured within the seven technology sectors. However, while these patent categories may not relate specifically to the named technology sectors, the innovation that they capture may otherwise be related. For example, the "Other Special Machines" category, which accounted for 7.3% of all patents from 2016-2020, may be able to relate to various technology sectors, such as Precision Manufacturing, Forest Products, Environmental Technologies, or Composites/Advanced Materials. Individual activities within Transport; Civil Engineering; Measurement; and Engines, Pumps, and Turbines may also similarly relate more loosely to the seven technology sectors. Therefore, this patent activity may not necessarily represent gaps.

GAPS IN MTI SECTORS

Taking past literature, current organizations and initiatives, and existing innovation activity into consideration helps to inform whether there are emerging technologies that are not presently included within the seven technology sectors and whether they present opportunities to expand the targeted sectors.

Gaps and Overlap with Other Related Organizations

The above analysis of 14 organizations and initiatives includes insights about both multi-sector focused initiatives as well as individual-sector initiatives. Looking at MTI's sectors, all target sectors receive additional representation and support from at least one other organization, while the most overlap in the innovation and economic development ecosystem occurs in Biotechnology and Marine Technology/Aquaculture. Conversely, IT and Environmental Technology have the least overlap with existing organizations.

In addition to supporting the seven technology sectors, other organizations within the innovation and economic development ecosystem have specific focus areas outside of the seven technology sectors. These other areas include a diverse range of sectors covering both service-providing and goods-producing areas of the economy. Of these additional focus areas, several stand out as relating to an emerging technology or a gap that may not be otherwise easily covered in the seven sectors:

- Professional Services
- Outdoor Recreation
- FoodTech
- Finance and Insurance Technology

Gaps and Overlap with Other Existing Innovation Activity

Data on existing innovation activity demonstrates that the bulk of venture capital and patent activity occurs within technologies and sectors related to the seven targeted technology sectors. However, the following categories are identified as opportunity categories that may not be otherwise easily covered in the seven sectors:

- FinTech
- Outdoor Recreation
- Retail
- InsurTech

Gaps and Overlap with State Innovation Literature

Past strategies, plans, and research reports highlight the critical innovation ecosystem and advancements made over the past 2+ decades. Several key connecting themes are present within this collection of reports as they relate to the technology sectors.

- Technology relating to professional and technical services is mentioned across multiple reports as an emerging opportunity and are not included in the existing seven technology sectors. For example, the State's 10-year economic plan notes Technical Services as a target area
- Overall, the cross-cutting technologies and intersections between the targeted tech sectors are of utmost importance, suggesting that the specific sectors themselves are less important than the way that they can be combined in innovative ways
- While somewhat related to Forestry and Agriculture as well as the Marine and Aquaculture technology sectors, the specific callout of Food Technology is noted as an emerging opportunity not explicitly covered in the seven tech sectors

CHALLENGES OF NAICS-BASED STRATEGY

In the US, businesses are categorized using the North American Industry Classification System (NAICS). The conceptually simple design of NAICS makes it easy to understand; however, the rigid framework is not capable of adjusting to accurately account for emerging industries or products that do not fit neatly into the existing categories. For example, NAICS does not currently have a code for biotechnology, artificial intelligence, robotics, or additive manufacturing. Instead, researchers who are interested in data relating to these new industries must explore several sources and make a series of judgment calls to measure their performance. While NAICS data is a crucial tool for understanding the base industrial capabilities of a region, many emerging trends will likely fall through the cracks if researchers do not supplement these data with other sources. Combining existing resources with emerging industries and developing the existing labor pool will allow Maine to remain agile and foster innovation.

Moreover, it is critical to note the distinction between a *technology sector* versus an *industry sector*. For example, the **Forest Products industry sector** relates to logging, wood processing, and the manufacturing of wood-based products. However, multiple **technology sectors related to forest products** could be identified: using AI for forest management might fall within the IT technology sector; new machine technology to automate manufacturing of wood products might fall within the Forest Products & Agriculture technology sector; new uses for wood nanocellulose in building materials might fall under the Composites and Advanced Materials technology sector. Similarly, developing new offshore wind capabilities could involve the combination of new composite materials, new technologies in wind turbines, new developments of precision sensors, information transmitters and advanced electronic systems—in other words, nearly all of the technology sectors could be relevant to an emerging industry. Emerging and scalable technologies overall face complexities relating to the distinction between industry sector and technology.

For reasons discussed in the paragraph above, NAICS-based industrial definitions are not the best fit for the structure of MTI. The current statutory definitions of the target technology sectors only provide sector names but do not define sector composition. **These broad definitions allow for more agile and future-focused investments made at the discretion of experts at MTI, rather than at the discretion of NAICS codes rooted in historical industry structures. As the legislature considers the future of the technology sectors, it should remain focused on open-ended, flexible, and future-proof definitions of technology.**

What We Heard

Camoin Associates facilitated four virtual focus groups with over 75 people in attendance and conducted a survey for additional public feedback that received over 21 responses.

Stakeholders provided the following input about the relevancy of current industries and emerging opportunities in Maine. The comments below are general in nature and are summarized into key findings.

Relevancy of Targeted Industries

- Some participants felt that the targeted industries were still relevant while others suggested that some sectors may have shifted in importance since 2000 and attributing projects to specific sectors can be challenging
- Having industry classifications might limit business applications because a business owner might not identify with the targeted industry and feel excluded from the investment opportunity
- Expand current target industries to be more inclusive. Examples we heard include:
    - Combine seven industries into four very broad sectors to emphasize tech clusters
    - Rename the Marine sector to "Blue Economy"
    - Rename Biotech to "health sciences" or "life sciences"
    - Aquaculture having its own sector
    - Broaden Precision Manufacturing to include advanced manufacturing, engineering, and development.
- Remove sectors all together to focus on impactful technologies across all industries

Emerging Opportunities & Trends

- There is a need for an "emerging technologies" sector to allow MTI's discretion for dynamic opportunities
- Business Process Innovation, Engineering, and Development is highlighted as crucial innovation areas for future growth
- Emerging opportunities identified include:
    - Climate Tech
    - Artificial Intelligence (AI)
    - LEAN technologies
    - Life Sciences
    - Advanced Materials
    - 3-D Printing
    - FoodTech
    - FinTech
    - Insurtech
    - MedTech
    - Outdoor Recreation
    - Tourism
    - Hospitality
- Prioritize investments in supporting the workforce, skill development, infrastructure, and housing

Key Findings

Relevancy | Overall, while there is general agreement on the relevance of the current industry sectors, there are diverse perspectives on refining definitions, adding or removing sectors, and ensuring MTI's ability to adapt to Maine's economic landscape over time.

Emerging Opportunities & Trends | Stakeholders identified several emerging sectors in Maine including FoodTech, Climate Tech, FinTech, MedTech, Insurtech, Outdoor Recreation, Professional Services, Tourism & Hospitality, and Retail. While these emerging sectors may or may not fall under the current industry sectors, stakeholders raised a potential idea that creates a new "catch-all" sector called "Emerging Technologies" to expand investment opportunities.

It quickly became apparent throughout stakeholder feedback that there is a need for flexibility, adaptability, strategic focus, and consideration of Maine's unique advantages.

KEY FINDINGS

Taking into consideration the research conducted, stakeholder engagement, and work completed thus far, our key findings are as follows:

1. Since the initiation of the targeted sectors, Maine's economy and industry sectors have changed dramatically. This is driven primarily by global changes in technology and innovation. For example, when this work was established, artificial intelligence and nano technology were concepts but had little to no applications. Additionally, the advancement of computing capacity and increased access have made technology ubiquitous across all of the sectors.
2. Based on the changes in the economy, defining and measuring sectors remains imperfect. It is important to note that *technology sectors* are different from *industry sectors*, and this is evident in Maine's body of work around these sectors.[13]
3. Current targeted sectors are still economically relevant in Maine's economy. They are represented and serviced by multiple organizations across the state including industry associations, research initiatives, workforce development, and more.
4. The sectors themselves are highly connected and experience crossover due to NAICS codes, necessary industry work, and skillsets. For example, there is Precision Manufacturing within Forest Products & Agriculture and there is IT within all of the industry sectors. Due to industry crossover, it is hard to measure and understand each sector in isolation.
5. The naming and description of industry sectors have not been prohibitive in economic development work to the community, specifically MTI. While MTI categorizes activity within the sectors, their criteria for awards is based on other factors including innovation, use of technology, and market and financial potentials.
6. The current target sectors are not prohibitive, meaning that new technologies relating to any given industry could reasonably be considered for funding by MTI under the current structure. For instance, the use of IT in sectors like retail, outdoor recreation, or healthcare services would be considered a potential viable candidate for funding. Furthermore, there are trends and topics that are not specifically named in the targeted sectors like outdoor recreation, tourism, and hospitality as well as FoodTech, MedTech, FinTech, InsurTech but were identified through the data collection and stakeholder engagement process. Ultimately, much of Maine's economy is grounded in climate and natural resources that influence all of the industry sectors.
7. Stakeholders were primarily concerned about the inclusivity of the current target sectors because they identified them as relevant but may not be broad enough to include emerging opportunities.
8. Stakeholders identified several emerging sectors in Maine and while these emerging sectors may or may not fall under the current industry sectors, stakeholders raised a potential idea that creates a new "catch-all" sector called "Emerging Technologies" to expand investment opportunities.

[13] Please see page 20 for detailed information on the distinction.

RECOMMENDATIONS

Moving forward, MTI and the Maine Legislature may consider the following options regarding the best way to nurture future growth and innovation in the state. Each observation has associated advantages and disadvantages that will impact investment opportunities. It is important to note that any changes to MTI's seven target sectors will affect not only MTI but also MEIF, and as a result, have cascading impacts on university-based R&D across the UMaine System.

1. Maintain the Status Quo | MTI will continue to support the current seven technology sectors as they are worded: Biotechnology, Composites & Advanced Materials, Environmental Technologies, Forest Products & Agriculture, Information Technology, Marine Technology & Aquaculture, and Precision Manufacturing. This approach continues the current system in place to fund businesses and innovative ideas without changing anything that MTI is currently doing.

Advantages

The current sectors have been used in the past 20 years and MTI has been able to provide funding to qualified applicants. For example, voter approved in 2017, the Maine Technology Asset Fund 2.0 allocated $45 million to support infrastructure, equipment, and technology upgrades in the seven target sectors. MTI oversaw the disbursement of these funds, choosing to invest in 18 new projects. It is estimated that these projects will generate more than 5,000 new jobs and have an economic impact of $1.4 billion. Under current guidelines, MTI is required to support innovation in the seven target technology sectors.

Through stakeholder meetings and a review of MTI's annual reports, Camoin Associates learned that the current broad sector definitions enable MTI's investment officers to "find a home" for almost any promising innovative idea/business regardless of that idea/businesses' traditional NAICS definition.

Disadvantages

The specific target sector names may mislead potential applicants and discourage innovative business owners from applying for funding if the owners do not think their idea or technology falls within the target sectors.

Naming the sectors overshadows the significance of innovation and technology that is at the cross section of industries.

Identifying and naming specific technology sectors assumes that the sectors that were relevant in the past will still be relevant in the future. Relying on this assumption may reduce MTI's ability to pivot and support unanticipated technological innovation in the future.

2. Adopt a Hybrid Approach | MTI will continue to support the seven technology sectors using the current broad definitions and add *Emerging Technologies* as the eighth target sector. This approach includes maintaining MTI's current funding criteria but might add additional evaluation guidelines for an Emerging Technologies sector.

Advantages

Adopting a hybrid approach maintains a working system that creates consistency while adding a new element for potential opportunities. This hybrid approach continues MTI's current work but provides additional adaptability over time. Technology and innovation is constantly evolving across all sectors and the advantage of a hybrid approach gives MTI flexibility to fund projects that meet MTI's funding criteria but are outside of the current seven sectors.

The inclusion of an Emerging Technologies sector may encourage business owners to apply for funding when previously they may not have believed their business or idea fit under the seven original sectors.

Disadvantages

While all of the sectors have broad definitions, an Emerging Technologies sector would be even broader and less connected to traditional NAICS based industries. Funding decisions would need to strictly follow an evaluation framework to provide investment officers guidance on how to fund projects outside of the current sectors. If the hybrid approach is adopted, MTI should be cautious about the number of projects it supports in the new sector to avoid losing focus on the other seven sectors.

Furthermore, the hybrid approach means that MTI will still be operating under the assumption that the current sectors that were relevant in the past will still be relevant in the future even if there is a new sector, Emerging Technologies. Finally, the addition of an eighth target sector will need to be approved by the State Legislature which can have challenges during the decision-making process.

Naming the sectors overshadows the significance of innovation and technology that is at the cross section of industries.

3. Discontinue the Target Sectors Approach | MTI will focus solely on supporting businesses and ideas that are innovative and have a technological component. This approach includes creating a new evaluation criteria framework for funding decision making.

Advantages

Discontinuing the target sector approach is the most flexible approach to supporting innovation in Maine. Under this approach, MTI will be able to offer support to innovative ideas and businesses without worrying about the project fitting neatly into a specific target sector. This allows for adaptability and potential growth in all industry sectors that are seeking financial support for innovation and technological advances. Moreover, by eliminating the target sectors, MTI will also eliminate the risk of misleading or discouraging deserving business owners who are seeking support.

Disadvantages

If adopting this approach, MTI will need to develop new evaluation guidelines and protocols for assessing funding applications. MTI and the State will also need to create new tools and methods to measure the impacts of MTI's efforts which requires building additional capacity and resources. Without any targeted sector guidance, it potentially becomes more difficult to disseminate and align investments that are consistent with Maine's economic base.

ATTACHMENT A: DATA SOURCES

fDi Markets is the most comprehensive online database of cross-border greenfield investments available, covering all countries and sectors worldwide. The fDi Markets database tracks capital expenditures and jobs at the sector and project level for country-to-country foreign direct investment projects as well as domestic state-to-state investment projects. Click to learn more.

Crunchbase offers a best-in-class live database on innovative companies across industries, powered by contributors, partners, and in-house data experts. With a focus on tech companies and startups, the platform aggregates information on investment and funding, founding members and leadership, mergers and acquisitions, news, and industry trends. Designed as both a market research and prospecting solution, Crunchbase offers the ability to narrow down companies matching criteria such as headquarter location, investment stage, or industry, while automatically offering recommendations based on these criteria. Click to learn more.

ABOUT CAMOIN ASSOCIATES

As the nation's only full-service economic development and lead generation consulting firm, Camoin Associates empowers communities through human connection backed by robust analytics.

Since 1999, Camoin Associates has helped local and state governments, economic development organizations, nonprofit organizations, and private businesses across the country generate economic results marked by resiliency and prosperity.

To learn more about our experience and projects in all of our service lines, please visit our website at www.camoinassociates.com. You can also find us on LinkedIn, Facebook, and YouTube.

The Project Team

Jim Damicis
Principal

Tori McNiff
Project Manager

Angela Hallowell
Analyst

Dawn Otterby
Analyst

Service Lines


Strategic and Organizational Planning


Real Estate Development Services

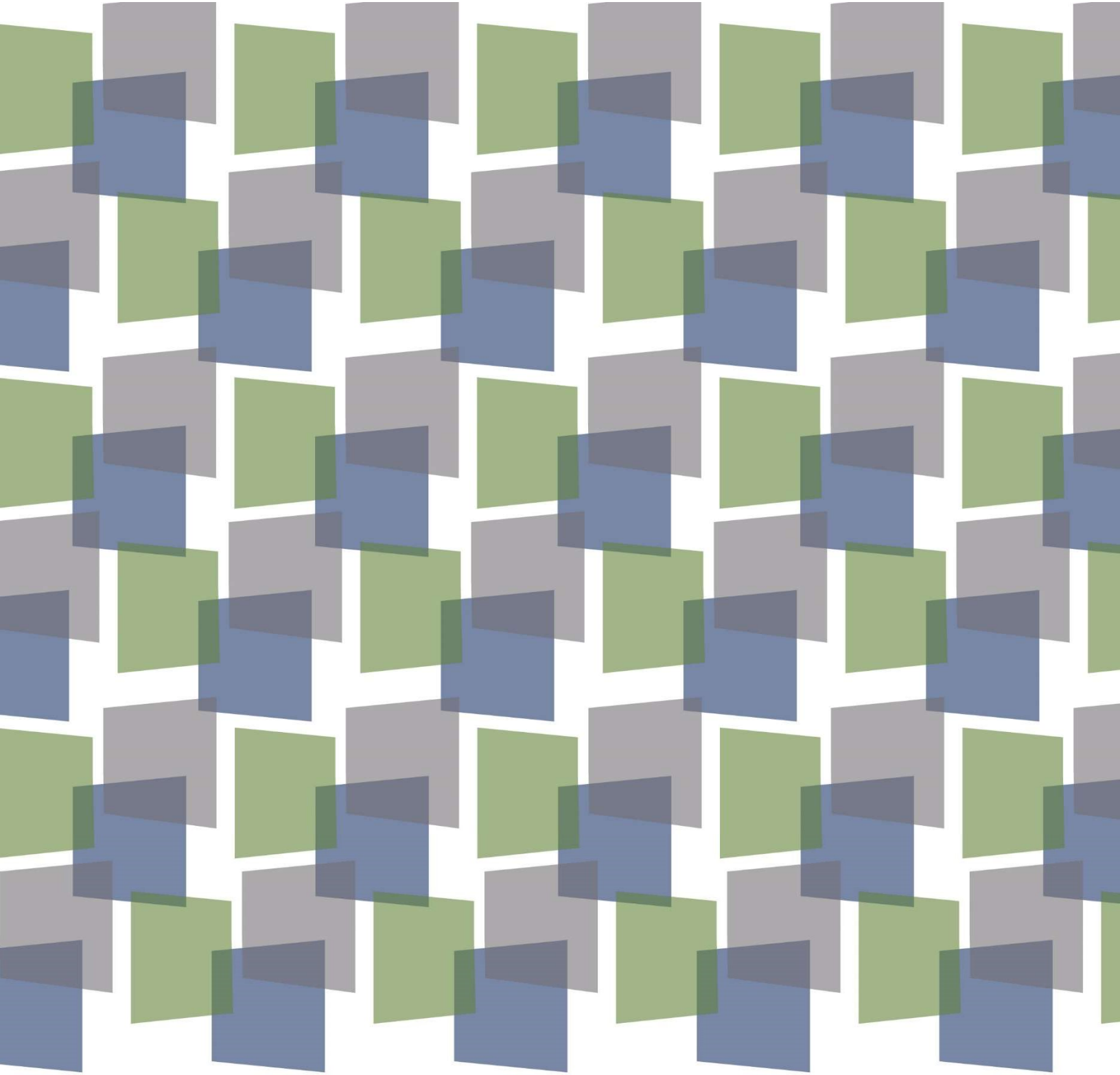

Impact Analysis


Lead Generation and Relationships


Industry and Workforce Analytics


Entrepreneurship and Innovation


Business Attraction and Retention



camoin associates

www.camoinassociates.com