

Northeastern  
University



2023

# IMPACT ENGINES

ANNUAL REPORT



# Foreword

Our academic plan, Experience Unleashed, identifies impact as our North Star. We achieve this impact through excellence in experiential undergraduate, professional, and graduate education, research, and entrepreneurship. Propelling all of this is the global university system, opening up heretofore unimaginable possibilities. In many ways, the world has not looked to great research universities like ours for solutions to pressing problems, but our experiential partnership-driven global model is changing that.

Impact Engines embody this ideal. Unlike much research that begins with an intellectual puzzle, an Impact Engine begins with a problem in the world. Through partnerships, working across disciplines, they forge solutions. This is not business as usual. The yardsticks for Impact Engine success are tied to that problem that is being solved. An Impact Engine related to sea level rise will focus on sea level, not on citations.

This new vision for discovery doesn't necessarily look like other research at Northeastern, and not all research fits the Impact Engine mold. Yet, for the right idea, it's an opportunity to use solution-based metrics to accelerate growth through trial and error out in the field—with city officials, police, and even book publishers.

This model harmonizes closely to Northeastern's academic plan in an intentional way and it's just the beginning. Year after year, we will continue to challenge the boundaries of experiential learning and research, supporting a diverse array of projects across various fields. In doing so, we aim to create a pathway for our faculty—and others—to amplify their impact in support of common good.

**David Madigan**

*Provost and Senior Vice President for Academic Affairs*



# Introducing the Impact Engines

**S**OLVING TODAY'S INTERCONNECTED challenges requires more than any one individual, discipline, or even organization. It requires diverse clusters of interdisciplinary expertise and experience, each focused on a global problem and its contexts and perspectives. We call these clusters Impact Engines.

**Impact Engines galvanize and organize interdisciplinary learning, research, and partnerships around solving a challenge or set of challenges, with the goal of maximum impact.**

They move the needle on challenges in an accelerated manner. Impact Engines span disciplines, colleges, campuses, and industry sectors, connecting diverse communities of problem-solvers around creating measurable change. They are a key pillar of the university's academic plan, Experience Unleashed, and a means for Northeastern to expand its leadership as an institution with broad societal impact.

Innovation emerges organically when challenges and research partnerships intersect. This lively ecosystem positions our faculty to work more productively with industry, government, and our local communities on the research that matters most. They aim to fully activate our humanics curriculum while ensuring the continuous integration of ideas, people, and experiences across our system. Impact Engines highlight that Northeastern University enables seamless collaboration beyond disciplines to make measurable impact on real-world problems.

Impact Engine projects are tackling socially aware product design, bias in the publishing industry, analyses to dismantle the cradle-to-prison pipeline, degree completion pathways for historically underrepresented learners, and AI-enabled healthcare for improved heart surgery outcomes. They also are supporting hyperlocal air pollution models for sustainable policy solutions, reproducibility of health research studies, community-engaged research for long-term partnerships, and brain health research.

This report invites you to enjoy these motivational stories. Community to Community is activating scholars across the global university system to engage with their communities on local challenges. Healthier Air and People: Intelligent Solutions to Urban Pollution for Equity and Resilience is providing tools for city leaders to understand and prioritize mitigation strategies for air pollution. Cradle-to-Prison Pipeline is launching an unprecedented database and visualization tool to map the web of deep inequities in legal and social systems that funnel people into the criminal justice system. Booknet is providing a rich new set of metrics to help publishers discover new authors and books.

Experiential Associate to Master's is helping learners streamline the community college transfer process and find experiential opportunities in the field. Healthcare Enabled by AI in Real Time is using AI to reduce adverse outcomes of heart surgery. Real World Healthcare Navigator is tapping into the world of existing observational data to create a transparent, reproducible way to determine

the best treatment for patients in real-world settings. The Center for Cognitive Brain Health is predicting abnormal development and guiding novel interventions for diseases like Alzheimer's and Parkinson's. And finally, Advanced Design Augmentation Through AI for Socially Aware Product Design launched a new partnership to prove their concept with a multinational footwear company.

**This inaugural annual report contains stories of inspiration, discovery, innovation, partnership, and groundbreaking approaches... in summary, stories of impact.**

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# Who's Making an Impact?

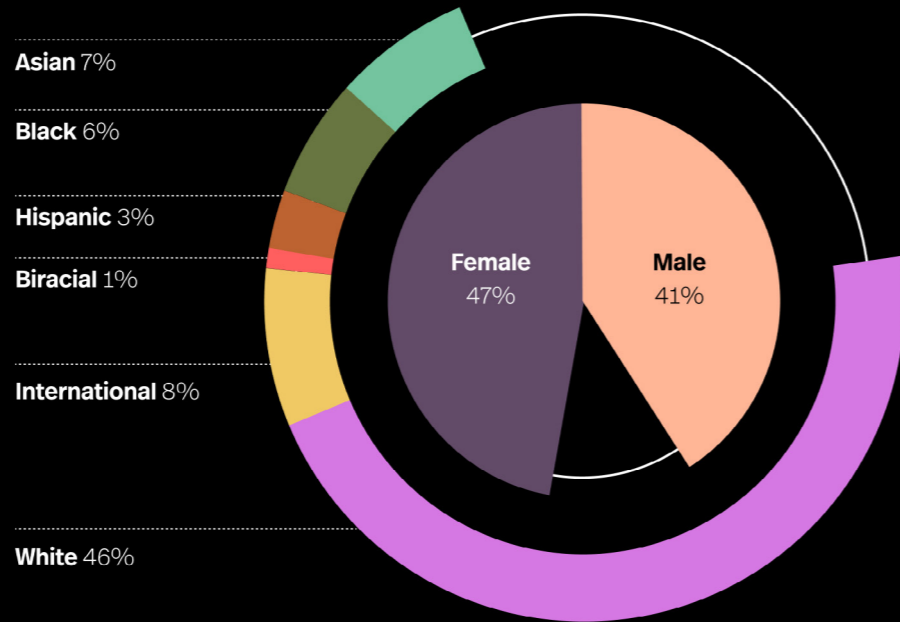
Impact Engines bring together faculty, staff, students, and external contributors with diverse backgrounds and expertise. Teams include participants and communities from across the global network and the disciplinary expertise of all of Northeastern's colleges.

Information on this page represents data reported by Impact Engine project leads in their regular reporting to the program's leadership team.

Summer 2023

## Faculty/Staff

Missing data, beyond volunteered responses, is represented by the thin white lines.

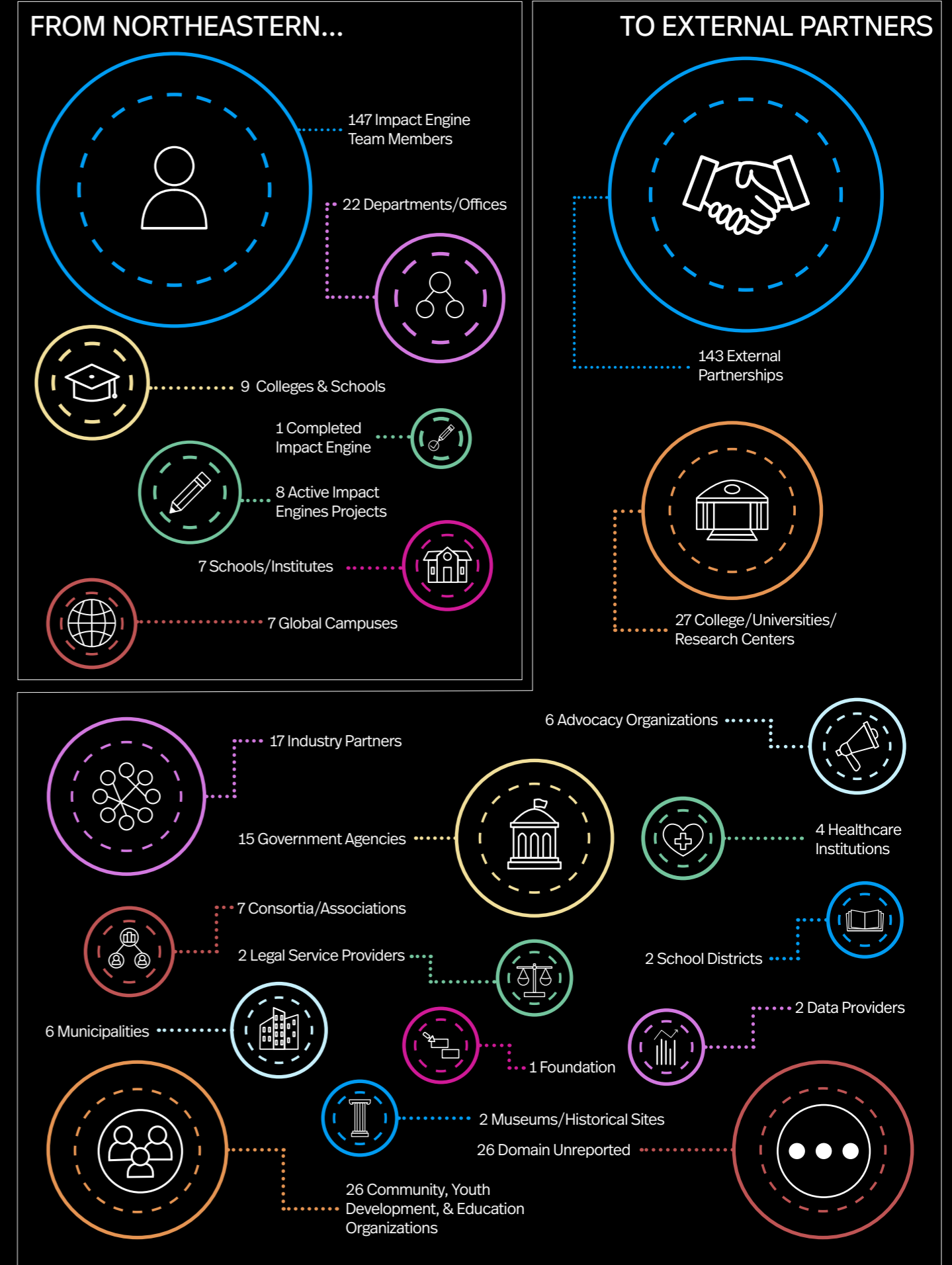


## Student Participants

59 Northeastern Students



## Year 1 at a Glance: Reach



BookNet

Cradle-to-Prison Pipeline (C2P)

Center for Cognitive Brain Health (CBH)

Community to Community (C2C)

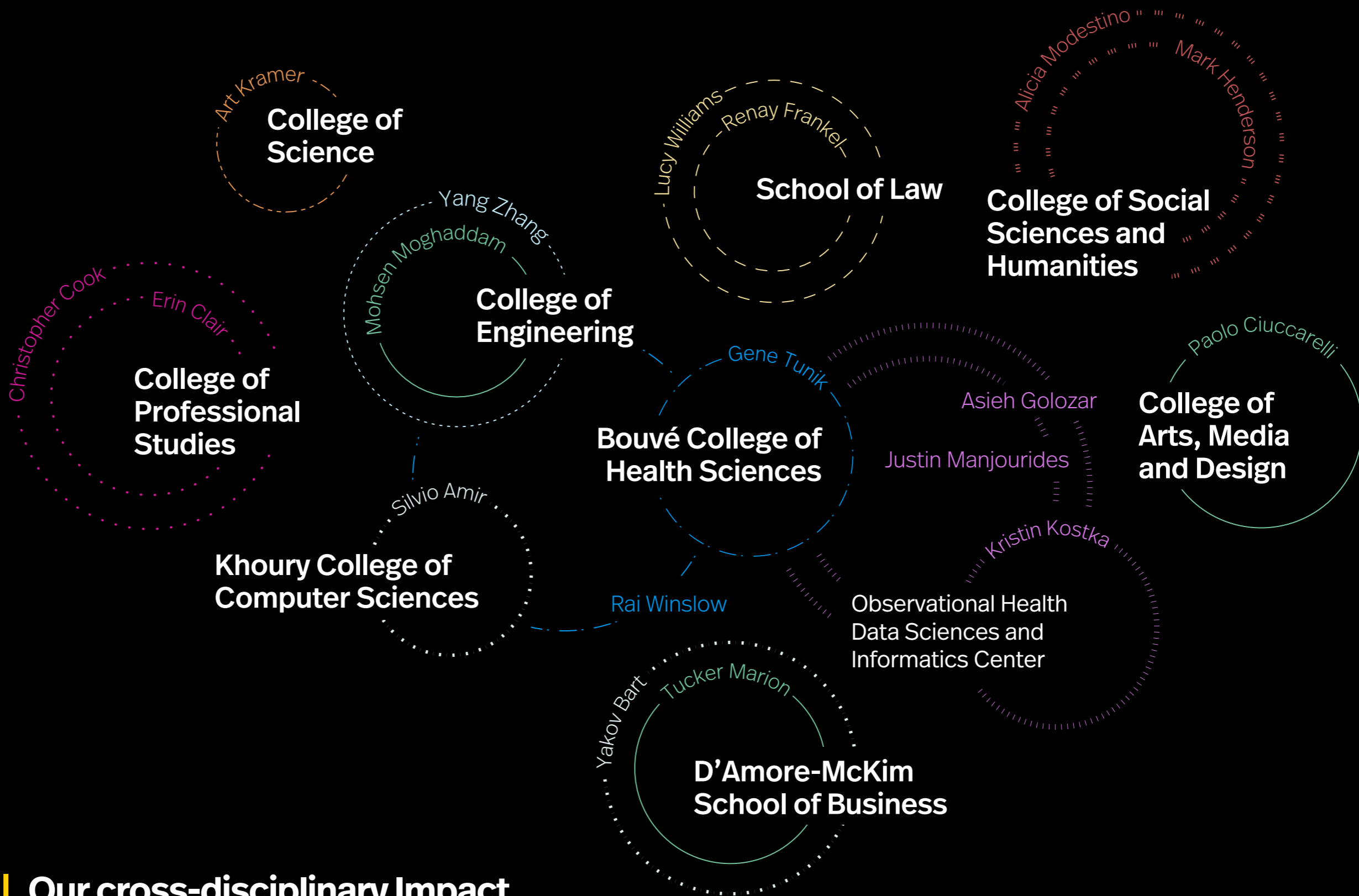
Experiential Associate to Master's (eA2M)

Real World Healthcare Navigator (RWHN)

Healthcare Enabled by AI in Real Time (HEA(RT))

Intelligent Solutions to Urban Pollution for Equity and Resilience (iSUPER)

Advanced Design Augmentation Through AI for Socially-Aware Product Design (ADATech)



**Our cross-disciplinary Impact Engines demonstrate the power of innovation when diverse teams join forces.**



# The Impact Engines

In a sea of applicants, a nimble nine have been chosen to fast track their forward-looking ideas into the real world through Northeastern University's cutting-edge Impact Engine program. With overlapping work across disciplines, from literature to justice to medicine, each set out to address a unique societal problem and each holds the potential to make a greater impact in the world. Behind this work are thought leaders helping to change the way that university research is done.

"There's no other university doing work like this," says Alicia Modestino, founder of Northeastern's Community to Community Impact Engine who worked as a senior economist for the Federal Reserve Bank after earning a PhD from Harvard University. "Some at other universities are doing their own research using this kind of approach. But they are only a handful in one small field."

The Impact Engines are leading this new movement in academia to target funding for applied university research and scholarship to improve lives. This innovative global effort is breaking down barriers between higher-education and the real-world. Because if there's great potential for something, why not get out in the field and put it to the test?

# Forming Community Partnerships

True to Northeastern form, the Impact Engines are integrating the classroom and the real world to tackle one challenge or a small set of challenges at a time. In many cases, investigators are working to find solutions to problems in local neighborhoods. They're on the ground working with schools and police, city employees, local health agencies, and environmentalists. These individuals are thinking critically in new ways not only across a rapidly expanding global university network, but out in the field to reimagine social justice and policy reform and cut new paths to sustainability. And in doing so, more often than not, they're demonstrating a societal impact.

## IN THIS SECTION

Community to Community

Intelligent Solutions to Urban Pollution  
for Equity and Resilience

Cradle-to-Prison Pipeline



# Community to Community

## PROBLEM:

Local policymakers often lack rigorous data and analyses to help them determine what policies in areas such as housing, crime, opioids, and workforce development are most effective.

## SOLUTION:

Scale across Northeastern's global network a "think and do" model that fosters long-term, local collaborations between academic scholars and government officials to create local data-driven solutions.

So far, the team has provided executive education workshops to policymakers, supported practitioner and faculty partnerships through seed grants, and provided an algorithm for equitable placement of 9,000 youth in the city of Boston's summer youth employment program.

Photo by Alyssa Stone

**B**RIDGING THE GAP between academic research and policy making, the Community to Community (C2C) Impact Engine is putting research into practice through data and analyses—just not in the way you might think. Faculty are helping to develop research questions, design data analysis, and create solutions to complex problems in local areas, starting with the places that Northeastern calls home across the global university system. They're connecting policymakers and academics and offering seed grants to the projects they develop.

Building on a long-standing partnership with the city of Boston, C2C researchers, for example, helped the Mayor's Office improve the efficiency and equity of its summer youth employment program in the wake of the pandemic. Under the direction of Project Lead Alicia Modestino, last year the research team analyzed youth application

and hiring records, conducted interviews, and evaluated potential pilot programs, including a job matching algorithm, to increase both the number of jobs filled and the diversity of youth served. As a result, this past summer Boston invested an unprecedented \$18.7 million in summer jobs, successfully employing over 9,000 young people, 155 of which worked for Northeastern, and rebuilding the backbone for a more holistic and inclusive workforce development system for Boston's youth. Summer youth employment programs have shown to produce transformational positive impacts for young people in both the short and long term, raising academic aspirations, boosting community engagement, and reducing crime. The city will use the C2C algorithm to select up to 30 percent of its summer youth employees to ensure that the racial and ethnic distribution of youth hired equals that of the youth

## TEAM

Alicia Modestino

Project Lead

Mark Henderson

Project Lead

who applied. And only now is Modestino writing a scientific paper about that work.

"We identify an issue, find a solution, work together on implementing that solution, and then write the research evaluating whether or not it worked," says Modestino, who is also the research director for Northeastern's Dukakis Center and an associate professor in the School of Public Policy and Urban Affairs.

Across the global university system, C2C researchers, policymakers, and students are working together to carry out this kind of community-engaged research, fostering long-term mutually beneficial partnerships to move the needle on societal problems at the local level. Modestino knows from experience what can happen if you remove silos between academics and government officials. That's why she started C2C, which launched as an Impact Engine in late 2022.

“Just because you have a lot of data and it shows a trend doesn’t mean it’s right. Just because a lot of umbrellas get sold when it rains doesn’t mean umbrellas cause rain,” says Modestino. “You need to interview people and find out if people are buying umbrellas because it’s raining.”

The secret to C2C’s success, true to Northeastern’s experiential model, is getting researchers on the ground at different Northeastern global campuses to foster deep connections with policymakers, practitioners, and community organizations. It’s providing training, coaching, and mentoring to ensure researchers understand how to collaborate with community members. In each location, it’s understanding the needs of different populations, the socioeconomic factors at play, and the financial and political constraints to change a policy or practice.

The group’s research lab has postdoc, graduate, master’s, and undergraduate researchers assisting 13 newly funded scholars on a wide range of new projects. Whether it’s developing an opioid buyback program for community health centers, designing a green jobs training program for marginalized workers, or helping police departments reduce discrimination in traffic stops,

**The secret to C2C’s success, true to Northeastern’s experiential model, is getting researchers on the ground at different Northeastern global campuses to foster deep connections with policymakers, practitioners, and community organizations.**

C2C is growing quickly to add value to the communities it serves—across the global university network.

C2C now has big plans to utilize the expertise of faculty across Northeastern’s global campuses, with the goal of expanding the program at a rate of two new locations per year. Already, the Oakland campus, which merged with Northeastern last year, has hit the ground running to support reparations, combat homelessness, and address the caregiving shortage. Next locations on the docket? The Roux Institute (in Portland, Maine) and the Arlington, Virginia campus, Modestino hopes.

“The things that are near and dear to the city of Oakland are very different from what Boston needs,” she says. “But the reason why Northeastern has such an advantage in doing this in Oakland is because we have faculty on the ground there at Mills College who feel just as passionately about Oakland as I feel about Boston.”

And, while providing the infrastructure for community-engaged research at Northeastern, C2C is also reaching out a helping hand to other Impact Engines, conducting workforce development research to help close the wealth gap through higher education opportunities with eA2M, and funneling young summer employees into the iSUPER Impact Engine, which uses sensing technologies to develop pollution prediction models.

# The C2C job matching algorithm has placed 9,000 youth in Boston-area summer jobs.



The Northeastern Summer Jobs Program orientation in the John D. O’Bryant Center  
Photo by Alyssa Stone

# Intelligent Solutions to Urban Pollution for Equity and Resilience

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**TEAM**

Yang Zhang  
Project Lead  
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**PROBLEM:**

Municipalities lack real-time actionable information for developing strategies to mitigate the impacts of air pollution at a hyperlocal community level.

**SOLUTION:**

Pair low-cost, adaptable sensing technologies with novel pollution prediction models to accurately identify hyperlocal pollution hot spots in real time.

Already the Engine has partnered with two local municipalities and deployed a network of sensors and a mobile van to collect real-time data from the field.

Photo by Mark Olsen

**W**ORKING WITH INDIVIDUALS on a hyperlocal level, the Impact Engines are gaining a better understanding of an area's unique needs and what each can tell us about how to prioritize greater global challenges. From geography to infrastructure to residents, access to timely, real-world data can help scientists, citizens, and lawmakers make informed decisions about where to intervene to improve quality of life.

“The opportunity to let our work really be inspired by and shaped by real world challenges is huge,” says Amy Mueller, associate professor of civil and environmental engineering. “It’s fundamental to Northeastern as a university.”

Healthier Air and People: Intelligent Solutions to Urban Pollution for Equity and Resilience (iSUPER) pairs local data with new research tools to improve how municipalities understand sources of pollution and prioritize mitigation strategies. Mueller and the team are collecting air quality data from solar-powered sensors and running those data through machine learning and physics-based models to identify air pollution hot spots and better project the effects of mitigation actions, like infrastructure updates.

Taking a hyperlocal approach to urban air quality research—placing the sensors closer together than anyone to date—will help the iSUPER team, led by Yang Zhang, professor of

civil and environmental engineering, work with lawmakers to improve how policy decisions support air pollution control, environmental justice, and urban infrastructure renovations. “How can we build cities in a different way that would optimize the health of the people who live there?” says Mueller, chair of the iSUPER subcommittee on community partnerships. “A big missing piece now is really understanding air quality at a relevant spatial scale for what people experience.”

Following the launch of iSUPER’s five-year Impact Engine in 2023, small square-foot box-like sensors are now being placed around greater Boston neighborhoods to monitor air quality. Meanwhile, iSUPER is also operating a mobile van to track air quality between the sensors and more broadly around greater Boston. “We can drive it on the same streets where our stationary sensors are installed and use that combination of stationary and mobile measurements to really get at this question of spatial variability of air quality,” says Mueller. As pollution data accumulates, iSUPER will work with community partners to pinpoint the right density of sensors and the spatial scale

of change in air quality to understand how to optimize these networks in cities. It will also help guide the decisions of city dwellers—for example, where those with asthma choose to spend time outside. Since air quality can vary from one block to another—between tall buildings or downwind of an airport, for example—what they find could also be applied to help make predictions about air quality effects across the world, on a greater scale.

But Mueller’s biggest takeaway on the value of building something to become useful in society through the Impact Engine isn’t about innovation and insightful data. It’s about having as many voices at the table as possible.

“A city is not a monolith. It’s a place full of different offices and community groups in the same way that a university is a place full of different departments,” says Mueller. “And there are still so many different people and connections to make and perspectives to consider. Having those voices with us really early on has been instrumental in helping us design a better project.”

PL Yang Zhang and doctoral student Yiyue Yang in the iSUPER Mobile Lab  
Photo by Alyssa Stone



The analyzers for gas and particle air pollutants in the iSUPER Mobile Lab  
Photos by Alyssa Stone

**Since air quality can vary from one block to another—between tall buildings or downwind of an airport, for example—what [the team finds] could also be applied to help make predictions about air quality effects across the world, on a greater scale.**

# Cradle-to-Prison Pipeline

## PROBLEM:

The cradle-to-prison pipeline describes a web of legal and social systems that funnels children into mass incarceration. The pipeline is rooted in structural racism, beginning before birth and persisting through the teen years, and is perpetuated by a lack of transparency and accountability within systems and agencies that interact with these youth.

## SOLUTION:

Provide legislators, advocates, and community activists with easily accessible, high-quality, standardized, and up-to-date department and agency data they can use to influence policymakers and advocate for youth, reducing pipeline entry and lowering rates of incarceration.

C2P has filed over 300 public record requests, collecting, cleaning, and standardizing a trove of school-based arrest data that are accessible via a dynamic dashboard that enables users to quickly visualize geographic, racial, and ethnic disparities.

Photo by Chiamaka Nwolisa

**“ If an attorney could argue that four times as many black girls are suspended in one school district compared to white girls it could persuade a federal or state body.”**

– Erin Stewart JD '21

**S**ADLY, in the United States in 2023, a person of color is still significantly more likely than a white person to end up in jail, and as most know by now, the pattern of inequity often starts in childhood, carrying through teenage years into adulthood. But what if an advocate had easy access to public police and school data about systemic regional racial disparities to help inform policy changes, measure the impact of reform, or support a case in court?

“If an attorney could argue that four times as many black girls are suspended in one school district compared to white girls it could persuade a federal or state body,” says Erin Stewart JD '21, a Skadden Fellow at Citizens for Juvenile Justice now working on the Cradle-to-Prison Pipeline (C2P) Impact Engine at Northeastern University.

A novel interactive tool being built by C2P will be the first to compile K-12 data on school discipline, exclusions, children and family services, mental health, public health, and policing to provide advocates and policymakers with accurate, up-to-date, and accessible information about

persistent race disparities. Through an online dashboard display, the database—which is largely unprecedented beyond a few specific efforts like child welfare data in Florida—will fill in gaps and help map the cradle-to-prison pipeline, identifying contributing factors that lead to incarceration. The end goal? The first continuously updated, publicly accessible database—complete with navigable interactive displays—to inform policy changes and help measure the impact of reform, ultimately becoming a model for similar federal and state databases.

But the tool is just one aspect of C2P, which creates resources to support advocates who are working to dismantle the structural contributors to incarceration through a collaboration between Northeastern’s Center for Public Interest Advocacy and Collaboration (based in the School of Law), the College of Arts, Media and Design, and the College of Social Sciences and Humanities.

C2P’s work dismantling the cradle-to-prison pipeline to identify and validate policy interventions in Massachusetts is yet another example of how Impact Engines are collecting

## TEAM

Lucy Williams

Project Lead

Renay Frankel

Project Lead

and analyzing data to disrupt a pipeline down on a ground community level. The idea is to work directly with local entities to solve a problem.

“The Impact Engine has allowed us to dedicate more resources to gathering this data, but filing public records requests has been a bigger undertaking than we ever expected,” says Katherine Stathulis, a J.D. fellow conducting research for C2P who graduated in 2022 from the Northeastern University School of Law.

It all began with a survey of inmates across Massachusetts prisons showing that nearly half of prisoners were dealing with disabilities, many were underserved growing up, and over 70 percent were arrested before the age of 18—no surprise, connecting early juvenile and later adult criminal justice system involvement. Stewart and Professor Stephanie Roberts Hartung then wrote a paper summarizing the results of that survey and their additional recorded interviews with incarcerated individuals to identify gaps in the system. Hearing about the lack of access to accurate, up-to-date, and accessible information about persistent race disparity convinced them to create the tool. Becoming an Impact Engine last year allowed them to get to work filing hundreds of public records requests for arrest data with every school and police department in Massachusetts. What they didn’t expect was such a lack of transparency.

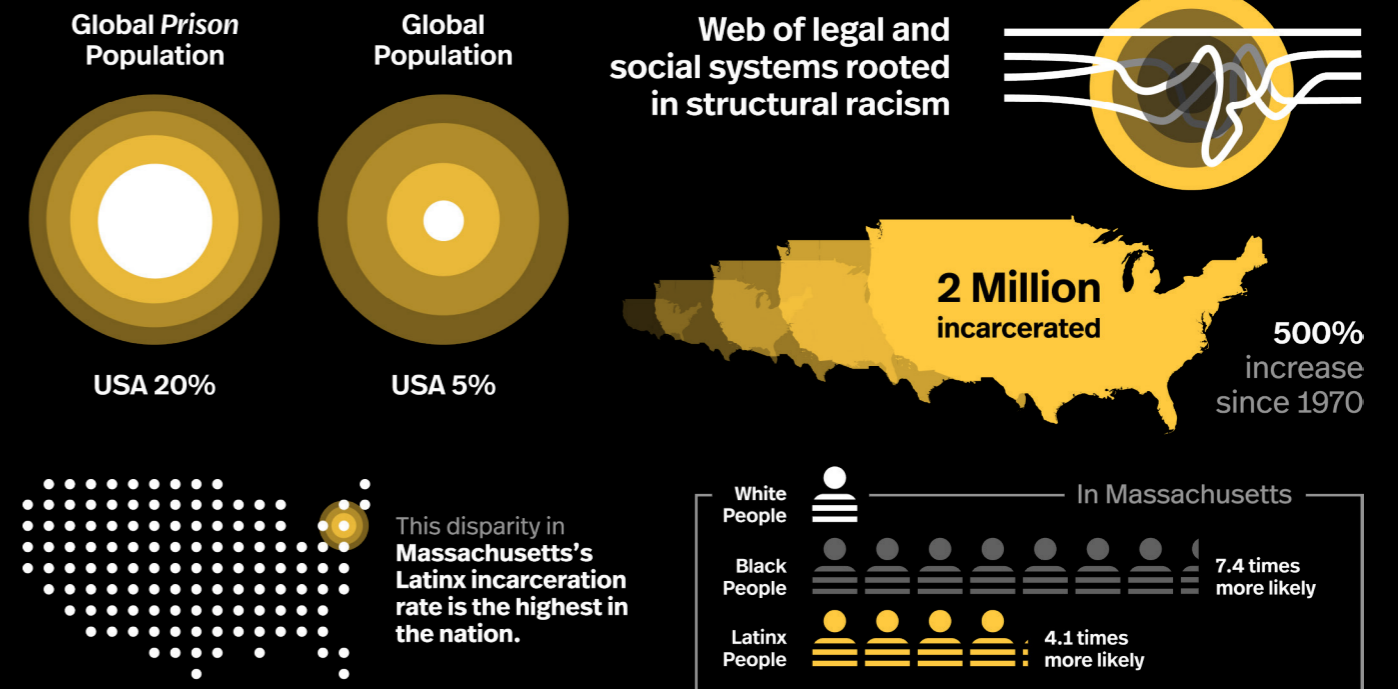
“We weren’t anticipating just how poor the transparency of this data was and how time-consuming filing public records requests would be,” says Stewart, adding the team now plans to publish a grade system on the level of compliance for each police and school department to improve that transparency.

The team went in expecting to gather school-based arrest data in Massachusetts, following a 2018 statute change requiring police departments and school districts to share school-based arrest data. What they found was that the data being shared through the state agency is often inaccurate and wasn’t being updated on a regular basis.

One thing that did speed up the process was the interdisciplinary support they found with Northeastern University’s Institute for Experiential AI. EAI’s AI Solutions’ Hub helped categorize, label, and sort C2P’s records from police and school districts, bringing the team closer to launching a public tool.

“Our end goal is for people to be able to use this tool for advocacy, whether it be in court or in the legislature to lobby to change laws around discrepancies among races or people with disabilities,” says Stewart, who will continue research based on the tool’s findings to help address racial inequity in the United States.

It’s about working with a community to solve a problem directly, starting with interdisciplinary collaboration at one of the largest global university systems in the world.



**Through an online dashboard display the database will fill in gaps and help map the cradle-to-prison pipeline, identifying contributing factors that lead to incarceration.**

Northeastern School of Law students interview formerly incarcerated people at a returning citizens event in partnership with Everyday Boston.



# Experiential Research Across Disciplines

Building on Northeastern University's long-standing distinction as a leader in cooperative education, the Impact Engines are putting research to the test out in the field. Across the global network, life-long learners are developing interdisciplinary ideas through industry partnerships. In two examples, these research teams are finding innovative ways to introduce minorities and underrepresented groups to STEM and publishing.

IN THIS SECTION

BookNet

Experiential Associate to Master's

# BookNet

## PROBLEM:

Publishers now choose new manuscripts based on the success of previously published books, often preventing new and diverse voices from breaking into the market.

## SOLUTION:

Use reader input, content analyses, and historical records to create a novel demand forecasting tool that can identify promising narratives from authors of underrepresented backgrounds.

The BookNet Impact Engine is developing a novel dataset of narratives to innovate current practices in U.S. publishing and help more out-of-the-mainstream stories succeed.

Photo by Matthew Modoono

**Y**OU MIGHT SAY publishers are stuck in a rut, with many failing to pursue storylines outside the mainstream or titles by underrepresented authors.

Take queer author Carmen Maria Machado, whose manuscript, “Her Body and Other Parties,” was turned down by almost 30 publishers before it was published by a small independent press. She wasn’t what readers expected, which is now a credit to her success. Machado’s collection of short stories went on to win the Shirley Jackson Award and became a finalist for the National Book Award for Fiction, with the New York Times calling it one of the “15 remarkable books by women that are shaping the way we read and write fiction in the 21st century.” It landed on banned book lists, and she also went on to become a critically acclaimed and highly sought after author.

To introduce captivating new narrative themes and authors, Northeastern’s latest Impact Engine, called BookNet, is developing a rich new set of metrics to help publishers discover new authors and books.

“We’re looking to build better analyses and tools to help those in the story making space understand the mechanisms of stories and to build out more exciting and new forms,” says Samsun Knight, an affiliate research scholar at Northeastern’s DATA Initiative and assistant professor at the University of Toronto.

Now and for ages, publishers have decided whether to pursue a title, how much to promote it, and how big of a print run it will have simply by comparing it to yesterday’s bestsellers. You can see it on book jackets—“This book is like ‘Gone Girl’ meets ‘Normal

## TEAM

Yakov Bart

Project Lead

Silvio Amir

Project Lead



People,” says Knight, who knows it firsthand. BookNet was formed last year after Knight, a quantitative researcher, wrote his first book. “The Diver,” a horror novel about accidental death, was released in November by the University of Iowa Press.

“Coming into the book publishing space where qualitative reasoning tends to be more dominant, I felt discouraged, mainly because the book publishing process seemed so easy to improve upon,” he says. It only took a few conversations to discover he wasn’t the only one who felt frustrated with the system.

To establish a common experience among readers and publishers, the BookNet team is designing and administering a reader survey comparing story attributes, from the pace of a novel to perception of the main character. Once they’ve built out and validated this large dataset with thousands of reader responses, they’ll develop innovative approaches to help publishers quantify narrative pacing, cohesion, and flow.

Across disciplines through Northeastern’s experiential research model, Knight, with Associate Professor of Marketing and Thomas E.

Moore Faculty Fellow Yakov Bart, Assistant Professor in the Khoury College of Computer Sciences Silvio Amir, and Cornell University Associate Professor Imke Reimers, plan to partner with publishers, who would add the tool to their process to evaluate stories.

“We’re trying to innovate this new methodology that allows books to be published based on their characteristics, not only based on what’s popular or by comparing one book to another,” says Knight. “We’re hoping to capture more of what’s inside the book than what’s on the cover.”

“**We’re hoping to capture more of what’s inside the book than what’s on the cover.”**

– Samsun Knight

The number of attempts to ban books from schools and public libraries is on the rise.

Photo by Matthew MODOONO



# Experiential Associate to Master's

**PROBLEM:**

Millions of Americans, many from under-represented backgrounds, enter the higher-education system but leave before earning a degree or credential.

**SOLUTION:**

Collaborate with local communities to create pathways for learners from historically underrepresented groups to pursue credentials at multiple levels, all while providing robust student supports, mentoring, and experiential learning opportunities.

The team welcomed its first cohort of students to Miami this year, with plans to launch on two more campuses.

**TEAM**

Erin Clair

Project Lead

Chris Cook

Director

**A** DOOR OPENED for two young Floridians this past September. They entered Northeastern University's Experiential Associate to Master's (eA2M) program to obtain a bachelor's degree in the College of Professional Studies in partnership with the largest community college in the country, Miami-Dade Community College.

Born in Guantanamo Bay, Cesar Perez, who attended the Junior Reserve Officer Training Corps Program and plans to join the Marine Reserves, has his sights set on a venture capital firm. Tamara Palmer, who was born in Jamaica, will decide between a career in the music industry and healthcare technology.

As the first to join Northeastern's new eA2M Impact Engine, the associate degree holders are following their dreams deeper into

academia. The eA2M Impact Engine gives historically underrepresented students, who may have an associate degree or a few classes under their belts, a fast-tracked bachelor's degree and pathways to a master's degree, while providing each with extra support to succeed in their coursework, research, internships, and other customized learning opportunities. Through community partnerships, the program aims to help learners streamline the community college transfer process and find experiential opportunities in the field.

Today, most high-paying jobs require post-secondary education, yet the majority of Americans don't hold a college degree. And the reality is that many of them are disadvantaged and identify as black, indigenous, or of color who've been left behind in a rapidly advancing

STEM economy. Now, though, eA2M is preparing learners for science, technology, finance, and other promising fields, harnessing the power of education to close the wealth gap and ultimately introduce their families to educational opportunities for generations to come.

“We believe there are many brilliant and capable people who just simply do not have access to education and therefore do not get the degree that positions them to pursue economic opportunity and upward mobility,” says Chris Cook, eA2M Impact Engine director.

The idea is to build a bridge to higher education so underrepresented learners can reach their full potential. That means providing support to give eA2M students the confidence to raise their hand in class, show up during office hours for extra help, ask for a two-hour extension, or find uninterrupted time to study.

“At the end of the day, students have to produce learning outcomes, but there are students who need flexibility and a different way of learning to progress toward those learning outcomes

and that’s what we’re building,” says Cook, who, after earning his bachelor’s in sociology from Northeastern, worked in Boston charter schools and New York public schools for 16 years as a teacher, principal, and assistant superintendent.

The seed for eA2M was planted by a Northeastern University program launched by Liz Zulick in 2022 called Associates to Masters, which creates pathways from bachelor’s programming into master’s degree biotech pipelines, specifically for those with an associates degree from Boston’s Middlesex Community College and Bunker Hill Community College. Now, eA2M brings the concept to campuses across Northeastern’s global university system and a wide range of individualized paths for each student, from a certificate to a bachelor’s degree and even aligning them with master’s degree programming.

“Our hope is that Northeastern’s impact through this model is so compelling that it becomes a roadmap for other institutions,” says Cook.

Miami-Dade Community College, located in a city where many fall below the poverty line, seemed like a good place to start, but the purpose of eA2M was always to have an impact across the world. Beyond the growing Miami program, the plan is to roll eA2M programs out across the global network, next in Oakland, California, at Mills College at Northeastern University.

Because at the end of the day eA2M is simply about trying to solve a problem: To help get the 40 million Americans with some college or an associate degree back on track so they earn a bachelor’s degree and find success. “It’s about saying hey, we believe in you and your future,” adds Cook.

“Our hope is that Northeastern’s impact through this model is so compelling that it becomes a roadmap for other institutions.”

– Chris Cook

# Changing the Way Research is Done

Northeastern University's Impact Engine program was designed to encourage investigators to solve a very specific problem out in the real world. In the field, researchers have the flexibility to collaborate freely with experts and practitioners to put ideas into practice. They use science to build real-world evidence and ultimately improve quality and cost across industries. And in the healthcare setting, where clinical trials and observation data are the standard, it's proving particularly useful.

## IN THIS SECTION

Healthcare Enabled by AI in Real Time

Real-World Healthcare Navigator

Center for Cognitive Brain Health

# Healthcare Enabled by AI in Real Time

## PROBLEM:

Currently, 20 percent of cardiac surgery patients develop complications, but there is no way to anticipate who will experience these adverse events. Adverse events, which in the cardiothoracic ICU cost an estimated \$4 billion yearly.

## SOLUTION:

MaineHealth is using AI in real time to uncover patterns in patient data that could alert caretakers to complications and prevent adverse cardiac events.

The initial successes of this research-healthcare partnership have led to discussions at MaineHealth about multiple potential new projects.

Photo by Piron Guillaume

## TEAM

Rai Winslow

Project Lead

Gene Tunik

Project Lead

ARTIFICIAL INTELLIGENCE HAS raised eyebrows in healthcare settings where a computer error could come at the cost of human life. But in one hospital department dedicated to the care of patients with heart disease—the leading cause of death in the United States—astonishingly, the opposite is happening. Northeastern’s Roux Institute introduced an AI project to Maine’s largest healthcare system, MaineHealth, that is so auspicious it is creating a ripple effect of AI in medicine across the state.

These are the waves one Impact Engine can make.

“This is already a dramatic success story at MaineHealth,” says Rai Winslow, the director of life science and medicine research behind the effort. “If I had a dollar for every time I’ve heard it, I’d be a rich man. That visibility is bringing an explosion of activity from clinicians with their own very different ideas about how to use AI.”

It all started in October 2022 with the launch of the Healthcare Enabled by AI in Real Time, or HEA(RT) Impact Engine, which will run algorithms on patients rotating in and out of 12 Cardiothoracic Intensive Care Unit (CTICU) beds at Maine’s largest hospital. In

virtually every hospital in the country, the bedside physiological data is gone forever the second it leaves the screen. But Winslow’s novel machine learning tool at Maine Medical Center captures, stores, and analyzes the information, ranging from blood pressure to electrical signals, to help inform the medical team about when to intervene, ultimately preventing a heart attack, for example. Always testing the reliability of its predictions, this algorithm will sync physiological data up with vital signs and electronic health records to identify early warning signs of life-threatening cardiac events. It will deliver insight into survival and readmission rates, extending life, and improving care and cost for heartsurgery patients.

Simply put, HEA(RT) gives a cardiologist warning time to treat the patient before it’s too late—an important step given that approximately 20 percent of cardiac surgical patients at MaineHealth develop complications, and of those patients, 20 percent don’t survive, according to data. The heart health data will continuously stream from each CTICU patient to MaineHealth’s first AI-supporting HIPAA-protected data warehouse, where the algorithm can learn on intervals over time. (For now, until the real-time data system is ready,



Portland, Maine skyline by Ruby Wallau

the center is running data recorded at the time of admission to pick up on potential adverse cardiac events.)

The idea, no different than many Impact Engines, was to develop an approach that can be applied on a greater scale—in this case, in critical care units all over the world. That’s exactly why the Roux Institute has partnered with leading medical electronics manufacturer Nihon Kohden to license the technology to grow real-time AI commercially. What Winslow, a national leader in computational medicine, didn’t expect was to see HEA(RT) drum up so much momentum around AI in healthcare.

“We wanted to identify the people who are going to get into trouble so that we can alert caregivers to intervene before that trouble is there,” says Winslow, former director of the seminal Institute for Computational Medicine at Johns Hopkins University. “But as researchers at MaineHealth have heard about HEA(RT) they’ve had new ideas about how to connect into it.”

Just a year after the launch of the HEA(RT) Impact Engine, AI-focused computational initiatives are popping up across Maine. One involves tracking patients after they leave

the CTICU to predict the likelihood of cardiac arrest, since only about 10 percent of cardiac arrest patients survive in rural Maine, according to MaineHealth statistics. The idea is to help clinicians understand post-operative outcomes and identify heart failure patients at home and in rural step-down units by placing and tracking sensors, or “wearables,” on a patient’s body.

And just as important as following a patient in and after the ICU is knowing their physiological status before they even walk through the operating room doors. That’s why, in a related effort, MaineHealth vascular surgeon Brian Nolan is setting out to similarly use HEA(RT)’s CTICU data and wearables to prioritize who is admitted into the operating room first.

“This is potentially a better risk profiler than the static demographic data they now rely on to determine the nature of the kind of operation they’re going to have,” says Winslow. “Once we begin basing these decisions on the actual physiology and biology of the patient, complemented by the other information, I think it’s going to transform surgical triage.”

Meanwhile, HEA(RT) has laid the legal, technical, and human relationship groundwork for additional partnerships with Maine Medical

Center. Doug Sawyer, MaineHealth’s chief academic officer, is making use of an existing collection of blood samples to build a blood bank that uses AI to identify potential protein biomarkers. In collaboration with investigators from University College Dublin, the new project is helping predict a patient’s health by flagging potential disease.

It’s all just the beginning of AI in Maine healthcare, starting with an Impact Engine. Now, other HEA(RT) spinoff projects at MaineHealth range from an effort to improve cardiovascular surgeries by recording and analyzing how long each step takes and the amount of bleeding, for example; to a new

spinoff using data to improve healthcare delivery in urban and rural areas. Because, after all, Maine is the most rural state in the country, which is exactly why one last but certainly not the least unexpected development came to fruition. Following the HEA(RT) Impact Engine, MaineHealth has also reaped the rewards of tracking data by joining Northeastern’s recently awarded \$17 million CDC grant to launch an infectious disease prediction center that will help prepare for the next outbreak, especially in rural areas.

“We can provide the CDC a large wealth of hospital data,” says Sawyer. “Having all that regional data was the secret sauce.”



**We wanted to identify the people who are going to get into trouble so that we can alert caregivers to intervene before that trouble is there.”**

– Rai Winslow

# Real-World Healthcare Navigator

**PROBLEM:**

A lack of appropriate data and methods to rigorously calibrate results across multiple observational health studies results in the disproportionate implementation of new clinical practices.

**SOLUTION:**

To establish a transparent and reproducible framework that helps scientists infer meaning across large-scale, multi-study observational research so they can discover the best treatment for patients in real-world settings.

Already this team has data agreements in place and is working with industry partners to develop a sustainable market delivery plan.



**A** CROSS A MOSAIC of healthcare studies today, conflicting evidence can make it difficult for healthcare providers to identify the best treatment for individual patients. The Real-World Healthcare Navigator (or The Navigator) improves how research is translated into clinical practice. Since last year, The Navigator has been working to create the first standardized approach to help infer meaningful results across large-scale, multi-study observational healthcare research.

“We are at the forefront of a methodological approach to observational data to help society do a better job of studying health outcomes

at scale,” says Kristin Kostka, director of Northeastern’s Observational Health Data Sciences and Informatics Center and project lead of The Navigator. “We see this as a major opportunity for Northeastern.”

The Navigator is tapping into the world of existing observational data to create a transparent, reproducible framework to determine the best treatment for patients in real-world settings. “It is crucial to understand and measure the effects of clinical treatments on people in the real world, not just the specific subsets of people we tend to include in our clinical trials,” says Justin Manjourides,

**TEAM**

Kristin Kostka  
Project Lead

Justin Manjourides  
Project Lead

Asieh Golozar  
Project Lead

associate professor of biostatistics and co-lead of The Navigator. “Because we’re conducting these studies outside of a clinical trial setting, we need to ensure our methods are transparent and our results are fully reproducible.” Stepping back to create this system for large-scale research is important now, as the digital health space shifts exponentially from a single-study model to larger multi-study observational research, based on a growing influx of digital health resources. If even one aspect of a single paper

is not reproducible, it could create misinformation or potential harm, costing lives and dollars, billions of which are already spent annually on large-scale studies.

For The Navigator team, valid observational research requires implementing best practices on mining available health data across diverse populations and in different patient care settings. It is adopting an approach to preserve privacy that makes those results trustworthy and reliable. And it all starts with framing the right question.

For example, ultimately looking to establish proof of principle for their observational research model, The Navigator is broadly testing the validity of the relationship between anticoagulant use and outcomes of atrial fibrillation (or AFib), an irregular and often rapid heart rhythm that increases the risk of stroke, heart failure, and other heart-related complications, across nine distinct large-scale health datasets. Their analyses across datasets of diverse subjects will help form a clearer research process for

evaluating real-world evidence across different patient populations, based on background and medical history. From this multiple-source data, The Navigator will be able to generate reliable evidence measuring the impact of anticoagulants on the risk of AFib across different care settings.

To understand how research is playing out in the real world, setting this new research standard for the next generation of healthcare analysts requires

all hands on deck. It is relying on epidemiologists, biostatisticians, clinicians, engineers, computer programmers, and others to break down the building blocks of how studies are designed to create a new model, ultimately transforming how healthcare is delivered, clinical decisions are made, and patients are cared for.

“Systems thinking and network science as it relates to replication is very much a team sport,” says Kostka.

The Navigator launched last year in partnership with the Bouvé College of Health Sciences as part of Northeastern’s commitment to building a real-world evidence capability across the global university system. The program includes efforts related to international research and entrepreneurship to commercialize its products.



**The Navigator is tapping into the world of existing observational data to create a transparent, reproducible framework to determine the best treatment for patients in real-world settings.**

L: Photo by Matthew Modoono  
R: Photo by Martin Sanchez



# Center for Cognitive Brain Health

## PROBLEM:

Approaches to health and wellbeing must be interdisciplinary and applied across the lifespan. This requires understanding how the brain's activity and structure is affected by lifestyle choices and behavior.

## SOLUTION:

Bring together multiple disciplines and methodologies that can improve the lives of individuals across the lifespan through the development of novel treatments, precision medicine, and scalable technologies. CBH supports interdisciplinary research projects among faculty who span disciplines as diverse as neuroscience, public health, and music.

Photo by Adam Glanzman

## TEAM

Art Kramer

Project Lead

**T**ODAY, TECHNOLOGY IS THE KEY to one of science's biggest mysteries: the brain. While a protective membrane between the blood and the brain, called the blood brain barrier, has always prevented the passage of most drug molecules into the brain's bloodstream, now, advanced imaging is able to unlock new treatments in neurology.

Through advanced techniques in magnetic resonance imaging (MRI), for example, Northeastern University's interdisciplinary Cognition and Brain Health (CBH) Impact Engine is elucidating our rapidly growing knowledge of how the brain's activity and

structure is affected by lifestyle choices and behavior. This widening network of Northeastern researchers is helping predict abnormal development and guiding novel interventions for diseases like Alzheimer's and Parkinson's. Inside the new state-of-the-art CBH research center in the Interdisciplinary Science and Engineering Complex, they're considering different perspectives and methodologies to decipher mechanisms of brain health and disease to improve the lives of individuals of all ages.

In this rapidly emerging branch of neuroscience called brain enhancement,

regular everyday activity has shown improvements in cognitive function and brain efficiency. “We want to know: can you train people’s memory ability? Can you train reasoning and problem solving?” asks Art Kramer, professor of psychology and project lead of CBH. This nascent field considers the effects of everything from exercise and sleep to music and diet on the brain.

For example, one new technique by Laurel Gabard-Durham, assistant

professor of psychology and director of the Plasticity in Neurodevelopment Lab in CBH, is working to diagnose autism in babies using a type of brain scan called electroencephalogram. Gabard-Durham and her team have been so successful that they’re now setting up clinics to implement this research in Africa through the Bill & Melinda Gates Foundation.

Another project within the CBH Impact Engine by Aston McCullough, a kinesiologist and computer scientist who doubles as a dancer, involves developing a technique right inside the dance studio to quantify movement and physical interaction for everyone from children to adults living with Parkinson’s disease.

Meanwhile, Susan Whitfield-Gabrieli, director of the Northeastern University MRI Center, is using real-time neuroimaging to understand negative impacts on mental health among adolescents, which, Kramer notes, has been exacerbated by the pandemic. Specifically, Whitfield-Gabrieli is looking to identify biomarkers to improve diagnosis, early detection, and therapeutic techniques for psychiatric disorders, including schizophrenia, depression, bipolar disorder, anxiety, and ADHD.

And it’s just a small sample of how scientists are challenging the way we think about the brain and behavior at the CBH Impact Engine.

“We’ve been growing by leaps and bounds, and that’s thanks to the Impact Engine, now that this approach to research is en vogue,” says Kramer.



**Cognitive Brain Health Center researchers are studying how health and lifestyle factors influence brain and behavior.**

Photos by Matthew Modoono

# ADATech

## Lessons From an Impact Engine Alum

The young company is changing the future of generative design, starting with PUMA and its test run.

Photo by Braden Hopkins

**B**YOND THE ACADEMIC HURDLES of traditional research, Northeastern University's Impact Engine teams are paving their own way in the real world. In the case of one of the earliest, a company called The Advanced Design Augmentation Through AI for Socially-Aware Product Design (ADATech), that means hopping the fast-track to transform the emerging field of generative design, which relies on user reviews to help designers make better products.

By the time Northeastern University's ADATech team completed its short six-month Impact Engine in the fall of 2022, the group had become a new company, disclosed multiple patents, and had entered its first agreement to test its concept with multinational footwear designer, PUMA. The new company is now uniquely positioned to share lessons learned about how, outside time-consuming formal funding mechanisms, an Impact Engine can accelerate research—in this case, faster than they ever expected.

"Not every project is the same," says Tucker Marion, associate professor of technological entrepreneurship at D'Amore-McKim School of Business. "The Impact Engines provide flexibility to translate research in whatever way works the best for a particular idea or research area."

### TEAM

Tucker Marion  
Project Lead

Paolo Ciuccarelli  
Project Lead

Mohsen Moghaddam  
Project Lead

## 1. Set a Targeted Goal

ADATech's artificial intelligence (AI) and machine learning technologies are novel and straightforward. The team analyzed over a million product reviews—from retailers such as Amazon and Footlocker—to predict customer sentiment about color, fit, traction, and other attributes of each shoe in the database. Relying on these user-generated natural language predictions, the prototype combs through images and text descriptions to recognize the characteristics, spitting out a predicted customer sentiment about ten attributes of the shoe. But that's not all.

The cutting-edge tool also gauges the success of a new sneaker design to predict customer satisfaction about an unreleased shoe concept by analyzing concept images and text. That information is then embedded into novel generative design algorithms to produce more new and diverse design concepts.

Now, with the ultimate goal of making front-end product development more efficient and a better match for each customer, the team plans to implement the technology not just with footwear but across many other industries.

## 2. Build Interdisciplinary Collaboration

ADATech began as an interdisciplinary collaboration within Northeastern's global university system between the Business School, College of Engineering, and the College of Arts, Media and Design (CAMD), based on the work of Mohsen Moghaddam, assistant professor of mechanical and industrial engineering. In 2021, Moghaddam, Marion, and Professor Paolo Ciuccarelli, CAMD's director of the Center for Design, received a grant from the National Science Foundation to advance AI design forward, with a particular focus on the challenging task of using AI to identify latent needs. With the PhD researchers busy on grants, the Impact Engine afforded the group time and resources to fast-track commercialization through the development of an early prototype, with help on initial design from a CAMD master's student. The PUMA connection came to fruition through another Northeastern connection, Marion's former student Matt Lancor (MSI, '16), who now serves as vice president of sales at PUMA.

"Different pieces and parts of Northeastern all came together to make this happen," says Marion.

## 3. Think Long Term

After meeting the Impact Engine goal of developing a prototype, ADATech now is working to raise funds to help product designers create more "socially aware" products that meet the individual lifestyle of each consumer. The team is pursuing outside capital with help from Northeastern's Center for Research Innovation—which provided the project with \$50,000 in Spark Funds.

"We were able to work as a team, bring in some outside help, and use resources like project management that the Impact Engine effort provided us to successfully complete and deliver the prototype to the initial user for testing," says Marion. "But this has universal appeal."

Looking ahead, ADATech anticipates its next testing agreement with a Boston-based company in a completely different industry, while continuing promising discussions with car manufacturers and others. And, if all goes as planned, the team will move forward to help change the way shoes and other consumer products are designed.

## 4. Know the Global Impact

ADATech's vision to advance generative design has the team thinking big. They've not only set out to identify the online origin of a particular image used to predict customer sentiment that will better inform a designer, but the team also aims to evolve beyond today's algorithms used to generate 2D images. Their plan? To become the first to run algorithms that recognizes 3D images—of a sneaker or any product.

"The ultimate goal of this is to do it in the 3D world of computer-aided design to integrate any kind of customer needs and user data into those models that are developed," says Marion. "That's the long-term vision."

# On the Horizon

**T**HE IMPACT ENGINES PROGRAM has been in operation for only 18 months, but its nine funded projects have made extraordinary progress. With a relentless focus on meeting milestones and addressing a clear problem, the Impact Engines are disrupting the traditional ways a major university does research, interacting with community partners, and fostering interdisciplinary approaches to solving complex problems.

The leadership team now aims to scale the program while continuing to build foundations for success. Though proposals have been submitted from across Northeastern's global university system (so far from Burlington, London, Miami, Oakland, Portland, Toronto, and Vancouver), the majority have originated in Boston. Moving forward, the program will expand its outreach to increase awareness and ultimately support a more distributed portfolio across Northeastern's 13-campus network.

As the program grows, the team will continue to prioritize process, quality, and ongoing improvement. The first 18 months have shown that new ways of work require the development of new administrative processes—processes that can better support the interdisciplinary approach that is the foundation of the Impact Engines program. Working with a senior evaluator from the

Northeastern Public Evaluation Lab, the team is taking steps to ensure that the successes and challenges experienced by each Impact Engine are used to shape improvements to the set-up, execution, and monitoring of projects. These improvements include new strategies to address institutional processes that cause delays, developing guidelines for engaging with external partners and encouraging adequate project management resources from the get-go.

Impact Engines seek to eliminate boundaries between disciplines to focus holistically on a real-world problem. Northeastern faculty have responded to the call by proposing bold, ambitious ideas that go beyond scholarship and affect real change in the communities they serve. In the coming years, the Impact Engines will continue to distinguish Northeastern as a pioneering force driving impact and innovation.

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## CONTACT

To find out more about Impact Engines visit [impactengines.northeastern.edu](http://impactengines.northeastern.edu).

**Amy Carroll**, vice-provost for global impact, leads the Impact Engines initiative. **Olivia Saucier** is the program manager. **Wendy Friedman** is the senior evaluator.

To reach out and discuss your idea with them please complete the contact form on the website.

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