The New England AI innovation ecosystem

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THE NEW ENGLAND AI INNOVATION ECOSYSTEM

Trends and Opportunities, Now and Into the Future

ABSTRACT

The New England ecosystem is home to world-renowned universities, avant-garde start-ups, and seasoned industry that use AI as the next technological tool, and where it ventures, others do well to pay attention. This report explores current and future AI developments within New England through the lens of the MIT Innovation Ecosystem Stakeholder Model

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Executive Summary

That Artificial Intelligence (AI) is on the rise is no surprise. Yet in this current moment, where are we, and what does the future hold? The New England ecosystem is home to world-renowned universities, avant-garde start-ups, and seasoned industry that use AI as the next technological tool, and where it ventures, others do well to pay attention. This report explores current and future AI developments within New England through the lens of the MIT Innovation Ecosystem Stakeholder Model. Applying the model, the Netherlands Innovation Network team in Boston conducted interviews with the ecosystem's top private and public sector stakeholders, including research institutions, start-ups, corporates, investors, and government actors to see what their vision on the current status and future predictions for the ecosystem are.

What did we find? First and foremost, as a region home to a historically strong research community, New England's universities have developed well-defined expertise and considerable budgets and talent dedicated to AI. On global trend, we also observe rapidly increasing, widespread application of AI across many sectors of industry. In combination with the local research powerhouses and their exceptional talent pools, this makes New England an interesting place for innovative companies looking to land and grow. In terms of application area, New England is home to a globally leading Life Sciences & Health (LSH) sector, and this was a point of emphasis among the stakeholders we interviewed. New England also leads in other innovation sectors where AI is prevalent, such as cleantech and advanced manufacturing, to name a few.

We also found that the region is unique in growing innovation ecosystems that promote strong flow and collaboration between diverse stakeholders and sectors. Quasi-governmental organizations, such as Mass Robotics and Mass Life Sciences, are tasked with accelerating start-ups and driving the State of Massachusetts' innovation economy, resulting in strengthening of the entire ecosystem. The stakeholders within the ecosystem hold a close connectivity to each other, creating space for potential cross-sectoral collaborations. It's a robust environment for AI to flow freely between sectors, and investors in the region have seconded this observation. In a future full of AI, the responsible use of the tool remains a point of importance that receives growing attention in all sectors, but especially in New England's research community. Finally, any start-up looking to this region can find a positive environment for launching and scaling.

Introduction

Located in the US Northeast, New England is home to a major innovation ecosystem radiating from the Greater Boston area. The region is often recognized first and foremost as home to leading global universities, including the Massachusetts Institute of Technology (MIT) and Harvard University, both in Cambridge. In addition, the presence of large corporations such as Philips, Google, General Electric, Moderna, and Amazon form an overall interesting corporate climate that is met with ambitious local governmental leadership. There is also a move to decentralize innovation, without diluting the unique benefits that arise from the small, tight environment in which the Greater Boston innovation ecosystem thrives. This is reflected in, for example, Northeastern University's launch of the Roux Institute for Advanced Technology in Portland, Maine.

This combination of stakeholders creates a unique ecosystem, where AI as an enabling technology has an ascending and versatile role. As the expectation is that AI is shortly going to be everywhere and present in everything (some would say it already is), a number of the takeaways in this report can be perceived as insights also true for or applicable to a number of other innovation ecosystems around the world. This report covers a lot of bases, such as the emerging growth of AI within Life Sciences & Health (LSH), policy directions, and upcoming fields of particular interest to risk capital, including sustainable built environment, security, and industrial automation.

The Netherlands Innovation Network team in Boston has been following developments surrounding AI, as it is also a major strength of the Netherlands' innovation economy and presents opportunities for connection between the two ecosystems—hence the impetus for this report. The growing presence and horizontal application of technology in many sectors makes the idea of a future world without AI unthinkable. To get a better understanding of which direction these rapid developments are evolving into, we provide a data-driven, objective analysis. This report seeks to examine and provide an overview on what unique strengths and emerging developments define the New England AI ecosystem.

In achieving these objectives, this report is comprised of three components:
- Current snapshot of the ecosystem
- Future predictions
- Identification of notable developments (trends, gaps, and opportunities)

This report aims to provide relevant insight and observations for Dutch companies considering expansion into the US Northeast, universities and research institutes, and governmental institutions, such as the Netherlands Enterprise Agency and the Netherlands' Ministry of Economic Affairs and Climate Policy.

Approach

This report is based on both primary and secondary research, including stakeholder interviews, review of existing reports and articles, and analysis of start-ups in the region. To provide a balanced and multidimensional perspective, we chose MIT's Stakeholder Framework for Building & Accelerating Innovation Ecosystems as the guiding structure by which our interviewees were selected. The MIT Framework is a theory based on historical analysis of global successful ecosystems and identifies five essential stakeholders and their interactions as forming the foundation of successful innovation-driven ecosystems.[1] We chose this framework due both to MIT's leadership role in the very ecosystem we are analyzing and the model's global recognition and application. Ultimately, we conducted interviews with 11 leading actors from each of the five different stakeholder groups identified in the figure below to build a complete view of the ecosystem.

MIT's five stakeholders in an Innovation Ecosystem (2019)

The following organizations were consulted (find an overview of interviewees in Annex I):

Cambridge Innovation Partners, City of Somerville, Deep1, Hyperplane VC, Harvard University's Berkman Klein Center for Internet & Society, Harvard University's John F. Kennedy School of Government, Massachusetts Institute of Technology's Abdul Latif Jameel Clinic for Machine Learning in Health, Massachusetts Institute of Technology's Computer Science and Artificial Intelligence Laboratory, Northeastern University's Khoury College of Computer Sciences, Philips, The Routing Company.

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[1] Dr. P. Budden & Prof. F. Murray, MIT's Stakeholder Framework for Building & Accelerating Innovation Ecosystems, MIT Lab for Innovation Science Policy (April 2019), pp. 5 & 6.

Where are we now?

Academia as the cornerstone

New England's 208 universities and colleges[2], amongst which are well-known and high-ranking schools such as MIT, Harvard, and Yale University, provide historically strong research infrastructure within the region, each from a distinctive point of view and expertise. To choose one university and zoom in on the ways in which it demonstrates the prevalence and acceleration of AI, we can first look at MIT.

Since its founding, MIT has focused on technology, engineering, and innovation. It launched the Schwarzman College of Computing in 2019, which loosely unifies its AI-related research and education initiatives across the university, while still allowing space for broad research and experimental moonshot projects on AI through entities such as the Computer Science and Artificial Intelligence Laboratory (CSAIL). The launch of the Schwarzman College also reflects MIT's positioning in close connection to industry and the broad, cross-cutting, and interdisciplinary nature of AI. The inherent cross-cutting nature of AI and machine learning is exemplified in entities pursuing thematic work, such as the MIT Media Lab, which promotes interdisciplinary research on a more horizontal basis via projects like Responsible AI for Social Empowerment and Education (RAISE).

MIT also puts focus on sector-specific developments through initiatives such as the Jameel Clinic. The Jameel Clinic at MIT (J-Clinic) falls under the larger umbrella of the Schwarzman College of Computing. In partnership with the international organization Community Jameel, it drives development of healthcare through AI. The J-Clinic has the intention to explore whether there are future collaborations or partnerships to make with Dutch ecosystems in this field.

Furthermore, while Harvard University allies with MIT and other actors through joint research initiatives, as a university, it contributes, in particular, to ethical AI policy and principles of business practice, as well as research, through entities such as the Berkman Klein Center for Internet and Society. On themes such as Facial Recognition Technology, state regulation, and national AI strategies, the Berkman Klein Center advises and partners up with local and national governments, as well as supranational actors, such as the OECD.

In addition to Harvard and MIT, and as a rising AI star with an eminently practical approach, Northeastern University is an example of university with an interdisciplinary focus that finds connection in and across sectors, including the intersection of AI with health and with ethics. This allows for a forward-looking attitude to new areas. In addition, Northeastern University focuses on the application of AI and the workforce of the future. This emphasis is visible in the various labs Northeastern is part of, in addition to the launch of the $100 million Roux Institute

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[2] Riley Sullivan, College Towns and COVID-19: The Impact on New England, New England Public Policy Center Regional Briefs (June, 2020). https://www.bostonfed.org/publications/new-england-public-policy-center-regional-briefs/2020/college-towns-and-covid-19-the-impact-on-new-england.aspx

in Portland, Maine. The Roux Institute aligns its curricula, student recruitment, and research with employers. The move towards the northern part of New England, along with other innovation initiatives, is indicative of a trend to decentralize and grow AI hubs in the region. The cooperative education system that Northeastern exercises gives students the opportunity to gain practical working experience in industry during the academic year.

Zooming back out to the whole research community, New England's leading universities in AI all focus on its application through different angles, varying from policy, technical, and workforce of the future. By doing so, they form a complementary whole and strengthen the ecosystem from a multitude of ways instead of yielding an ecosystem that excels in one area solely.

The major advantage of this region's particularly dense, high-performing, and deeply interconnected academic network is the attraction of world-class students and researchers, which leads to a large number of highly educated professionals within the area. Abi Barrow, consultant within the greater Boston area, states that this a major reason companies of all sizes are settling in the region. Although it is often difficult for companies to hold on to talent in the long run, the presence of these universities will continue to be a source of top upcoming young professionals.

Bridge from academia to business

Building on the theme of talent, universities can form a bridge to industry also via start-ups that spin out of their research labs, launched by students and professors. Mid-size companies may find incentives to collaborate with university research labs as a way of becoming more visible within the ecosystem. For them, value can also be found in IP licenses and affiliation with an institution that has a large network and considerable resources—from talent to hardware—at its disposal. Corporations use the research sphere to outsource innovation and research projects. Outsourcing makes it possible for corporations, which are often less nimble or flexible, to continue focusing on their core business, while new ideas are explored by external partners. Corporates might also work with universities and other knowledge institutions on innovation in order to advance the field and, in doing so, provide an opportunity for their talent to grow through collaboration in an external lab.

Minnan Xu, Department Head of Connected Care and Personal Health at Phillips, explains there are a wide variety of models in collaborating with other actors, such as hospitals and universities. Activities can vary from funding early-stage clinicians at research hospitals on a small scale to see how AI and data can help their work, to exploring co-creation models with hospitals to take ideas from the operating table or from administration records to the next level of development. Additionally, three-way collaboration between hospitals, academia, and industry leverages the clinical, scientific, and engineering expertise of each institution.

Although collaboration between universities and industry can be beneficial on all levels, Luis Ruben Soenksen, Venture Builder in AI and Healthcare at the J-Clinic, holds that academic

institutions will consistently steer toward collaborative projects that find alignment with their core mission. This oftentimes means that possibility for an academic publication remains a central ambition to the university when entering into new collaborations with the private sector. Even as universities value entrepreneurship, partnering up for commercial reasons remains of secondary importance.

Connectivity

One of the unique selling points of the New England ecosystem is the sheer density and physical proximity of all the actors within the area. Proximity creates even more opportunities for crossovers. Byron Wallace, professor at Northeastern University, observes this at the intersection of machine learning and health. Xu expresses that a strong reason for moving Philips' research activities to the Greater Boston area has been the proximity to academic excellence that allows for new talent recruitment and information flow, in addition to the area containing a large number of hospitals. It's a simple matter for Philips' scientists to move between labs at hospitals, universities, and Philips' own buildings on collaborative projects.

Another prime example of the sheer density is Kendall Square in Cambridge, where an incredible synergy between leading innovators across sectors can be found every day, within a single square mile. Deemed "the most innovative square mile on earth" by BCG in 2009, Kendall Square is, as of 2018, home to 62 public companies with a total market value of $170 billion.[3] In addition to proximity, it provides a great number of opportunities to interact through initiatives like the Cambridge Innovation Center (CIC) and Venture Café, bringing people together across industries and sectors in shared physical spaces and informal to formal programming, bridging a variety of disciplines and interests.

Helping to promote this interconnectivity in the New England ecosystem are a special form of organizations: the quasi-governmental actors. These include the aforementioned Mass Life Sciences Center, Mass Robotics, and Mass Clean Energy Center. As publicly funded agencies that operate outside the normal government structures, they function to grow the innovation ecosystems in their respective verticals, providing both physical and institutional infrastructure, funding projects, and acting as incubators/accelerators in which companies can develop and grow. In a variety of verticals, such as LSH, clean energy, and more, the quasi-governmental agencies extensively work with companies that apply machine learning or natural language processing as a tool.

Initiatives such as these, but also other not-for-profit organizations focused at growing early-stage companies, such as Deep1, The Engine, and MassChallenge, are epicenters for growth and connectivity within the AI community, which continues to flourish.

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[3] https://archive.curbed.com/2018/11/6/18067326/boston-real-estate-cambridge-mit-biotech-kendall-square

Building further on the theme of connectivity, and circling back to earlier points on talent, due to the existence of the many universities that integrate AI within their curricula, many founders of start-ups will have also studied and obtained degrees in this area.[4] The amount of talent and knowledge creates a birthplace for high quality start-ups and spin-offs. MIT's E14 Fund, founded to deploy ideas conceived in the MIT Media Lab, forms an example of how research institutions try to stimulate spin-offs originating from their own labs. E14's current portfolio holds spin-offs that work with applied AI in areas such as manufacturing, diagnostics, supply chain, and food & agriculture. Menno van der Zee, originally from the Netherlands and former MIT student, is co-founder of The Routing Company, a computationally-driven start-up. He cites interconnectivity in this ecosystem as one of the impetuses for using this ecosystem as his launchpad for The Routing Company.

Abi Barrow mentioned that the East Coast forms a great landing place for European companies, in particular. This is both due to the density of the ecosystem and its geographic proximity to Europe. It makes it easier to move talent and keep business flowing across space and time zones.

Risk Capital

AI has been around the block and in development for a long time, and it is mainly the larger tech companies that have led the way in commercializing the technology and its application. Rags Gupta, Venture Partner at local VC firm Hyperplane, holds that, in the past, risk capital on the East Coast was more hesitant to invest in sectors such as robotics, Internet of Things (IoT), and AI. A stronger focus was put on software and apps. The tide has since turned. Where five years ago AI was predominantly adopted by big tech and other cloud platforms, it has now transformed into a tool for all companies to apply, regardless of software versus hardware focus and across markets.

Van der Zee notes that finding early-stage funding in the US is a factor that played a large role in deciding to launch The Routing Company in New England. He mentions that in European ecosystems, start-ups oftentimes rely on public funds during initial investment rounds. These application processes can be long and extensive, which is tricky for founders in early stages, and the sums of money aren't necessarily worth the time investment. He observes that New England investors seem more inclined to take the leap of faith based on the presentation of compelling concepts and plans alone. There is an additional impression that within the New England ecosystem, there is a stronger sense of competition amongst investors, as well as a larger pool of angel investors. This can result in investors starting to explore opportunities in early-stage investments more aggressively and with a greater appetite for risk.

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[4] https://emerj.com/ai-market-research/artificial-intelligence-boston-overview-startups-funding-trends/#3

Life Sciences & Health

Focusing on a particularly booming application area for AI, New England has a world leading LSH sector, particularly in biotech, employing roughly 1,2 million people.[5] Investment in AI start-ups focused on health is expected to peak at $6.6B, registering a compound annual growth rate (CAGR) of 40% through 2021 in the US.[6]

In nearly all interviews for this report, not only the size, but additionally great opportunities and expectations were voiced when it specifically comes down to the use of AI in LSH. Areas such as diagnostics and medical imaging, drug discovery, and natural language processing are recognized high potential areas. In diagnostics and medical imaging, the focus has been on tools for early detection and personalized patient therapies. AI can reduce costs, analyze, and find correlations between molecular structures and traits providing potential for new drug discovery. As the LSH sector holds a lot of data, the use of natural language processing has risen for dictation, generation of medical codes, billing, and patient care.[7]

Large corporations such as Google, Microsoft, Amazon, Sanofi, Pfizer, Johnson & Johnson, and Phillips have offices surrounding MIT's campus in Kendall Square and beyond. The presence of these giants shows the maturity of the ecosystem with regard to LSH. Soenksen notes that the J-Clinic set a record amount of investment in LSH in 2020. MassBio reported that in 2020, Massachusetts-based biopharma companies alone raised $5.8 billion in venture funding, surpassing former years.[8] Deep1's founder Josh Wachman states that the focus has organically grown, and pharma's interest in AI and machine learning has really picked up over the past five to six years.

Policy and government

Adam Nagy, researcher and project coordinator at the Berkman Klein Center, finds that regulations on a federal level broadly will be unlikely, and if so, probably very sector dependent. Most regulations so far have been on a state level—notably focusing on facial recognition technology (FRT).

In FRT, an algorithm is trained to recognize faces and identify individuals.[9] Within New England, the Cities of Boston and Somerville and the Town of Brookline were early movers and are leaders in the United States in banning FRT. City of Somerville residents, aware of the risks of surveillance, reached out to the local government on the matter. Ben Ewen-Campen, Somerville City Councilor, observes that in response to that outreach, surveillance in general, and FRT

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[5] https://statisticalatlas.com/division/New-England/Industries

[6] Artificial Intelligence in Healthcare | Accenture

[7] Connecting Innovation Worldwide (rvo.nl)

[8] Industry Snapshot - MassBio

[9] https://www.nytimes.com/wirecutter/blog/how-facial-recognition-works/

specifically in combination with the role of law enforcement, was an area where local government had to act. The City of Somerville is a distinctly liberal community, so the city's decisions garnered public support, creating an easier path toward enacting an FRT ban. In doing so, the city set a strong example for others.

Largely, we do not see further or alternative steps taken within policy to regulate industry. In the absence of regulation, AI Blindspot, a tool developed through the Berkman Klein Center Assembly program that helps to recognize unconscious biases and inequalities in AI, is an initiative set up to create and raise more awareness among decision and policy makers.

AI start-ups in portfolios of incubators, accelerators, and investors

In addition to conducting interviews, this report analyzed a total of 173 companies that fall within the portfolios of AI investors, incubators, and accelerators in New England to analyze trends.

Figure 1 – AI companies per sector (total of 173 companies, with a threshold minimum of 10 per distinct sector)
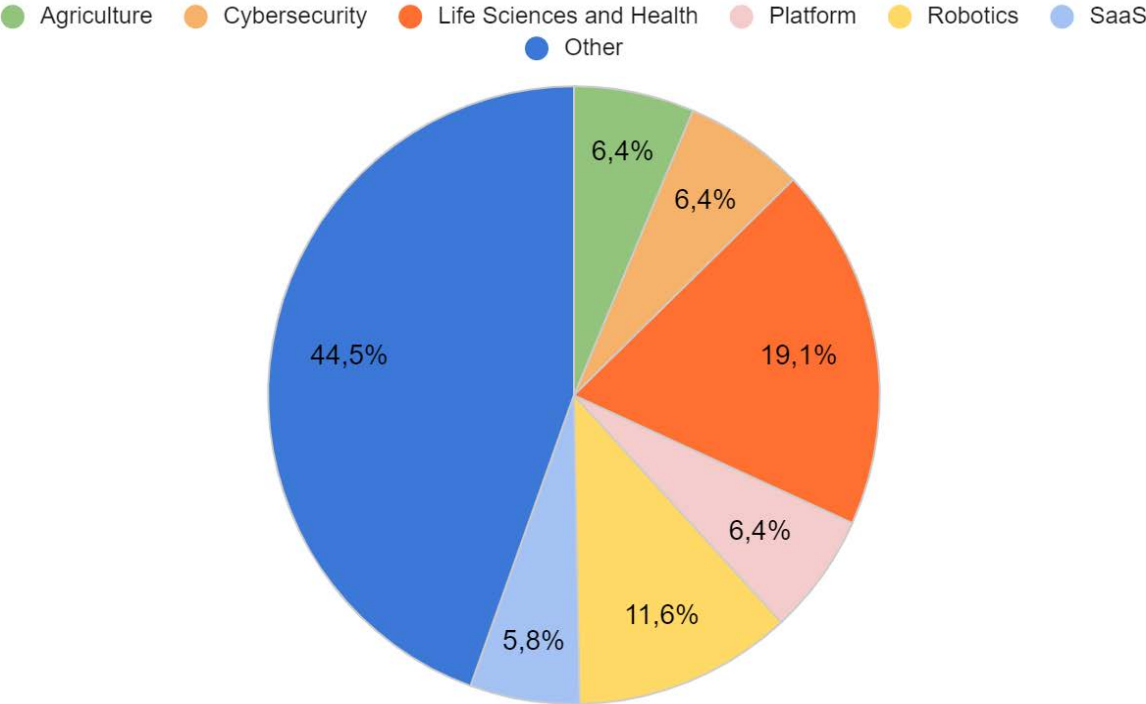
After analyzing the companies, it is striking to see that AI does not keep to one sector in this region. The use of AI has spread cross-sectorally and is, as aforementioned, developing beyond the big tech that made it largely known. This shows us that even in an ecosystem with a dominant sector like LSH, an AI start-up can productively make its way forward in almost any

sector. This analysis also shows that many AI start-ups and scale-ups in New England are defined by hyper-specific niches which vary so widely that they did not meet our threshold of 10 for a single sector, and therefore are reflected in a pool of 44,5% described as "other". The dominance of LSH is still visible, as a solid 19,1% of the AI-driven companies active within this ecosystem have an LSH focus.

Figure 2 – AI companies in the Life Sciences & Health (total of 33 companies)
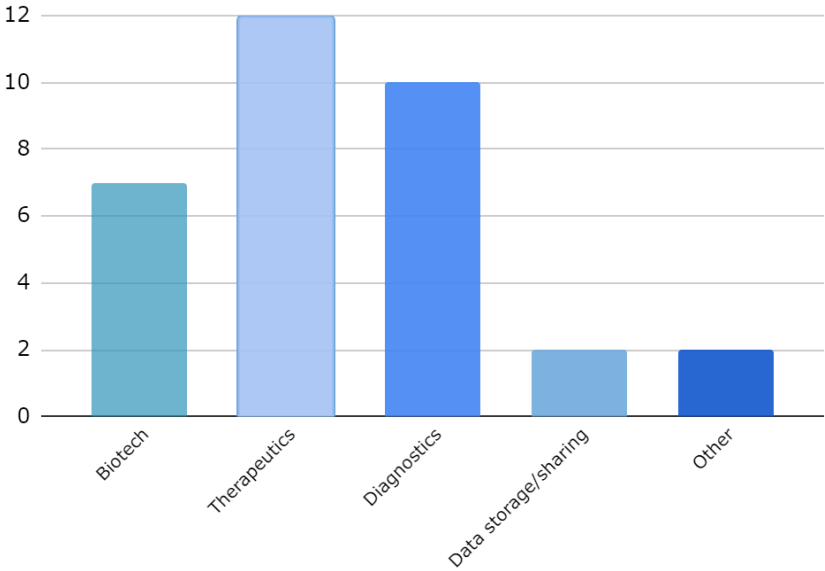
When observing the 19.1% of companies that work at the intersection of LSH and AI, by far, most of these companies work in therapeutics. Often, AI within this area is used for image or pattern recognition.

Figure 3 – AI companies in the "Other" category (represented in weighted bubbles, with a threshold minimum of 2 per distinct sector for inclusion)
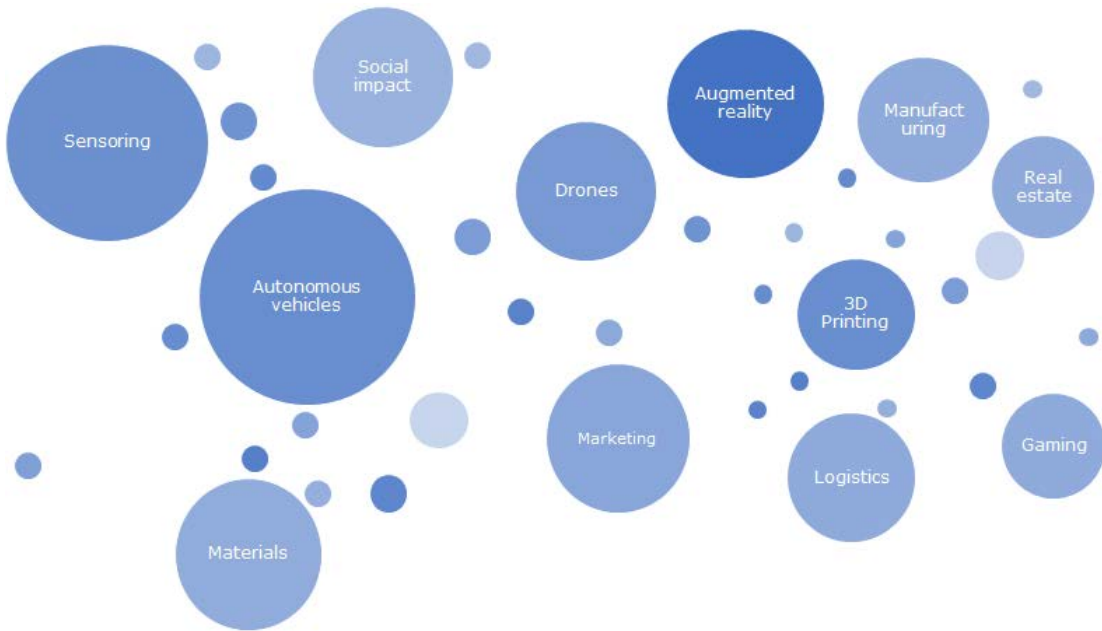
As noted earlier, the largest group of companies did not fall into one of the larger sectoral groups. Yet, collectively, this group represented 44,5% of the 173 companies analyzed. As the figure shows, the fields these companies individually focus on are quite diverse in topic. It confirms the notion of broad application of AI throughout the ecosystem.

Figure 4 – Incubators and accelerators focusing on AI (total of 95 companies, with a threshold minimum of 4 per distinct sector for inclusion)
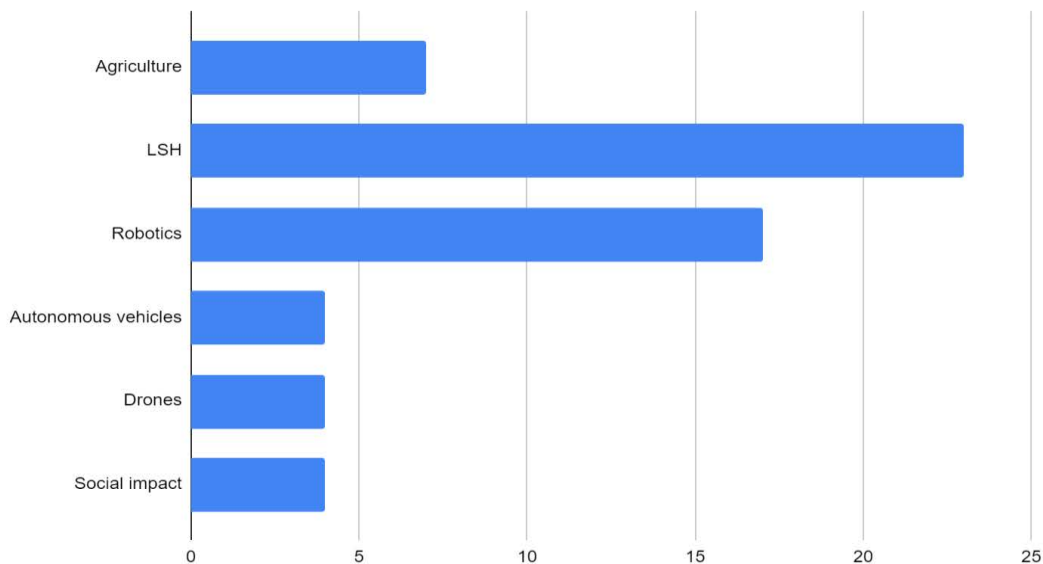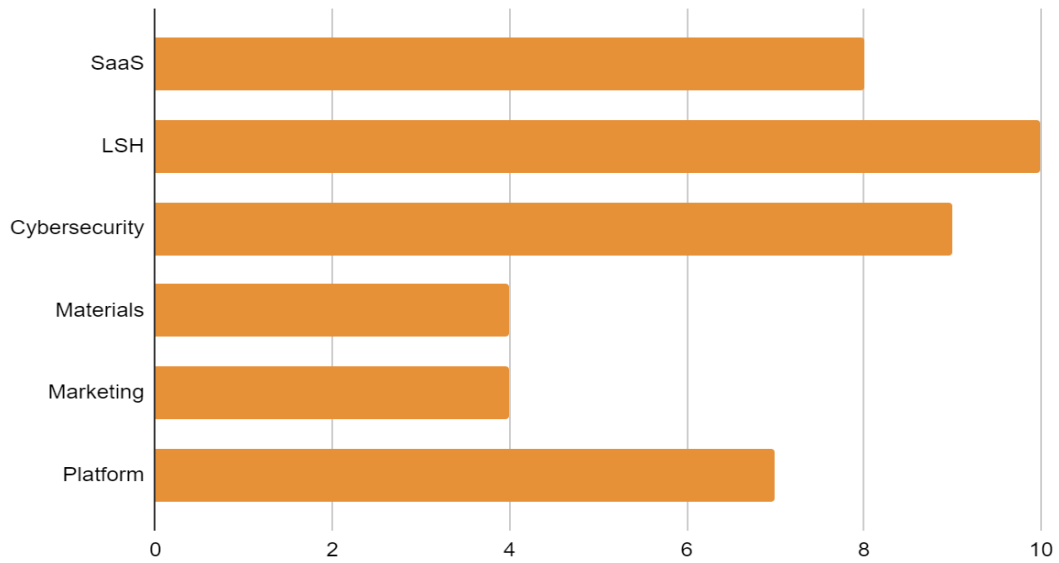
Figure 5 - Venture capital focusing on AI (total of 78 companies, with a threshold minimum of 4 per distinct sector for inclusion)

In comparing Figures 4 and 5, LSH maintains a strong presence within both the portfolios of incubators/accelerators and VC firms.

What's next?

AI is going to be everywhere

The question of what the future brings remains a difficult one, and 2020 has proven times can be unpredictable. AI is definitely here to stay and will not hold itself to the original business structures in which it has gained fame, such as big tech, which has relied on AI to speed up and scale its services. The technology is not to be seen within the barriers or siloes of narrow sectors, but rather as having a cross-cutting nature. The most interesting future trend for AI in this region was hard to pinpoint via interviews. Rather, our interviewees were more likely to say that they're always looking for a particularly novel way of using AI to make a big difference in a sector, or they're looking for AI that's tackling previously untapped datasets. In addition to this, both Wachman and Gupta note that data—accessing it, sharing it, identifying, and building new sets—has really become of key importance when it comes to AI. Specifically for LSH, Xu underscored that the value of data access, collection, and sharing in areas such as critical care remains a challenge of such significance that finding a way forward would make a major difference for both the field and industry.

Innovative value vs commercial value

Even though moonshot-problem solving is the holy grail in any quarter of innovation, investors are quick to point out that commercial value is more readily found in some sectors that have an easy, straightforward fit for AI and machine learning.

Automation is a straightforward application for AI, in spaces such as manufacturing, industrial automation, and education, where there is a historically heavy dedication of human labor to pattern recognition. Deep learning and machine learning can take on much of this work. In New England, initiatives such as the Massachusetts Manufacturing Accelerate Program, established by the Commonwealth of Massachusetts, invests in small-to-medium enterprises (SMEs) and offer grants to companies that use AI, automation, and data analytics.[10] Though there are clear challenges in the short-term, as we consider how to sustainably transition traditional industries and occupations, scholar Hong Qu reminds us that this must be considered in light of an overall aging population in different spots around the world.

From the perspective of financial services, another sector that would benefit from increasing application of AI, the only downside to consider (in addition to, again, transitioning existing jobs), is that the sector is bound to heavy government regulation. This means that regulation, while necessary, can slow down the pace and confine the scope of AI innovation in the sector.

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[10] Massachusetts Announces New Manufacturing Grants | CAM (masstech.org)

When it comes to LSH and the ever-growing potential of AI, Soenksen finds that the right question for those looking to understand areas of opportunity is which area will be most immediately impacted. As previously noted, pattern recognition is one such area, which can play a role in diagnostics. But while these developments are on the move, Xu raises the point that clinicians are sometimes voicing a preference for AI's assistance in realms such as hospital administration, where they feel they have a greater need of support, than necessarily in clinical decision making. So again, it is sometimes the straightforward, less glamorous applications where AI is most needed by industry.

Soenksen additionally mentions that the post-pandemic year will become the year of fundraising at the intersection of health and AI. The availability of more funds, however, does not mean that it will be easier for start-ups to secure new rounds of investment. Next to investment, the life sciences are also stimulated by initiatives such as the Mass Life Sciences Center's data science internship program, which connects research institutions and companies to interns and reimburses the wages. In the Bits to Bytes program, up to $5 million dollars in funds can be awarded to those that employ data analytics and/or machine learning techniques to solve pressing LSH questions.[11]

Hand-in-hand with LSH and questions and imperatives surrounding data sharing and access, as well as growing dependence on AI in LSH, there is the need for greater security. AI can play a role in securing data in cybersecurity. In this field, New England is exploring ways to drive innovation between sectors and industries via new stimuli and the launch of a quasi dedicated to the space. The Massachusetts Cybersecurity Mentorship Program is an example of an initiative that exists to foster connections between universities and companies.

As the growth of AI within this ecosystem increases to the point that its use is ubiquitous and becomes more of a marketing buzzword than term with clear boundaries, we need to make a distinction between deep, cutting-edge uses of the technology and ways that algorithms can simply create room for further automation. So, as innovations in automation are an inevitability and ripe for near-term commercialization, investors in New England continue to keep their eyes open for AI innovations that can address our biggest societal challenges. What are these high potential investment fields that exist more in that moonshot, grand ideas + challenges space?

Rags Gupta names three to which we should pay attention:
- Sustainable built environment – property tech in real estate and climate tech
- Security – crypto currencies and blockchain
- Industrial automation – autonomous vehicles and robotics

Responsible use of AI

To date, the municipal governments of Somerville, Boston, Cambridge, and Brookline have banned FRT at a local level, which has been impactful in the sphere of privacy protection and

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[11] https://www.masslifesciences.com/programs/bits-to-bytes/

transparency in New England. But aside from this movement, which is growing across the United States, significant regulation of the private sector has not yet been enacted. Grassroot initiatives that seek to strive for better accountability and transparency in industry's use of AI and data form an active community. Qu firmly believes that AI's use needs to be regulated, and its application must be responsible. He emphasizes the importance of AI governance at every level. Wachman additionally emphasizes industry's responsibility to consumers and society to draw back the curtain on its algorithms, explaining how they work and are used in accessible ways.

Recommendations

Based on interviews and the earlier analysis, this report issues four recommendations. Some of what is reflected below might already be applied in any number of innovation ecosystems, yet are still worth acknowledging, given the success of the New England AI ecosystem.

Multi-angle academic focus

Bottom line, the academic wealth of this region constitutes the New England innovation ecosystem's unique selling point. Specific to AI, the added value of the universities and other knowledge institutes is not only that they strive to achieve academic and research excellence, but also that they each have diverse foci areas, as opposed to heavily overlapping or duplicative expertise. This varies from engineering to policy to ethics to creative design to industrial applicability to workforce development, forming an all-round synergy on most academic fronts.

As referred to earlier, a couple of exemplary cases are the Massachusetts Institute of Technology's research strength, Harvard University's dedication to ethical AI, and Northeastern University's applied AI programs.

In summary, strategically approaching a technology from different angles by various stakeholders has value for the overall improvement, synergy, and future use.

Stimulate knowledge valorization

Turning knowledge into business ideas with real commercial potential is a central element of innovative ecosystems. This bears no difference when it comes down to the evolution of AI as a tool. Within the New England ecosystem, the innovation links between government, society, academia, and industry are strong. But specific to AI, the link between academia and industry in particular, could be most productive. There are two models from the New England ecosystem that are interesting illustrations.

1. The Jameel Clinic at Massachusetts Institute of Technology (J-Clinic) falls under the larger umbrella of the Schwarzman College of Computing, and it drives the further development of healthcare through focus on the AI x healthcare nexus. This is done through collaborations between hospitals, industry partners, and faculty.

   MIT's Innovation Initiative, which helps stimulate innovation across campus, launched the Proto Ventures program to discover, source, and select new venture opportunities within MIT. In this program, start-ups birthed in MIT labs are grown from concept to launch, creating a clear and direct bridge between the knowledge institution and the market. One of the thematic tracks within Proto Ventures is sponsored by the J-Clinic. This can form a practical illustration of how a university can build further on existing

sectoral/thematic strengths in ecosystems to increase their industry competitiveness.

2. The Roux Institute is a research institute opened in 2020 by Northeastern University, in collaboration with tech entrepreneur David Roux, in Portland, Maine. The institute acknowledges a changing digital world and the imperative to prepare a workforce in high-tech. The Institute aims to create a strong and future-ready workforce for the Portland region. As Northeastern is known for an education that aligns with the needs of industry, the focus is on educating talent that will apply their AI skills in industry. Additionally, working closely together with existing companies within the region and hosting resident start-up companies will enhance the Institute's interconnectivity with needs from the field.

   What is also striking about the Roux institute is that the knowledge route from Boston is stretching into Maine, hinting towards an expansion of research expertise over the broader northern New England region. We see future AI hubs potentially on the horizon.

Bottom-up regulatory strategy?

The notion that AI is going to structurally change the way we do business is pervasive, and the pace of development in that regard is moving incredibly fast in the US. Although on a federal level, activities on advancing AI have been introduced through the 2019 Artificial Intelligence Initiative Act, there is less of a centralized national approach when it comes down to regulation. In the absence of clear federal regulation and also a clear national strategy for AI innovation, the New England ecosystem has made rapid gains on its own, likely due to the perfect mix (or storm) of research, industry, risk capital, supportive sub-national government, and civil society.

Looking at New England as a closed region, for the sake of this exercise, it therefore raises the following question: If the application of AI as an enabling technology is so broad, are regulations at a federal level on the technology as a whole and its use really the best way forward? Or even at a state level? Would there possibly be another way to confront the ethical issues presented by AI, such as regulation on a sector basis, e.g., AI x LSH, AI x cleantech, AI x robotics? This way, innovation ambitions and a regulatory framework could potentially be more tailored to specific sector-related challenges and aspirations, instead of trying to regulate a highly complex and broadly applicable technology in one macro swoop. It is a question whether exploring a bottom-up approach, catering to sector-specific needs, as opposed to a more broadly top-down approach, may be worth looking at.

Alternative start-up aid

Looking at the US as a whole, the investment landscape generally has consistent characteristics across innovation ecosystems and technologies.

Private funding forms a common and central practice in the US and is often relied on during early-stage financing. As the US holds a large variety of investor types and avenues, e.g., venture capital, angels, accelerators, and incubators, who present different forms of investment, they do also come with different requirements and investment ambitions when building their portfolios and making offers. Diverse risk capital, in combination with the availability of resources, seems to make early-stage public funding for start-ups less of an imperative, though we have seen an uptick of this across recent presidential administrations' economic plans. While instruments and avenues are fairly consistent, investment culture can differ, however, from coast to coast, in the way that investment is courted, ideas are pitched, entrepreneurs are mentored, investment goals are driven, and deals are closed.

Regardless of the sector or the application, we all know that start-ups improve by gaining experience. In working with AI, this point cannot be emphasized enough: it is the very training of a given algorithm on extensive datasets that yields innovative AI. Aside from the necessity of training to develop an algorithm good enough to bring to market, it is especially important at an early stage to define the right dataset and access the data in question, so that, via testing, unexpected ill side effects can be confronted and resolved sooner than later.

One way to encourage this is via pilot projects, and a prime provider of pilots can be (local) governments and universities. An example of such a successful pilot in New England is the project between Green City Watch, a Dutch environmental AI start-up, with the Mayor's Office of [New Urban Mechanics](#) in Boston. These two organizations partnered up in order to monitor urban trees and their health through machine learning. The City of Boston outsourced a sustainability challenge, and through an openness to trial-and-error, it also gave a start-up a chance to further hone its product.

. Conclusion

In interviews with diverse stakeholders and in diving into the characteristics of the startups blossoming in this region, there are two major takeaways: AI innovation can be found in all of New England's sectors, both big and small. Further, the Life Sciences and Health, with its particularly close links between research and industry, is, as a single sector, leading the way in AI. So, foreign AI entrepreneurs, researchers, and more looking to the US Northeast can regard New England as a prime launchpad for a diversity of innovations.

Annex I – Interviewees

Abigail Barrow, Founder and Managing Partner, Cambridge Innovation Partners

Cambridge Innovation Partners (CIP) based in Kendall Square supports emerging technology companies through consultancy and coaching in addition stimulating the regional and academic ecosystems by forming a bridge between stakeholders.

Ben Ewen-Campen, City Councilor, City of Somerville

Biologist at Harvard Medical School and since 2017 councilor for Ward 3 in the City of Somerville. As city councilor Ewen-Campen works on topics such as affordable housing, transportation, civic engagement, equality and has led efforts in the enactment of the use of facial recognition technology in Somerville.

Lori Glover, Managing Director, Global Strategic Alliances, Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology (MIT CSAIL)

CSAIL is MIT's largest research lab and has played an essential role in the computer revolution, focusing on development of innovative applications for tomorrow's information technology. MIT CSAIL Alliances forms the portal between industry, government and CSAIL. Connection and exploration to future collaborations is central to their work.

Rags Gupta, Serial Entrepreneur and Venture Capital Investor, Butlr and Hyperplane VC

Butlr provides an AI driven sensing IoT platform to optimize indoor space utilization. In addition, Hyperplane VC is a Boston based venture capital firm focused on early-stage funding specializing in artificial intelligence, machine learning, and data technology companies.

Adam Nagy, Researcher and Project Coordinator, the Berkman Klein Center for Internet & Society, Harvard University

The Berkman Klein Center for Internet & Society at Harvard University is an interdisciplinary research center focusing on the largest global challenges presented by the Internet. The Center does this by conducting research, converting ideas into tools, educate and connect. As researcher and project coordinator Nagy's works within the Algorithms and Justice track of the Ethics and Governance of Artificial Intelligence Initiative, in specific his efforts regarding the Risk Assessment Tools Database and the AGtech Forum.

Luis Ruben Soenksen, Serial Entrepreneur and Venture Builder in AI and Healthcare, Abdul Latif Jameel Clinic for Machine Learning in Health (Jameel Clinic/J-Clinic), Massachusetts Institute of Technology

MIT's Jameel Clinic is co-founded by MIT and Community Jameel and falls under the MIT Schwarzman College of Computing with a goal to develop AI technologies that will change healthcare. Working on AI in life sciences on topics including early diagnostics, drug discovery, care personalization and management.

Soenksen is currently Venture Builder in AI and healthcare, in which under the Proto Ventures program he leads in the development of multiple scientific start-ups within the intersection. In doing so, forming a direct link between research and the start-up community.

Hong Qu, Researcher, Lecturer, and Developer, John F. Kennedy School of Government, Harvard University, Northeastern University, and AI Blindspot

With a background in industry, Qu currently is a lecturer in data visualization at Harvard Kennedy School while obtaining a PhD at the Network Science Institute at Northeastern University. In addition, Qu participated in Berkman Klein Center and MIT Media Lab 2019 Assembly program working on AI Blindspot, a tool that identifies the harmful unintended consequences of AI that arise from unconscious biases or structural inequalities embedded in society.

Josh Wachman, Serial Entrepreneur, Early-Stage Investor, and Executive director, Deep1 and Nor'easter Ventures

Deep1 is a not-for-profit organization that bridges the gap between start-ups and corporations providing the next generation of leading AI entrepreneurs with strategic resources and guidance in bringing their solutions to market. In addition, Nor'easter Ventures is an early-stage investment firm that focuses on disruptive deep tech ventures such as AI, machine learning and generative adversarial networks (GANs) and other cross cutting technology spaces.

Byron Wallace, Associate Professor and Director of the Bachelor of Science Data Science Program, Khoury College of Computer Sciences, Northeastern University

Wallace is an associate professor and director of the undergrad data science program at Northeastern University. His research areas include artificial intelligence and natural language in the space of health, processing methods on synthesizing biomedical evidence-base more efficiently.

Minnan Xu, Department Head of Connected Care and Personal Health, Philips

Xu is currently Head of Connected Care and Personal Health at Philips, leading a team of scientists and engineers that focus on creating solutions for health care enabled by AI and data science.

Menno van der Zee, Co-Founder, The Routing Company

The Routing Company is a fast-growing start-up with the vision of taking public transportation to a new dimension. Working with mathematical solutions to improve specific transportation challenges ahead.