IDENTIFICATION OF INNOVATIVE SECTOR-SPECIFIC STRATEGIES FOR THE LIFE SCIENCES AND TECHNOLOGY SECTORS IN NEW JERSEY

by Kristine Joy Bacani, Liana Lin, Grace Maruska, Brittney Donovan, and Jessica Starace

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RUTGERS–NEW BRUNSWICK
Edward J. Bloustein School
of Planning and Public Policy
John J. Heldrich Center for Workforce Development

NJ EDA
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ABSTRACT

The John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey, in conjunction with the New Jersey Economic Development Authority, has prepared a workforce analysis of the life sciences and technology sectors in New Jersey, with a particular emphasis on these two sectors' intersection with artificial intelligence. This report offers workforce strategies for the New Jersey Economic Development Authority and sector stakeholders to continue to cultivate top talent, increase workforce diversity, and prepare for occupational and skill changes resulting from the emergence and integration of new technologies in the workplace.

EXECUTIVE SUMMARY

The John J. Heldrich Center for Workforce Development at Rutgers, The State University of New Jersey was contracted by the New Jersey Economic Development Authority (NJEDA) to conduct a study on the influence of artificial intelligence (AI) on the life sciences and technology sector workforces in New Jersey. This study broadly aimed to garner an understanding of the workforce dynamics within each priority sector as well as ascertain the impacts of AI on occupational demand and skill requirements for jobs in the life sciences and technology sectors.

The Heldrich Center research team maintained two overarching objectives in this research:

> To establish a baseline understanding of the workforce characteristics and changing dynamics of the life sciences and technology sector workforces in New Jersey, and

> To understand how AI is currently affecting occupational demand and skill requirements for occupations in these sectors and predict how AI is likely to affect them in the future.

In advancing these research objectives, the Heldrich Center employed a multimodal research approach. The Heldrich Center examined publicly available labor market information for the life sciences and technology sectors, leveraged Felten et al.'s (2021) Artificial Intelligence Occupational Exposure (AIOE) measure to assess AI's potential impacts on occupations within these sectors, and consulted with numerous sector stakeholders and AI experts through qualitative research methods.

This report represents the culmination of a comprehensive research effort, providing NJEDA with evidence-based workforce strategies specifically designed for New Jersey's life sciences and technology sectors. The Heldrich Center synthesized the findings into 7 workforce strategies and 15 actionable recommendations to operationalize these evidence-based suggestions for these two critical sectors.

These strategies aim to capitalize on existing investments and programs across the state, enhance workforce readiness, and promote innovation that easily adapts the integration of AI technologies.

This work builds upon New Jersey Governor Murphy's identification of AI adoption as a strategic priority and aligns with the Governor's economic development strategic plan. NJEDA has already invested in three Strategic Innovation Centers — NJ AI Hub, NJ Nokia Bell Labs Innovation Center, and NJ Biomedical Strategic Innovation Center — to catalyze innovation and workforce development in life sciences, technology, and AI, ensuring that this research will foster critical investments and programming in New Jersey.

KEY TAKEAWAYS

The multimodal research approach to understanding the influence of AI on the workforce within the life sciences and technology sectors in New Jersey yielded the following insights:

> The impact of AI, particularly Generative AI (GenAI), on New Jersey's economy, especially in the life sciences and technology sectors, remains uncertain as the technology evolves. AI is already integrated into various jobs globally, from automating text to analyzing medical images, and AI-related job postings in biopharmaceuticals have increased significantly. GenAI is expected to accelerate automation, enhance creativity, and streamline workflows, but its full impact, including workforce changes, is speculative and will vary across organizations. As enterprises experiment with AI use cases, the technology will transform roles, tasks, and skills, potentially creating new job opportunities and reshaping workforce planning. While larger companies may see benefits in the early stages of AI integration, sector-based collaboration and governmental policy will be essential to ensure that workforce strategies support workers and businesses through this transition.

> The labor market scan revealed several key trends within the workforce for each sector:

  • Jobs in New Jersey's **life sciences** sector are primarily concentrated in the northern and central regions of the state, with Middlesex County hosting the majority of establishments. By 2033, the state is expected to see significant growth, including 5,300 new jobs in scientific research and development services and pharmaceutical and medicine manufacturing, as well as a 13% increase (1,800 jobs) in industrial machinery mechanics. The workforce has also diversified, with the number of Asian workers doubling since 1997.

  • Employment in New Jersey's **technology** sector is concentrated in central New Jersey, with significant growth projected for computer systems design and related services by 2033. The workforce has seen a 233% increase in Asian workers since 1997, and there has also been growth among older workers, raising concerns about expanding retirement risks. New Jersey is expected to add 15,000 jobs for software developers by 2033, while job losses (420 jobs) are anticipated for computer programmers, potentially indicating a decline in demand for this role.

> The assessment of AI exposure revealed similar results for both the life sciences and technology sectors in New Jersey. Using a novel dataset from Felten et al. (2021), Heldrich Center researchers found that business and finance occupations tend to have high AI exposure, meaning that the tasks and responsibilities associated with those jobs are at risk of becoming automated. For example, business and finance occupations represented 8% of jobs in the life sciences sector as of 2023, but 93% have high AI exposure. Within the technology sector, computer and mathematics occupations have moderate (44%) and high (56%) AI exposure, respectively. Conversely, production occupations in both the life sciences and technology sectors — and across every industry and subsector — had very low AI exposure. Such findings align with existing literature, as well as this study's findings, in that certain jobs are more AI-facing (e.g., accountants and auditors, computer programmers, marketing analysts) and, therefore, have greater risk of performing tasks that will become automated. At the same time, jobs that fall under the production occupation, such as industrial machinery mechanics and laborers and freight, stock, and material movers, are less likely to encounter AI and have lower AI exposure.

> AI experts and stakeholders from New Jersey's life sciences and technology sectors highlighted the evolution and transformative impact of AI. From traditional algorithms to modern machine learning and neural networks, AI has overcome challenges in speed, computing power, data quality, and the availability of skilled professionals. GenAI is enhancing workers' capabilities by boosting productivity, particularly for novice workers, and is revolutionizing sectors like biopharmaceuticals, drug development, and personalized medicine. The shift toward leadership, communication, and domain knowledge is critical for organizational adaptation, with an emphasis on diversity and ethical AI use. Policymakers must be educated to create informed regulation, while training pipelines are essential to equip workers with the AI-related skills they will need to be successful in their roles. Stakeholders from both sectors stressed that clear communication between employers and educators is key to meeting evolving industry needs.

> The analysis highlighted several strengths, weaknesses, opportunities, and threats (SWOT) in New Jersey's life sciences and technology sector workforces and healthcare ecosystem.

  • For the **life sciences** sector, strengths include projected job growth over the next decade, a highly educated talent pool, a thriving innovation environment, and collaboration with international partners that increases investment. The state's large employers and advancements in healthcare technology further support its economic growth. Weaknesses include fewer job opportunities in southern New Jersey, higher vacancy rates in properties and laboratories, and prohibitive educational requirements for some roles. Additionally, concerns over data privacy and the pace of AI/GenAI adoption may hinder innovation. Opportunities lie in using AI to address health inequities, improve gender diversity, support minority-owned businesses, and expand educational initiatives. There is also potential for creating more career pathways, particularly for underrepresented groups. However, threats such as job displacement in specific occupations due to AI and the impact of the Inflation Reduction Act on the biopharmaceuticals sector pose challenges. Furthermore, the rapid pace of technological change and regulatory hurdles may slow adoption.

  • For the **technology** sector, strengths include a robust talent pipeline, integration of AI skills into education and training, a concentration of universities with research and development units, strong partnerships, and high-quality training opportunities supported by a highly adaptable workforce and advanced technology infrastructure. However, weaknesses include the absence of AI regulations, resource limitations for small and mid-sized businesses, employment concentration in specific areas of the state, and existing barriers for disadvantaged groups. Additionally, there is difficulty of defining the sector itself, since it encompasses and overlaps certain occupations within other sectors such as life sciences. Opportunities lie in increasing workforce diversity; expanding science, technology, engineering, and mathematics (STEM) education; creating new credential pathways; leveraging AI-focused initiatives; and fostering collaborations. Yet, threats to the sector such as an aging workforce, risks associated with AI exposure in certain occupations, and a reactionary environment driven by a lack of regulation could impede progress without strategic intervention.

Based on these key takeaways derived from each research method, Tables 1 and 2 summarize the strategies and recommendations for both the life sciences and technology sector workforces in New Jersey.

Table 1: Summary of Workforce Strategies and Recommendations for the Life Sciences Sector

#	Workforce Strategy	#	Recommendation
1.0	Expand education-to-employment pathways in the life sciences sector.	1.1	Expand training opportunities, such as foundational biotechnology training, and accessible career pathways via enhanced engagement with the New Jersey Department of Labor and Workforce Development's (NJDOL) industry partnerships.
2.0	Facilitate collaboration between state agencies to cultivate education and training opportunities focused on retaining top talent in New Jersey.	2.1	Strengthen postsecondary opportunities that support the education-to-employment pipeline to better align with the needs of the life sciences sector and help continue to foster talent.
		2.2	Develop targeted career mapping in collaboration with key sector stakeholders.
		2.3	Invest in statewide STEM educational initiatives aimed at K–12 students.
		2.4	Offer incentive mechanisms through state agencies that promote skills development and continued education to increase retention among top talent in New Jersey.
3.0	Direct resources and investments around workforce development in southern New Jersey.	3.1	Create a targeted marketing campaign in southern New Jersey to highlight existing programs in the state, with an emphasis on supporting businesses of all sizes and promoting current employment opportunities in the region.
		3.2	Explore a tax credit program for employers in the life sciences sector to attract new businesses to the southern region of the state.
		3.3	Prioritize efforts that strengthen partnerships with education and training providers in southern New Jersey.
4.0	Develop guidance around skills-based hiring and competency to strengthen talent acquisition and workforce diversity.	4.1	Implement the skills-based hiring guidance and competency model tailored specifically to the life sciences sector.

Table 2: Summary of Workforce Strategies and Recommendations for the Technology Sector

#	Workforce Strategy	#	Recommendation
1.0	Identify strategies and initiatives to promote diversity, equity, inclusion, and accessibility (DEIA) for the workforce in the technology sector.	1.1	Strengthen and expand existing programs, such as the Pathways in Technology Early College High School (P-TECH) model, that specifically address gaps in DEIA in the technology sector.
		1.2	Invest in targeted recruitment efforts that specifically engage underserved and underrepresented communities across the workforce development cycle, including career awareness, training, and employment.
		1.3	Expand access to entry-level positions and reduce barriers that may hinder equitable access to such opportunities.
2.0	Expand and strengthen key partnerships to better align goals across industry, educational institutions, and employers.	2.1	Consider the strategic development of targeted public-private partnerships for the technology sector in New Jersey.
3.0	Develop programs or initiatives that enhance domain knowledge and technical proficiency skills that allow participants to develop deeper understanding and practical application of AI.	3.1	Develop and implement training programs that offer an introduction to AI for New Jersey residents employed in the technology sector.
		3.2	Adapt the New Jersey AI Task Force's "Your Future of AI" survey of public-sector workers to reach broader audiences.

These workforce strategies provide NJEDA and other relevant stakeholders with effective ways to create meaningful opportunities while optimizing current investments across New Jersey. By prioritizing innovation and leveraging top talent from diverse backgrounds and identities, these strategies aim to strengthen the state's economy and drive inclusive growth. Through this work, New Jersey is well-positioned to further expand the footprint of its life sciences and technology sectors, further fueling the state as a hub of inclusive AI innovation.

INTRODUCTION

The Heldrich Center has prepared a report regarding innovative sector-specific workforce strategies for the life sciences and technology sectors in New Jersey for NJEDA as part of a collaborative research study aimed at understanding AI's intersection with these priority sectors and their respective workforces. The workforce strategies included in this report have been derived from the Heldrich Center's multimodal research study, including a literature review, labor market scan, qualitative data collection with AI experts and sector stakeholders, and SWOT analyses. This report is also informed by the Heldrich Center's expertise in workforce development policies and programs and involvement with key ongoing initiatives in the state, including the New Jersey Governor's Office AI Task Force.

In this report, the Heldrich Center outlines a series of workforce sector strategies for the life sciences and technology sectors. The report also offers recommendations for how each strategy can be effectively implemented. To further aid implementation, the Heldrich Center also highlights real-world examples of models and programs where similar strategies have been applied, or where the existing structures could be adapted to support the proposed recommendations. These examples are intended to guide NJEDA and other relevant stakeholders in developing future implementation plans and policy. The workforce strategies seek to build upon ongoing initiatives and proven program models, strengthening the capacity, innovation, and inclusivity of the workforces in the life sciences and technology sectors.
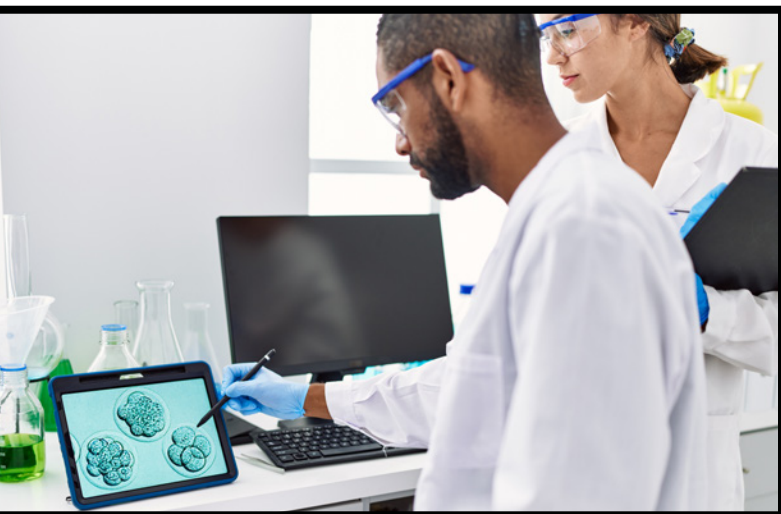
METHODOLOGY

The Heldrich Center used a mixed-methods approach for this study, incorporating a literature review, labor market scan, an assessment of AIOE, SWOT analyses, and semi-structured interviews and focus groups. Researchers employed these data collection efforts to gain clarity on the study's two overarching objectives:

OBJECTIVES

1 To establish a baseline understanding of the workforce characteristics and changing dynamics of the life sciences and technology sectors in New Jersey.

2 To understand how AI is currently affecting occupational demand and skill requirements for occupations in these sectors and predict how likely AI is to affect them in the future.

The Heldrich Center outlines the details of the study's research components below. See Appendix A for the relevant definitions used in all components of this research study.

LITERATURE REVIEW

To assist with the development of the qualitative research protocols and contextualize the study findings, the Heldrich Center conducted a review of literature on the deployment of AI and GenAI in the U.S. economy, as well as in the life sciences and technology sectors more specifically. The literature review focused on the impacts of AI, specifically GenAI, on jobs, workers, and organizations in the United States, using academic literature, media articles, and nonprofit research studies to summarize how the emerging technology may affect the labor market and workers, what stakeholders may consider when planning to deploy GenAI, and the role of public policy in facilitating how workers and leaders adapt. A specific emphasis on developments and initiatives in New Jersey is also described in the literature review. The literature review was an iterative document, with researchers completing three versions of it over the course of the study period. Researchers chose to develop an iterative literature review to capture new developments, studies, and/or prevailing dialogues in the AI and GenAI space, which is in a state of constant development. The literature reviews were delivered to NJEDA in April and July 2024, and the final version was released to the public in March 2025.

LABOR MARKET SCAN

The Heldrich Center conducted the labor market scan to better understand the life sciences and technology sectors in New Jersey. Researchers referenced NJDOL's industry sector information to define and examine the subsectors and industries associated with the life sciences and technology sectors (NJDOL, Office of Research and Information, 2021a, 2021b). Researchers leveraged Lightcast[1] and the Quarterly Workforce Indicators Explorer to examine key labor market information, including jobs, average earnings, establishments, location quotients, as well as demographic characteristics, by industry, occupation, and county. Researchers also used Lightcast to provide 10-year job projections for specific industries, occupational groups, and occupations. Data from the labor market scan include three classes of workers: the Quarterly Census of Employment and Wages (QCEW) employees, non-QCEW employees, and self-employed workers. A preliminary labor market scan analysis was presented to NJEDA, which was then followed by a final labor market scan memo and presentation. This work was conducted from February to June 2024.

ASSESSMENT OF AI EXPOSURE

Researchers used the novel dataset from Felten et al. (2021) to also assess the exposure risk of AI for occupations in the life sciences and technology sectors in New Jersey. The dataset assigns an AIOE score based on whether tasks for that occupation are at risk of becoming automated. Using the standardized score, researchers identified occupations with low, moderate, or high exposure to AI, and presented the proportion of workers employed under each occupation in New Jersey with that exposure. See Appendix B for greater detail on the Heldrich Center's application of the AIOE measure. This analysis was conducted from February to June 2024 and may not fully reflect recent developments or changes in AI technology.

INTERVIEWS AND FOCUS GROUPS

To address the overarching goals of establishing a baseline understanding of the current workforce landscape in the field, researchers conducted semi-structured interviews and focus groups. A total of 19 semi-structured interviews with 25 individuals were conducted via Zoom. Interviews were 60 minutes in length and took place between March and July 2024. Additionally, researchers conducted two 60-minute focus groups in April 2024, with a total of 14 participants. In total, the Heldrich Center connected with 39 individuals for the qualitative component of this study. Stakeholders participating in the interviews and focus groups

represented academia, large- and medium-sized business enterprises, state agencies, nonprofit organizations, sector-focused associations, and community-based organizations. The sample of stakeholders was recruited based on the Heldrich Center's research of relevant actors in the sectors, suggestions from NJEDA, and engagement with sector associations, such as BioNJ and the Healthcare Institute of New Jersey. Stakeholders represented organizations such as the Central New Jersey Life Sciences Industry Partnership, Bristol Myers Squibb, Nokia Bell Labs, Johnson & Johnson, SciMar ONE, Inc., MediaTek, Cranium AI, and others. All qualitative data collected in the interviews and focus groups were systematically coded and analyzed. A coding scheme was drafted by two researchers and verified by the full research team before coding commenced. Researchers used NVivo — a qualitative data analysis software package — to code all qualitative data, which yielded insights on the prevalence of themes across research modes.

SWOT ANALYSIS

Using the aforementioned sources of quantitative and qualitative data, the Heldrich Center then conducted two SWOT analyses — one for each sector — to highlight existing programs, policies, regulations, investments, and more. These analyses were conducted between August and September 2024. The SWOT analyses sought to provide NJEDA with an assessment of the state of the life sciences and technology sectors to inform future programming and investments.

These combined methodologies are the basis for the sector-specific workforce strategies outlined in this report. The Heldrich Center further supplemented the analyses in this report with researchers' experience and expertise in the workforce development field, as well as knowledge and/or involvement in ongoing key initiatives in the state involving AI and the workforce. For the purposes of this report, any references to AI means all AI technologies that have the potential to impact the workforces within the life sciences and technology sectors.

BACKGROUND

RESEARCH CONTEXT

The specific ways in which AI will impact the New Jersey economy, particularly in the life sciences and technology sectors, and the use cases that will emerge from its application, are uncertain as the technology evolves. AI technology is known and used by workers in today's labor market, as tools are currently being used daily by workers globally — for example, auto-completing text, auto-composing content, analyzing diagnostic imaging, and conducting meta-analyses of scientific literature (Gartner, 2023). In the United States, a 2024 Gallup survey found

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[1] Lightcast is an analytical tool with labor market information from various data sources, including QCEW, the American Community Survey, and more. Users can generate reports on data by occupations, programs, job postings, industries, and regions. For more detailed information, please visit the Lightcast knowledge base: https://kb.lightcast.io/en/.

that one in three workers reported AI technology or tools are being integrated into their organizations (33%); the same number — one in three — said they have used AI in their jobs (Houter, 2024). The underlying technology of AI, using machine-learning algorithms, is not new; however, the complexity of the new data created, and scale of that data, sets current and future applications and impacts of GenAI apart from previously known AI applications (Zewe, 2023; Orrell & Veldran, 2024).

Use cases of GenAI are iterative and, in many ways and for many enterprises, not yet conceived by government and most employers, even as deployment has begun for enterprises in the life sciences and technology sectors. For example, according to McKinsey & Company, AI-related job postings in the biopharmaceuticals industry have increased by 43% each year from 2018 to 2023 for the 10 leading pharmaceutical companies in the United States (Shah et al., 2024). Leaders of large corporations expect that, as with any technological change, a restructuring of the workplace will likely be needed, but many factors will determine where disruption occurs, and how quickly (Singhania, 2024). In general, when implemented, GenAI will accelerate automation, enhance creativity and innovation, and streamline workflows, to improve business and customer outcomes. Potential for automation (and purported, eventual exposure to GenAI technology), based on work tasks, is a predictor of impact, in addition to potential for "complementarity" (Cazzaniga et al., 2024). Estimates vary considerably; measuring and realizing the potential gains and accompanying shifts in organizational structure and workflow is speculative, giving rise to the need for companies to explore, experiment, pilot, and assess use cases of the technology (Lamarre et al., 2024).

GenAI will be implemented by enterprises that can ultimately measure and prove the technology's efficiency and/or effectiveness compared to current business practices; organizations having the capacity to pilot early use cases that demonstrate this value will lead deployment (Shah et al., 2024; Ratan et al., 2023; O'Donoghue & Roberts, 2024). These use cases — what systems, jobs, roles, tasks, and skills will either be replaced, supplemented, augmented, complemented, or created by GenAI — will impact the work activities undertaken by current and future workers, workforce planning and hiring decisions made by leaders, and, in turn, will ultimately impact credential pathways. Yet a "democratization of knowledge" in GenAI will occur for nearly all workers and organizations, with profound impacts on product ideation, process efficiency, organizational productivity, and personalization of products and services (Perri, 2023).

As development and adoption of GenAI in the labor market continues, experts agree that AI-facing jobs should be "decomposed" by tasks, and therefore skills, which will ultimately affect recruitment, upskilling, and reallocating talent in the workplace (Scoble-Williams et al., 2023; Daugherty et al., 2023). Notably, as with any technological innovation introduced into the labor market, new roles within sectors and organizations will likely be created (Lucas, 2023; Kempton, 2024; Shook & Daugherty, 2024). According to McKinsey & Company, approximately 12 million "occupational transitions" might be expected in the next five to six years, and a "reweighting" toward higher-wage jobs is possible (Ellingrud et al., 2023). Research suggests that there is some potential for reducing wage inequality, benefitting lower-skilled and lower-wage workers (Wilmers, 2024). In some cases, lower-wage workers may be more likely to need to transition compared to higher-wage workers, requiring upskilling and reskilling to do so. Chui et al. (2023) have written that workers with the highest levels of education will be affected the most. Yet researchers found that lower-skilled workers may experience a "leveling effect" that will allow them to enter the labor market easier, by improving job performance, decreasing the need for workers with advanced writing skills and other tasks replaced or supplemented by GenAI (Orrell & Veldran, 2024). On an organizational level, enterprises with more resources and access will disproportionately benefit from a quicker understanding and adoption of GenAI, compared to smaller, less-connected enterprises (Wilmers, 2024; Carlsson-Szlezak et al., 2023).

Sector-based collaboration within the labor market will be key as GenAI deployment continues. Research has shown that enterprises and government should plan for GenAI deployment mechanisms that are "worker-centered" and "domain-based" within sectors of the economy (Orrell & Veldran, 2024; Alavi, 2024; Shah et al., 2024; Relyea et al., 2024; Shelly Brown et al., 2023). Given the expected impact of GenAI on jobs and workers, the implementation of policy that supports the labor force and business will require targeted government-led workforce strategies, inclusive of but not limited to public training and incentive programs, that are rooted in continuous dialogue and collaboration between secondary and postsecondary institutions, industry, and government.

LANDSCAPE OF NEW JERSEY

The following subsections discuss the workforce landscape for the life sciences and technology sectors in New Jersey.

LIFE SCIENCES SECTOR

The workforce in the life sciences sector is becoming increasingly important as entities in New Jersey develop and adopt AI and GenAI technologies. Guided by NJDOL's identification of the life sciences industry cluster, the life sciences sector includes three industries and five subsectors as shown in Table 3. Provided below is high-level labor market information of particular relevance for the workforce strategies.

Table 3: Jobs within Industries and Subsectors in the Life Sciences Sector

| Life Sciences Sector			
Industry	**Subsector**	**Jobs**	**Percent**
Pharmaceuticals	Pharmaceutical and medicine manufacturing	28,762	33%
	Soap, cleaning compound, and toiletry manufacturing	9,705	11%
Biotechnology	Scientific research and development services	36,217	42%
Medical Devices	Medical equipment and supplies manufacturing	11,656	14%
Total		**86,340**	**100%**

Source: Lightcast (n.d.)[2]

As of 2023, most jobs in the life sciences sector were concentrated in scientific research and development services (36,217) followed by pharmaceutical and medicine manufacturing (28,762). These jobs tend to be concentrated in northern and central New Jersey, with high location quotients[3] in Somerset County (5.17) and Union County (4.66). Most establishments are located in Middlesex County. The number of Asian workers has grown substantially in the life sciences sector in the past 30 years, doubling since 1997.

The scientific research and development services and pharmaceutical and medicine manufacturing subsectors are projected to grow in the next 10 years. For example, New Jersey is projected to add 1,823 industrial machinery mechanics by 2033, increasing by 13%. Figure 1 shows which counties will see the most jobs added for industrial machinery mechanics in New Jersey. The state will also add approximately 1,400 packaging and filing machine operators and tenders and 1,000 first-line supervisors of production and operating workers. These occupations, among many others projected to increase by 2033, illustrate the importance of manufacturing in New Jersey as the life sciences sector continues to grow.

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[2] Data presented in Tables 3 and 4 include the most recent year available within Lightcast and represent three classes of workers: QCEW employees, non-QCEW employees, and self-employed workers. For more detailed information, please visit the Lightcast knowledge base: https://kb.lightcast.io/en/.

[3] A location quotient quantifies the concentration of a specific characteristic in one region compared to the nation. This study most commonly uses location quotients to demonstrate the concentration of jobs in each county relative to the United States. For more detailed information, please visit the Lightcast knowledge base: https://kb.lightcast.io/en/articles/7934027-location-quotient-lq.

Figure 1: Number of Projected Jobs for Industrial Machinery Mechanics in New Jersey, by County
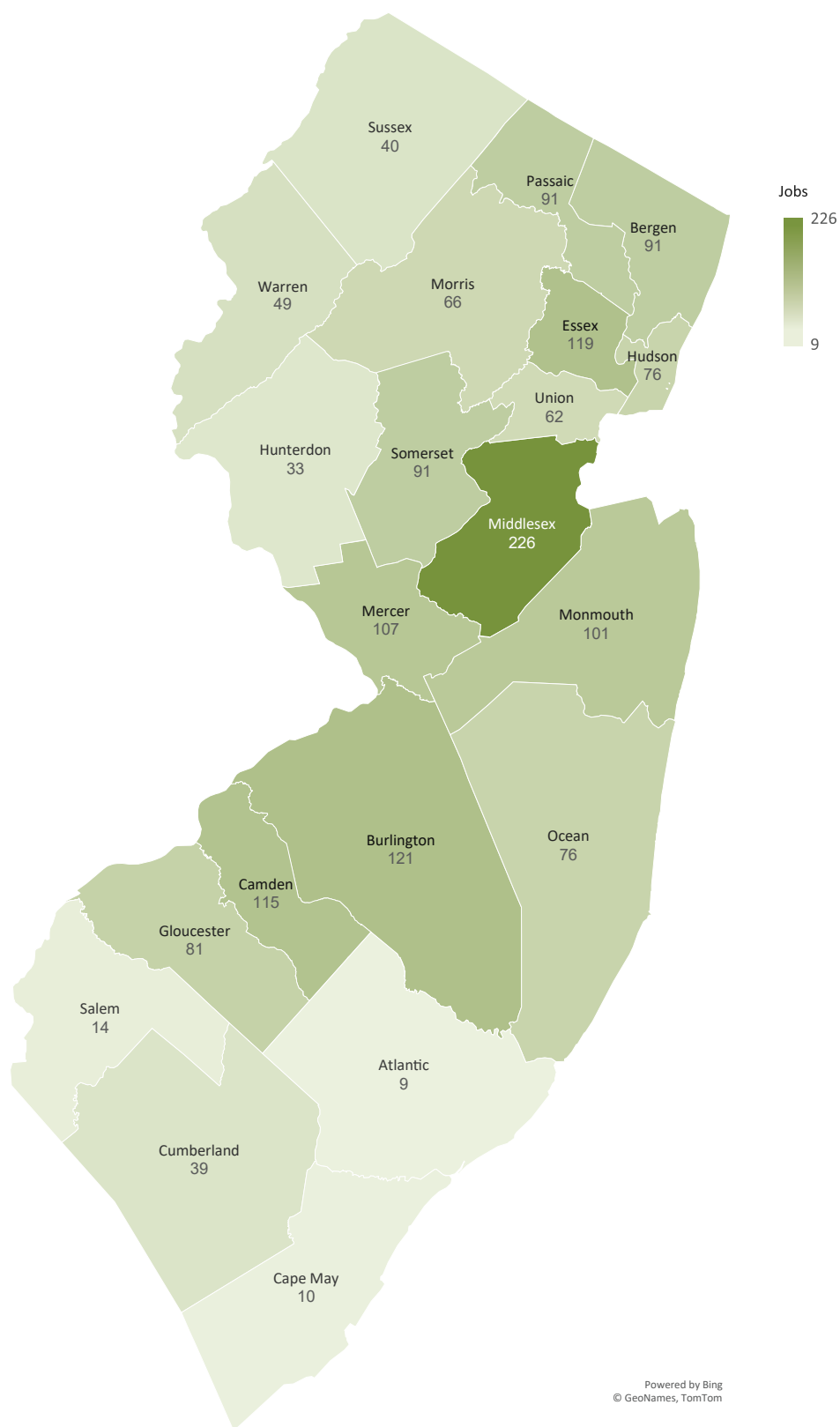
N = 1,617

Note: Figure 1 does not represent all 1,823 projected jobs in New Jersey, as 206 jobs are not reported under any specific county.

Using a novel dataset from Felten et al. (2021), Heldrich Center researchers found certain occupational groups have high exposure to AI.[4] Employing the AIOE measure, they found that business and finance occupations represent 8% of jobs in the life sciences sector as of 2023, and 93% have high risk of AI exposure. In other words, these jobs contain tasks and/or responsibilities at risk of becoming automated. Within this occupational group, 34% of accountants and auditors are at risk of high AI exposure, followed by 17% of management analysts and 16% of market research analysts and marketing specialists. Additionally, 62% of the office administration occupational group has high exposure to AI. Conversely, jobs in production have very low risk of being exposed to AI.

TECHNOLOGY SECTOR

Given the emergence of AI and GenAI, the technology sector will play an increasingly important role in the labor market in New Jersey. Heldrich Center researchers used guidance from NJDOL around what constitutes the technology sector, which includes two industries and six subsectors (see Table 4). Presented below is high-level labor market information of particular relevance for the workforce strategies.

Table 4: Jobs within Industries and Subsectors in the Technology Sector

| Technology Sector			
Industry	**Subsector**	**Jobs**	**Percent**
Professional, Scientific, and Technical Services	Software publishers	12,351	6%
	Telecommunications	21,876	10%
	Data processing and related services	14,847	7%
Information	Architectural engineering and related services	45,618	21%
	Computer systems design and related services	89,317	40%
	Scientific research and development services	36,582	17%
Total		**220,591**	**101%**

Note: Total may not sum to 100% due to rounding.

Source: Lightcast (n.d.)

As of 2023, there were 220,591 jobs in the technology sector in New Jersey, with 40% concentrated in computer systems design and related services. Since 2019, the number of jobs has increased by 15%. Jobs tend to be concentrated in central New Jersey, particularly Middlesex County (31,000) and Somerset County (23,000). Similar to the life sciences sector, an assessment of demographic characteristics from the Quarterly Workforce Indicators Explorer revealed that the number of Asian workers in the technology sector has increased by 233% since 1997. Over the same period, the number of workers aged 45 and older has steadily increased, heightening the retirement risk for technology sector occupations across the state.

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[4] The AIOE score measures the degree to which specific occupations or tasks are affected by the implementation of AI technologies. Simply put, the measure looked at how AI affects jobs with different skill and knowledge requirements. For example, tasks that require physical dexterity, social intelligence, or empathy may be less likely to be affected by AI, while jobs involving routine cognitive tasks like data analysis or document review are more exposed. For more detailed information about AIOE scores, please read the article by Felten et al. (2021): https://doi.org/10.1002/smj.3286.

Figure 2: Number of Projected Jobs for Software Developers in New Jersey, by County

Jobs
2,173

11
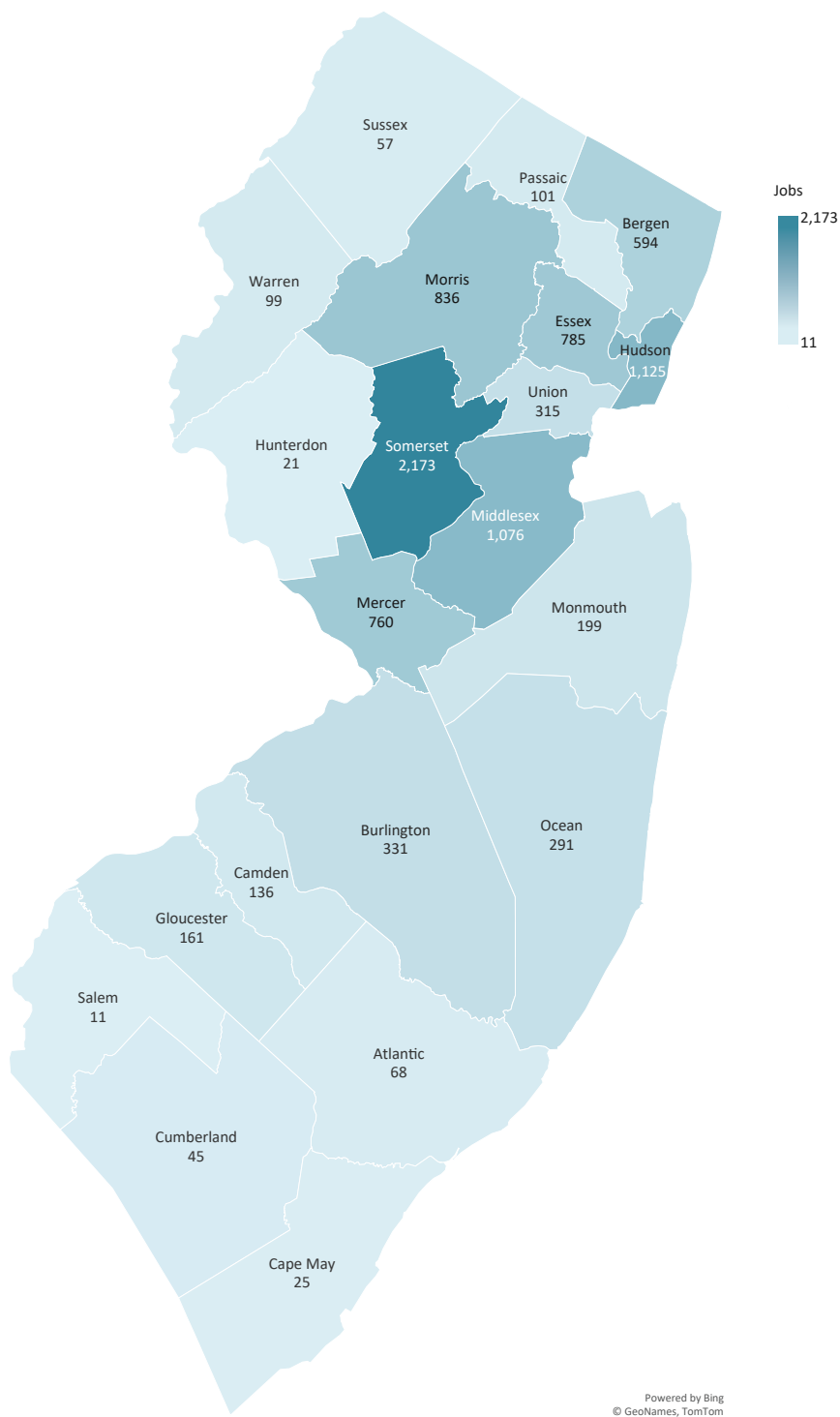
N = 9.209

Note: Figure 2 does not reflect all 14,814 projected jobs for software developers, as 5,605 jobs are not reported under any specific county in New Jersey.

Computer systems design and related services is a subsector with occupations projected to grow in the next 10 years. For example, New Jersey will add approximately 15,000 software developer jobs by 2033. Figure 2 illustrates where those projected jobs will be added, particularly in central New Jersey. Some occupations are expected to experience job loss, however, including computer programmers (420 jobs), over the next 10 years, potentially suggesting less demand. These projections are crucial considering the current development and adoption of AI technologies across sectors, but particularly in technology.

Based on the standardized AIOE score, researchers found that certain occupational groups were at greater risk of AI exposure. The architectural and engineering services occupational group represents around 24,000 jobs — or 11% — in New Jersey, and 56% have high exposure to AI. Across the two industries under the technology sector, 93% to 94% of jobs in business and finance have high risk of AI exposure. Computer and mathematics occupations are also at moderate (44%) and high (56%) exposure, respectively. There are specific occupations under this grouping that have high exposure to AI, including computer systems analysts (16%). At the same time, 21% of computer user support specialists have moderate exposure to AI. Most notably, the risk of AI exposure for the production occupational group is very low for both industries.


NEW JERSEY STRATEGIC INVESTMENTS

In New Jersey, statewide AI adoption has been identified as a strategic priority by Governor Murphy and is aligned with the Governor's broader economic development strategic plan. In January 2024, Governor Murphy announced New Jersey's "AI Moonshot" to capitalize on the state's world-leading investments and initiatives in the realm of AI, including:

> Formation of New Jersey's first-ever Task Force on AI, charged with studying the societal impact and encouraging the ethical use of AI;

> Establishment of a statewide initiative to train public-sector workers to use GenAI to help New Jersey residents access benefits;

> Issuance of the state's first policy on AI use to guide state employees to responsibly use GenAI to improve how government delivers services to New Jersey's residents;

> Promotion of international alliances to advance collaborative research and development in AI and create jobs in the industries of the future; and

> Appointment of New Jersey's first-ever Chief AI Strategist, Dr. Beth Simone Noveck, who will play a leading role in shaping the trajectory of New Jersey's AI Moonshot.

In addition, NJEDA has invested in three Strategic Innovation Centers that will leverage state and private funding to catalyze innovations and workforce development in life sciences, technology, and AI: NJ AI Hub, NJ Nokia Bell Labs Innovation Center, and NJ Biomedical Strategic Innovation Center. These investments are an opportunity to advance workforce development and grow employment in critical innovation industries in southern New Jersey and other parts of the state.

NJ AI HUB

NJEDA, Princeton University, Microsoft, and CoreWeave will be founding partners in the NJ AI Hub. The NJ AI Hub will serve as a state-of-the-art, collaborative ecosystem that integrates world-class research, innovation, education, and workforce development. As part of this investment, Microsoft will leverage its TechSpark program to provide expertise and resources for AI skilling and workforce development to create opportunities for innovation in New Jersey and the region. The NJ AI Hub will help position New Jersey as a leading East Coast center for AI innovation. It will be located along Route 1 — New Jersey's innovation corridor — in Princeton.
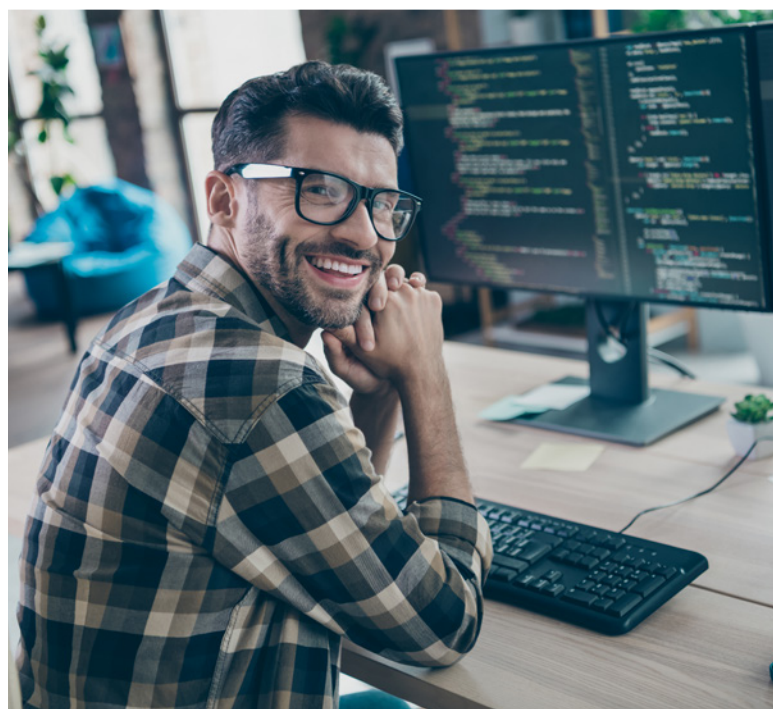
The founding partners will focus on research and development, commercializing and accelerating innovation, and strengthening AI education and workforce development. To advance the goal of strengthening AI education and workforce development, the NJ AI Hub will work closely with New Jersey's higher education community to promote high-quality talent development at all levels. By developing shared curricula, projects, and teaching tools for AI courses; training community college faculty in teaching AI; and creating upskilling opportunities to help workers across disciplines apply AI in their work, the NJ AI Hub will coordinate efforts to build the state's pool of AI talent. Ongoing collaboration with employers will ensure that education and training programs are providing trainees with industry-recognized credentials and in-demand skills for the workforce. The NJ AI Hub will also be able to connect employers with opportunities to host AI apprenticeships, develop customized upskilling training for their workers, recruit talent from New Jersey schools for jobs and internships, and partner with project-based AI courses at the undergraduate and graduate levels.

NJ NOKIA BELL LABS INNOVATION CENTER

NJEDA will partner with Nokia Bell Labs, the industrial research arm of Nokia, to launch a Strategic Innovation Center consisting of the NJ Nokia Bell Labs Innovation Center and Bell Labs Venture Studio. The innovation center will focus on enabling start-ups to accelerate and commercialize intellectual property from Nokia Bell Labs and local universities with an emphasis on the fields of communication, AI, cloud computing, and optical and wireless networks.

NJEDA plans to make a $25 million investment to support the NJ Nokia Bell Labs Innovation Center and the Bell Labs Venture Studio. The NJ Nokia Bell Labs Innovation Center will be located along the state's innovation corridor at the planned Health & Life Science Exchange 2 (HELIX NJ) building in New Brunswick. The Bell Labs Venture Studio will initially be located at Nokia Bell Labs' Murray Hill campus by mid-2025 and will later be housed within the NJ Nokia Bell Labs Innovation Center.

The NJ Nokia Bell Labs Innovation Center will be a 13,500 square feet co-working office and lab space and offer specialized equipment to support the companies' ongoing research. The center will provide emerging companies with necessary business training, operating services, physical space, and management guidance to transform their research into commercially viable products and services. Nokia plans to partner with at least one of the state's engineering schools, which will allow the companies at the center to benefit from various university resources.

The Bell Labs Venture Studio will be operated by the Nokia Ventures team, and over a five-year period, the studio will facilitate company creations that are expected to generate hundreds of high-skilled jobs in the state.

NJ BIOMEDICAL STRATEGIC INNOVATION CENTER

NJEDA and the Coriell Institute for Medical Research will create the NJ Biomedical Strategic Innovation Center in Camden, leveraging the world-class assets available at Coriell to support biomedical research and innovation. The new innovation center will be fully equipped with state-of-the-art incubator and laboratory spaces for emerging biotech companies and will drive economic growth in the region, establishing Camden as a leader in life sciences innovation. The project is expected to create approximately 150 new permanent jobs, plus 100 construction jobs. The NJ Biomedical Strategic Innovation Center will encompass approximately 45,000 square feet at the Lewis L. Coriell Medical Research Center in Camden. NJEDA intends to invest $20 million to support the new innovation center. The Coriell Institute for Medical Research will invest over $21 million to construct the innovation center, including lab and co-working space that will house specialized equipment and offices.

VOICES FROM THE FIELD

This study used a mixed-method approach that featured structured interviews and focus groups with key stakeholders and AI experts in the life sciences and technology sectors. Members of the Heldrich Center research team also took part in state-led working sessions, meetings, and conferences focused on examining AI's effects within the state. This section presents insights from these interactions, capturing both the voices of field participants and findings from the formal qualitative research. Together, these sources offer a comprehensive view of expert and stakeholder perspectives on AI's influence and implications for workforce dynamics in these sectors.

Interviews and focus groups brought to light several key themes around AI adoption and its impact in the life sciences and technology sectors (see Appendices C and D for the research instruments used in this study). Though a range of issues were discussed (see Appendix E for a full summary of the themes identified in this component of the research), the main findings from the qualitative research centered around five primary areas: equity and bias concerns, education and upskilling, workforce impacts, business size and AI adoption, and ethical and policy considerations. Table 5 summarizes the themes and key points from the interviews and focus groups.

Table 5: Themes and Data Summaries from Interviews and Focus Groups

Theme	Data Summary
Equity and Bias Concerns	> The need for human oversight > Concerns about bias via various entry points > Potential applications to correct historical inequities
Education and Upskilling	> The need for adaptation and upskilling > The value of foundational skills, including general literacy, digital and AI literacy, critical thinking, domain knowledge, technical proficiency, and communication > The role of educational institutions > Foster a robust workforce pipeline
Workforce Impacts	> AI augmentation of job roles > Predictions of job creation over job displacement
Business Size and AI Adoption	> A slower pace of innovation for small businesses
Ethical and Policy Considerations	> The need for policies prioritizing transparency and explainability > A need for AI regulation that considers ethical AI practices but do not stifle innovation

EQUITY AND BIAS CONCERNS

AI has been evolving and will continue to evolve rapidly in the coming years, and with it comes enormous potential and capabilities (McKinsey & Company, 2024). This aligns with sentiments expressed during the study's qualitative data collection. While stakeholders acknowledged the incredible opportunities that AI presents, several stakeholders cautioned about the necessity of human oversight. Stakeholders suggested that AI outputs need to be monitored closely for bias and accuracy, requiring human oversight to identify and correct any bias resulting from AI outputs. One stakeholder pointed out that AI is prone to producing biased and inaccurate outputs due to the way datasets are constructed and the type of data of which they are comprised. This issue was said to be especially true when AI technologies and tools are used for decision-making and based on datasets that, when combined, do not reflect the population or reality of interest.

"If the data that you have to train your tool on is biased and is not a complete and fair representation of the environment where you want to apply the tool, then your AI tool and your model will be biased because they're trained on non-representative data."

- Stakeholder in the technology sector

For several stakeholders, bias was regarded as a serious concern, particularly in the context of DEIA. Stakeholders highlighted concerns about the potential harm AI could cause for historically underserved and underrepresented groups that are perceived to be at an increased risk for experiencing negative impacts of bias produced by AI technologies. Stakeholders explained that this vulnerability arises from two main issues: the underrepresentation of these groups in datasets and the tendency of some datasets to generate outputs that are either exaggerated or diminished in harmful ways. Moreover, stakeholders explained that when AI models are trained on biased data, the resulting outputs — and any decisions resulting from those outputs — will be biased, and it should be anticipated that decisions made on biased data will have negative consequences.

In contrast to the concern expressed regarding the possibility of negative impacts on certain groups, a few stakeholders representing both the life sciences and technology sectors felt that there is significant potential for AI to improve historic health inequities. These stakeholders detailed that AI technologies could combine disparate datasets, resulting in more balanced datasets that increase the ability to learn from a representative population. This was said to be especially notable for women and people of color who have

been historically underrepresented in health data, thereby enhancing the capabilities of precision medicine.

"I think with AI, we will be able to move forward a lot easier because we'll be able to use those datasets from different ethnicities and cultures and backgrounds that we weren't able to use before."

- Stakeholder in the life sciences sector

Stakeholders also discussed AI's ability to act as a mitigator to address inequities in access to education and training. A few stakeholders highlighted how AI tools could help bridge skill gaps often faced by underserved groups due to unequal educational opportunities. They explained that by increasing access to information, AI can serve to "level the playing field" by supplementing workers' knowledge and enabling them to develop their skills and improve their performance on the job.

EDUCATION AND UPSKILLING

The education and upskilling of workers emerged as an important topic in conversations about AI adoption and integration among sector stakeholders and AI experts. Nearly all stakeholders spoke of the need for workers to be able to communicate with and manage AI technologies effectively on the job as employers incorporate AI into their business operations.

Stakeholders frequently mentioned the need to upskill the existing workforce to increase AI literacy among workers, while also placing greater importance on foundational skills, such as general literacy, digital literacy, and critical thinking skills. One fifth of the stakeholders mentioned these foundational skills as being essential to working with AI tools effectively.

Although no consensus was reached on who should lead upskilling efforts, stakeholders highlighted the importance of knowledge and skill-building surrounding the use of AI to ensure that current workers are able to remain productive in roles that are redefined with the integration of AI tools and technologies.

"If you [want to] talk about like how we prevent like people's jobs from being disrupted, you know, educating people early and having it be a fundamental part of their educational experience, I think is key."

- Stakeholder in the technology sector

Educational institutions were described as instrumental in providing foundational AI education to students and incumbent workers. Stakeholders highlighted the important role that educational institutions will have in ensuring a workforce that is trained and capable of harnessing AI technologies effectively on the job. Stakeholders further emphasized that education and skill-building related to AI should begin at a young age, starting in K–12 education and continuing through postsecondary education. Relatedly, colleges and universities were identified as critical to workforce development pipelines, which could advance training and familiarity to AI that supports long-term career readiness. This was said to be especially true as postsecondary institutions are well equipped with the resources to provide a multidisciplinary approach to AI education to enrolled students as well as the broader community.

Stakeholders emphasized the importance of education-to-workforce pipelines in the context of accelerated AI adoption and integration. One third of the stakeholders emphasized the need to secure and maintain education-to-workforce pipelines that educate and train individuals to be comfortable using and working alongside AI to maximize its benefits and utilize those skills and knowledge successfully while on the job. Stakeholders highlighted several examples, such as introducing AI technologies to the younger generation as early as the K–12 level, encouraging the current and future workforce to proactively leverage free AI courses available online and through local community programs to build foundational knowledge, and partnering with local higher education institutions to develop and offer comprehensive AI courses tailored for both existing professionals and future workers in the sectors.

WORKFORCE IMPACTS

When discussing the workforce impacts of widespread AI adoption, the consensus among stakeholders and experts was mixed. Nearly all felt that job creation was to be expected as AI adoption becomes more prevalent and that new roles will be needed to manage and provide oversight to AI systems. Additionally, many stakeholders felt that job displacement was not expected; rather, job roles will likely be redefined, leaving room for innovation and creativity in existing job roles as AI tools and systems are incorporated. Stakeholders similarly expressed workers who take action to keep up with evolving technologies and learn new skills to work with and alongside AI will be able to stay in their jobs. As one stakeholder stated:

"You will not be out of job if you pay attention to this technology and then learn to work with it. Right. So just like when people developed the car, the people that drive the carriage worried about it, meaning they're out of job, but they're not really out of job. They just go learn how to drive a car, right?"

- Stakeholder in the life sciences sector

On the contrary, others felt that job displacement was imminent due to increasing automation because of AI technologies. This disparity within stakeholders' views can, in part, be credited to the rapid evolution and development of AI technologies. Given the pace in which new technologies and capabilities of AI are emerging, one stakeholder explained that it is hard to predict which specific job roles are at risk for becoming obsolete, and which new roles will be created due to widespread AI integration.

BUSINESS SIZE AND AI ADOPTION

At 99.6%, New Jersey is largely comprised of small businesses (U.S. Small Business Administration, Office of Advocacy, 2022). When discussing the factors that impact AI adoption, business size was noted as a major determining factor. This was attributed to the capacity and resource constraints commonly faced by small and mid-sized businesses, which operate on a smaller scale, and with thinner margins than their larger counterparts.

"We're small, but we're taking a very aggressive approach to AI. And I think the mindset is we need to do this because we're not going to have, and don't have the ability to add, resources. So how do we become more productive, more effective with leveraging AI?"

- Stakeholder in the life sciences sector

Small and mid-sized businesses were described as less likely to have the internal and external support, such as established partnerships and available staff, to facilitate AI adoption and subsequent integration. Furthermore, stakeholders explained that larger businesses typically have more resources to put toward innovation and piloting and/or experimenting with AI than small businesses. Thus, large businesses have greater agility to retool and retrain their existing workforce, resulting in a faster pace of AI adoption than small and mid-sized businesses.

ETHICAL AND POLICY CONSIDERATIONS

Stakeholders frequently spoke of the ethical and policy considerations surrounding AI adoption. When describing how to ensure that AI technologies are deployed and used ethically, stakeholders stressed the importance of transparency regarding what data are being used by AI and what data cleaning, maintenance, and validation practices are in place. To ensure that ethical standards are upheld, stakeholders suggested placing the onus on leadership to establish clear guidelines on the use of AI technologies within their organizations, suggesting that these guidelines be codified in living documents and be coupled with open channels of communication. It was also emphasized by stakeholders and experts that there is value in having leaders from diverse backgrounds, noting that such diversity can play a crucial role in the successful adoption of AI technologies by companies.

"Knowing that bias exists, we have to look for it. And when you see it, you need to make people aware of it, so we can investigate it and make it healthy to talk about it within the company."

- Academic

Open channels of communication were said to be essential to foster a culture where people feel comfortable to discuss any concerns or issues of bias and discrimination resulting from AI outputs. Additionally, stakeholders expressed that companies must be committed to addressing and correcting any ethical issues or concerns brought forth.

When discussing AI policy, nearly half of the stakeholders and experts emphasized the importance of creating informed policy. This was said to involve including diverse perspectives when developing AI-related policies, which would work to ensure that voices from historically underserved and underrepresented groups and industry input are meaningfully included. Stakeholders explained that policy that is written with a one-size-fits-all approach would be detrimental, as different sectors have different needs and stipulations that must be considered. This was described as being especially true for the life sciences sector, as sensitive health and personal data should be regulated differently than other data being used by AI tools. Conversely, seven stakeholders advised that policy should also not thwart innovation. While they recognize the importance of rules and regulations regarding AI, if too many compliance-oriented regulations were put into place, it would prevent further advancements of AI technologies and tools.

SUMMARY

The above themes were heavily prevalent in conversations with stakeholders and in state-led convenings focused on investigating AI's impacts within New Jersey. These themes are all interrelated and speak to the New Jersey landscape in which AI was being adopted and integrated at the time of data collection. These prevailing themes offer insights into life sciences and technology sector stakeholders at a point in time, documenting sentiments on a variety of topics inclusive of, but not limited to, those highlighted in this research. Sector stakeholders expounded on their understanding of and experience with past cycles of rapid innovation, such as the Industrial Revolution and the dawn of the Internet, likening AI's impact on work and the workforce similarly. Stakeholders' reflections showcase individuals' and businesses' priorities and predictions for the growing impact of AI and GenAI, particularly as AI applications and use cases are tested, AI regulation emerges, and AI is further embedded in job roles.

VOICES AT LARGE: ENGAGEMENT WITH AI ACTIVITIES ACROSS THE STATE

In addition to engagement in direct data collection with life sciences and technology sector stakeholders, members of the Heldrich Center research team engaged with other critical AI initiatives taking place in the state, including but not limited to attending the New Jersey AI Summit hosted by the NJ AI Hub at Princeton University and involvement with multiple workgroups on the Governor's AI Task Force. Most critically, the Heldrich Center's design of the "Your Future of AI" survey to the public-sector workforce was an additive touchpoint with New Jersey workers and their perceptions of AI. The AI Task Force report, released in November 2024, contains key insights and practical recommendations to guide New Jersey's path forward on AI use, policy, and key considerations, such as security, privacy, equity, and literacy. While the Heldrich Center's research is distinct from the AI Task Force report, there are clear synergies with the recommendations emanating from each research body. The Heldrich Center's report serves to offer targeted workforce strategies and specific recommendations to operationalize change in the sectors, further supplementing the workforce-oriented recommendations from the Governor's AI Task Force.

LIFE SCIENCES SECTOR WORKFORCE STRATEGIES

This section discusses four workforce strategies, containing nine recommendations with supporting evidence for the life sciences sector (see Table 6). Researchers offer the following workforce strategies based upon the evidence collected in this study. This is not an exhaustive list of all potential workforce strategies, but rather an evidence-based prioritization of key strategies the Heldrich Center research team finds to be most applicable to the life sciences sector. These workforce strategies and recommendations further supplement recommendations outlined in the report to the Governor on AI, further adding potential pathways for NJEDA and sector stakeholders to consider.

Table 6: Summary of Workforce Strategies, Recommendations, and Evidence for the Life Sciences Sector

#	Workforce Strategy	#	Recommendation	Supporting Evidence
1.0	Expand education-to-employment pathways in the life sciences sector.	1.1	Expand training opportunities, such as foundational biotechnology training, and accessible career pathways via enhanced engagement with NJDOL's industry partnerships.	> Yale University's BioLaunch Program, a foundational biotechnology training opportunity, and Bioversity > RWJBarnabas Health Workforce Partnership > Massachusetts Life Sciences Center's Internship Challenge
2.0	Facilitate collaboration between state agencies to cultivate education and training opportunities focused on retaining top talent in New Jersey.	2.1	Strengthen postsecondary opportunities that support the education-to-employment pipeline to better align with the needs of the life sciences sector and help continue to foster talent.	> Raritan Valley Community College > Johnson & Johnson's STEM2D Initiative at Rutgers Honors College
		2.2	Develop targeted career mapping in collaboration with key sector stakeholders.	> Green Buildings Career Map
		2.3	Invest in statewide STEM educational initiatives aimed at K–12 students.	> Rutgers Bridge to Employment Program > Wisconsin Fast Forward Program
		2.4	Offer incentive mechanisms through state agencies that promote skills development and continued education to increase retention among top talent in New Jersey.	> UPSKILLL: NJ Incumbent Worker Training Grant Program
3.0	Direct resources and investments around workforce development in southern New Jersey.	3.1	Create a targeted marketing campaign in southern New Jersey to highlight existing programs in the state, with an emphasis on supporting businesses of all sizes and promoting current employment opportunities in the region.	> The Chamber of Commerce for Greater Philadelphia
		3.2	Explore a tax credit program for employers in the life sciences sector to attract new businesses to the southern region of the state.	> New York's Life Sciences Research and Development tax credit
		3.3	Prioritize efforts that strengthen partnerships with education and training providers in southern New Jersey.	> Southern California Biotechnology Center
4.0	Develop guidance around skills-based hiring and competency to strengthen talent acquisition and workforce diversity.	4.1	Implement the skills-based hiring guidance and competency model tailored specifically to the life sciences sector.	> U.S. Office of Personnel Management guidance > Skills-Based Hiring Guidance and Competency Model for Artificial Intelligence

WORKFORCE STRATEGY 1.0: EXPAND EDUCATION-TO-EMPLOYMENT PATHWAYS IN THE LIFE SCIENCES SECTOR.

The Heldrich Center's SWOT analysis indicated that there is a significant opportunity to expand access to entry-level roles in the life sciences sector by enhancing education and training pathways. Many positions in this field require formal degrees or specific credentials, which can be a barrier to employment for New Jersey residents. The state can address this gap through early training and accessible career pathways, which could help more individuals enter the sector. With the uncertainty of how AI will impact workforce dynamics and skill demands, as shared by experts and stakeholders interviewed for this study, building these pathways will become more imperative to ensure that New Jersey's workforce remains adaptable and competitive.

> *RECOMMENDATION 1.1: EXPAND TRAINING OPPORTUNITIES, SUCH AS FOUNDATIONAL BIOTECHNOLOGY TRAINING, AND ACCESSIBLE CAREER PATHWAYS VIA ENHANCED ENGAGEMENT WITH NJDOL'S INDUSTRY PARTNERSHIPS.*

NJDOL's New Jersey Industry Partnerships (NJIPs) bring together business leaders, public-sector representatives, and educators to support key industries, including healthcare; life sciences; manufacturing; and transportation, distribution, and logistics. NJIPs emphasize regional collaboration and aim to create sustainable talent pipelines through targeted training and education programs. It follows the "Next Generation Sector Partnerships" model, encouraging business-led initiatives that respond to local workforce and economic needs (NJDOL, n.d.). NJEDA has a valuable opportunity to partner with NJDOL to increase statewide awareness of the Life Sciences Industry Partnership (LSIP) and its benefits. By aligning efforts, NJEDA and NJDOL could effectively highlight industry partnerships and their value, particularly in subsectors facing significant skills gaps or experiencing impacts from AI advancements. Collaboration on targeted training and education programs, such as foundational biotechnology training, could be an area for exploration by NJEDA and NJDOL. As New Jersey is recognized as a biotechnology hub and home to companies like Johnson & Johnson and Bristol Myers Squibb, there is a clear need for specialized training opportunities in this growing subsector. These programs should focus on creating accessible career pathways for New Jersey students and job seekers. Moreover, LSIP has mainly focused on northern and central New Jersey, where a labor market scan for this study found a high concentration of life sciences employers, and there is strong

potential to extend this outreach and training opportunities to southern New Jersey.[5]

Targeting the southern region of the state through enhanced outreach would allow NJEDA and NJDOL to engage local stakeholders and incorporate their insights into the broader discussion on workforce needs. This approach could also attract new employers and innovators to the area, fostering growth and job creation within the life sciences sector. Expanding LSIP's presence would not only provide southern New Jersey with greater access to critical life sciences initiatives but could also spur local investment and workforce development. Additionally, this would add greater engagement with critical partners such as community colleges and training providers across all regions. By extending the geographic reach of industry partnerships and strengthening their impact through coordinated efforts, NJEDA and NJDOL could better address the needs and gaps within the life sciences sector workforce, which could create broader job opportunities and support long-term growth across all regions.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The development of a foundational biotechnology training program is a model of engagement and service offering that can be targeted to disadvantaged groups, encouraging their entrance into the life sciences sector. Yale University's BioLaunch program, a state-funded partnership of local biotechnology companies, the university, and the Connecticut Center for Arts and Technology, seeks to develop the local workforce to support the rapidly growing biotechnology industry. This training program targets marginalized communities, specifically seeking 18- to 26-year-old, non-college-bound participants. BioLaunch employs an "earn while you learn" model to reduce barriers to participation and includes internship and post-placement support for those who complete the program. Bioversity, a Massachusetts-based nonprofit, serves as a workforce training center, offering free short-term certification programs for individuals with a high school degree to learn the skill set needed to enter entry-level scientific operations positions within the life sciences sector. With the goal of making the life sciences sector more equitable and increase representation, Bioversity also assists program participants with career placement and offers career coaching upon program completion. By adopting similar models to BioLaunch and Bioversity, New Jersey could create an inclusive, equitable workforce pipeline that not only addresses industry demands but also empowers

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[5] Researchers define the southern region of New Jersey as Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean, and Salem counties.

underrepresented communities to thrive in the rapidly expanding life sciences sector.

> The RWJBarnabas Health Workforce Partnership, a collaboration involving Middlesex County, Middlesex College, Middlesex County Magnet Schools, and RWJBarnabas Health — aims to create a seamless pipeline from education to employment for entry-level healthcare jobs (Lindner, 2023a). The partnership meets immediate workforce needs and provides entry-level opportunities with a high chance of employment at RWJBarnabas Health. The model could be replicated across the state to create similar education-to-employment pathways for the life sciences sector in New Jersey.

> Massachusetts offers a successful model through the Massachusetts Life Sciences Center's internship challenge program. This program connects college students and recent graduates with life sciences internships by funding small companies (up to $9,600 per intern) and providing valuable industry experience and networking opportunities (Massachusetts Life Sciences Center, n.d.). Additionally, the program offers employers access to an online résumé database for easy candidate search. New Jersey could benefit from a similar initiative, creating a dedicated platform for life sciences employers to connect with emerging talent in the state.

These examples illustrate feasible program models by which fostering training opportunities and accessible career pathways can be expanded in the state, particularly through greater engagement and synergies with NJEDA and NJDOL's LSIP.

WORKFORCE STRATEGY 2.0: FACILITATE COLLABORATION BETWEEN STATE AGENCIES TO CULTIVATE EDUCATION AND TRAINING OPPORTUNITIES FOCUSED ON RETAINING TOP TALENT IN NEW JERSEY.

New Jersey already has a robust life sciences ecosystem, but to further cultivate and retain top talent, state agencies could focus on expanding educational pathways, incentivizing professional development, and fostering connections between academia, start-ups, and established companies. New Jersey has a highly educated talent pool, particularly in the life sciences sector, with the state ranking fourth in the United States for life sciences research talent (Lindner, 2023b) . Data showcase that New Jersey maintains a highly specialized workforce in the specific life sciences subsectors of biopharma manufacturing, biopharma research and development, medical devices, and cell and gene therapy (Choose New Jersey, 2024). With New Jersey's talent composition in mind, Heldrich Center researchers suggest

multiple avenues by which state agencies and employers can try to retain more of the state's highly skilled and qualified talent pool. Here are three actionable recommendations, along with examples, to help implement this strategy effectively.

> *RECOMMENDATION 2.1: STRENGTHEN POSTSECONDARY OPPORTUNITIES THAT SUPPORT THE EDUCATION-TO-EMPLOYMENT PIPELINE TO BETTER ALIGN WITH THE NEEDS OF THE LIFE SCIENCES SECTOR AND HELP CONTINUE TO FOSTER TALENT.*

State agencies like NJDOL, in collaboration with the New Jersey Department of Education and/or the Office of the Secretary of Higher Education, could enhance partnerships with higher education institutions, inclusive of public and private, two-year and four-year institutions. To better prepare the state's workforce for the evolving demands of AI, stakeholders interviewed for this study emphasized the importance of establishing education-to-workforce pipelines that can quickly equip workers with the skills to effectively use AI and other emerging technologies. They highlighted that educational institutions could offer comprehensive AI courses covering both the impacts of AI and strategies for adapting to its use, providing the current and future workforce with a strong foundation in AI skills. This could involve fostering collaborations among leading state universities, such as Rutgers University, Stevens Institute of Technology, and the New Jersey Institute of Technology, and key stakeholders in the life sciences sector (Choose New Jersey, 2024). For instance, the state could develop programs that bring key life sciences stakeholders, professionals, and/or employers into university curriculum committees to ensure that coursework reflects the current industry needs and skills. These partnerships could also involve developing hands-on learning opportunities like internships and co-op placements with companies within the sector to give college students valuable experiences and possible job opportunities after graduation.

Additionally, engagement with the state's community colleges is also needed to ensure that postsecondary opportunities that result in good-quality jobs are attainable for those pursuing an associate degree. Connection with the New Jersey Council of County Colleges, specifically its program, NJ Pathways to Career Opportunities: Aligning Education to Build an Innovative Workforce, could assist the state in making significant inroads with targeted programming for community college students.

> Recent efforts from New Jersey's community colleges and local municipalities started to address this gap in available and accessible education-to-employment pathways in their respective communities. For example, Raritan Valley Community College in Somerset County undertook the process of creating a program focused on exploring careers in the biopharmaceutical manufacturing industry (Deak, 2023). Raritan Valley Community College also received American Rescue Plan funding to grow its workforce training center so it could expand the college's advanced manufacturing programs and education, with a focus on developing life sciences manufacturing in the region (Deak, 2023).

> A partnership model that can be replicated across the sector is Johnson & Johnson's STEM2D initiative at Rutgers Honors College, which supports women in STEM through scholarships, mentorships, and internships, linking students with professionals and enhancing career pathways (Rutgers Today, 2016). While the STEM2D initiative is from 2016 and may not fully reflect the most current trends, its core structure of building industry and academic partnerships to support career development is still a strong and effective model. This approach could be adapted to incorporate emerging fields like AI, ensuring it stays aligned with current trends, and expanded to include additional companies, colleges, and universities within the state's life sciences sector.

Greater collaboration is needed to demarcate clear career pathways in the life sciences sector via New Jersey's higher education system. Researchers also suggest that NJEDA; state agencies like NJDOL, the New Jersey Department of Education, and/or the Office of the Secretary of Higher Education; key sector stakeholders; and representatives from key educational institutions in the state engage in targeted career mapping for the life sciences sector (see Recommendation 2.2). Life sciences career mapping will increase accessibility to education and employment pathways for students and prospective job seekers.

> *RECOMMENDATION 2.2: DEVELOP TARGETED CAREER MAPPING IN COLLABORATION WITH KEY SECTOR STAKEHOLDERS.*

Career mapping is a worthwhile collaborative exercise that brings together educational institutions and employers to delineate pathways and competencies critical to success in a given sector. While there are various models and applications of career mapping, it typically follows a step-by-step approach, starting with a deep dive into values and interests, which then guides individuals toward identifying a specific career goal (Whitehead & Alves, 2022). Research shows that career mapping can help develop career paths and ladders for employees and can improve their engagement, productivity, and retention in STEM, healthcare, and other fields (Whitehead & Alves, 2022; Webb et al., 2017; Society for Human Resource Management, n.d.). If sector stakeholders, in collaboration with educational institutions, were to engage in sector-wide mapping for in-demand career pathways, it could bolster the understanding of entrance points and trajectories within the field to increase both awareness and informed decision-making for students and prospective employees.

> Researchers have seen successful examples of career mapping in the growing green jobs sector. The [Green Buildings Career Map](#) is an example of an interactive tool that explores career pathways and job opportunities across four major sectors of the burgeoning green buildings and energy-efficiency industries (Interstate Renewable Energy Council, 2024). This tool was built with the intention of serving educators, career advisors, job seekers, employers, policymakers, and workforce professionals. In terms of collaboration, the Green Buildings Career Map was developed by the Interstate Renewable Energy Council in conjunction with a team of subject-matter experts representing the green buildings and energy-efficiency industry (Interstate Renewable Energy Council, 2024).

This example showcases an accessible and practical tool for career guidance, which was co-created by industry experts and sector stakeholders and supported by government funding. This model could be replicated in New Jersey for the life sciences sector under the direction of NJEDA and/or NJDOL's LSIP.

> *RECOMMENDATION 2.3: INVEST IN STATEWIDE STEM EDUCATIONAL INITIATIVES AIMED AT K–12 STUDENTS.*

Research from the Metropolitan Policy Program at the Brookings Institution and Child Trends suggests that work-based learning experiences — such an internships and apprenticeships — in high school significantly contribute to higher job quality later in life, which is particularly pronounced for individuals from disadvantaged backgrounds (Ross et al., 2018). Exposure to real-world challenges in biotechnology, pharmaceutical research, and medical technology can help spark interest and develop foundational skills early on. New Jersey could consider the expansion of work-based learning opportunities for K–12 students,

mirroring initiatives in the state and those taking place across the nation, such as the those being operationalized in Wisconsin.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The [Rutgers Bridge to Employment program](#) is a partnership with Johnson & Johnson that prepares high school students from New Brunswick for careers in healthcare. It enhances academic performance and college readiness, and offers internships, focusing on math and science improvement. Activities include academic support, career exploration, applied learning, and college links (Rutgers–New Brunswick, n.d.).

> In 2023, the Wisconsin Department of Workforce Development awarded over $473,000 in technical education equipment grants to 14 school districts, to support advanced manufacturing education for more than 2,200 students (Wisconsin Department of Workforce Development, 2023). Funded through the [Wisconsin Fast Forward Program](#), the grants aimed to help schools purchase industry-grade equipment like computer numerical control machines, robotic welders, and 3D printers, to provide students with hands-on training in high-demand manufacturing skills.

Through such initiatives, students can earn certifications and technical endorsements while still in K–12 education, which boosts their competitiveness and career readiness. By equipping students with both industry awareness and technical skills, these programs help build a robust talent pipeline for high-wage careers in advanced manufacturing and the broader life sciences sector. This approach not only supports economic growth but also addresses critical industry needs statewide.

RECOMMENDATION 2.4: OFFER INCENTIVE MECHANISMS THROUGH STATE AGENCIES THAT PROMOTE SKILLS DEVELOPMENT AND CONTINUED EDUCATION TO INCREASE RETENTION AMONG TOP TALENT IN NEW JERSEY.

While this research outlines investments that could be made to further support the pipeline of workers coming into the life sciences sector in New Jersey, more can be done to retain the top existing talent within the sector and further cultivate growth within the current workforce. As AI advances, professionals in the life sciences field would greatly benefit from specialized training or certifications and other opportunities to upskill. By 2030, as much as 30% of the work hours in the U.S. economy could be automated — a shift that GenAI is speeding up (Ellingrud et al., 2023). As one expert interviewed for this study described, "Individuals

won't be replaced by AI, but by those who know how to use it effectively." Rather than causing substantial job loss, GenAI is expected to improve how professionals in STEM and other fields perform their work. Stakeholders interviewed for this study believe AI will primarily augment jobs rather than replace them, though they emphasize the importance of employees developing new technological skills. To facilitate this, state agencies, including but not limited to NJEDA and NJDOL, could collaborate with industry leaders to provide funding for certifications that help professionals stay current with both technological advancements and the growing influence of AI on the sector. These certifications should provide opportunities for advancement and promotion for people employed in the life sciences sector, particularly women and/or people of color, to increase retention of top talent with diverse backgrounds.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The [UPSKILL: NJ Incumbent Worker Training Grant Program](#), funded by NJDOL, offers New Jersey employers up to 50% reimbursement for training incumbent frontline employees to meet current and future skill requirements. Although the program is open to all businesses, it primarily focuses on nine strategic sectors identified in Governor Murphy's economic development plan, including advanced manufacturing, clean energy, and technology (NJDOL, 2022). The UPSKILL grant currently accepts applications on a rolling basis and supports various training methods, including third-party classroom training, on-the-job training, and company in-house training.[6]

This existing program can be expanded to better address the sector's workforce needs. NJDOL could prioritize funding for employers in the life sciences sector that seek to upskill their workers in AI-related training and education. This expansion would enable employers to finance their employees' participation in specialized training programs, certifications, or even advanced degrees, such as master's or doctoral programs, and industry-recognized credentials in areas like biopharma research and development, clinical trials, management, or data analytics within the life sciences sector.

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[6] Third-party classroom training involves external organizations providing structured educational programs, while on-the-job training allows employees to learn directly through hands-on experience under supervision. Company in-house training consists of tailored programs developed internally to enhance specific skills relevant to the organization.

WORKFORCE STRATEGY 3.0: DIRECT RESOURCES AND INVESTMENTS AROUND WORKFORCE DEVELOPMENT IN SOUTHERN NEW JERSEY.

As evidenced by the labor market scan, there is a heavy concentration of life sciences sector employment and establishments in northern and central New Jersey, particularly in counties like Mercer, Middlesex, Morris, Somerset, and Union. This concentration limits opportunities for individuals in southern New Jersey, where there are fewer employers from the life sciences sector. As a result, talent from the state's southern region may either seek jobs outside the state or relocate within New Jersey for greater opportunities. Furthermore, the Heldrich Center's findings highlighted a significant regional difference in growth in the coming decade, where southern New Jersey is expected to add approximately 660 jobs in life sciences while the northern region is projected to gain more than 1,300 jobs. These projections provide a look at anticipated trends but may shift over time. To address potential outmigration of skilled workers to nearby areas like Philadelphia, New Jersey could consider introducing incentives to attract and retain key life sciences institutions in the southern part of the state. This would help create a more balanced distribution of opportunities across the state. Below are three recommendations to consider.

> *RECOMMENDATION 3.1: CREATE A TARGETED MARKETING CAMPAIGN IN SOUTHERN NEW JERSEY TO HIGHLIGHT EXISTING PROGRAMS IN THE STATE, WITH AN EMPHASIS ON SUPPORTING BUSINESSES OF ALL SIZES AND PROMOTING CURRENT EMPLOYMENT OPPORTUNITIES IN THE REGION.*

In addition to developing and retaining a skilled workforce, state agencies, including but not limited to NJEDA, state and local Chambers of Commerce, and local municipalities, could increase efforts to promote the range of opportunities and funding resources available to foster innovation and growth in the life sciences sector. New Jersey already provides a variety of programs designed to support start-ups, particularly in research, development, and technological innovation. Key initiatives include NJ Accelerate, New Jersey Innovation Fellows Program, and the Food and Agriculture Research & Development Pilot Grant Program, among others. However,

these programs may not be widely known, especially in southern New Jersey. A targeted marketing campaign could raise awareness and attract new ventures to the region, making it a worthwhile investment to further expand the life sciences sector across the state. This effort could align with other business attraction needs in southern New Jersey, including but not limited to the prevalence of top-tier universities such as Rutgers–Camden and Rowan University and new and/or in development office and lab space, research parks, and mixed-use campuses for companies looking to establish in the state (Choose New Jersey, n.d.-a). Furthermore, employers already located in the southern region of the state, perhaps working in conjunction with their local municipalities, could actively invest in comprehensive marketing and outreach initiatives to showcase current employment opportunities in the region. By effectively promoting these roles, employers can attract and retain local talent, ultimately mitigating outmigration and fostering a thriving workforce that contributes to regional economic growth.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The Chamber of Commerce for Greater Philadelphia offers an example of a business attraction marketing campaign for its region, which placed particular emphasis on attracting professionals in the life sciences sector. As part of its Fiscal Year 2023 multimedia marketing strategy, the Chamber ran paid ads on LinkedIn and Google, commissioned research ranking the Greater Philadelphia region second among 14 U.S. cell and gene therapy hubs, deployed a newsletter highlighting stories of companies expanding in the Greater Philadelphia region, and started a Momentum Makers video series (The Chamber of Commerce for Greater Philadelphia, 2023). These marketing strategies were also intended to reach national and international business audiences, spurring and directing investment in the region's life sciences sector by highlighting the story of the region's assets and successes (The Chamber of Commerce for Greater Philadelphia, 2023). This marketing approach offers a key example that could be replicated for New Jersey's southern region to draw greater attention to the available opportunities for employers and workers alike, while also further expanding and developing the life sciences sector's footprint in the state.

Strategically marketing the region's strengths, assets, and growing opportunities for businesses could assist with further developing the life sciences sector's footprint in the southern region of the state. This will help balance the state's regional disparities in the life sciences sector. The success of similar initiatives, such as the Chamber of Commerce for Greater Philadelphia's marketing strategy, demonstrates the potential impact of these efforts.

> *RECOMMENDATION 3.2: EXPLORE A TAX CREDIT PROGRAM FOR EMPLOYERS IN THE LIFE SCIENCES SECTOR TO ATTRACT NEW BUSINESSES TO THE SOUTHERN REGION OF THE STATE.*

As New Jersey continues to establish its prominence as a life sciences hub, with particular emphasis on the growing presence of biotechnology and pharmaceutical companies in the state, business development and attraction have been concentrated in northern and central New Jersey. This concentration is illustrated by the development of the Cove in Jersey City, a mixed-use campus offering academic and commercial life sciences laboratory and office space, and the Health & Life Science Exchange (HELIX NJ) in New Brunswick, a world-class research complex containing laboratories and work and learning spaces to connect research and industry (Choose New Jersey, n.d.-b). These developments, amongst New Jersey's other investments in the life sciences sector, foster a vibrant ecosystem for existing establishments, as well as emerging start-ups, entrepreneurs, and companies looking to locate in the state. This ecosystem could be extended and expanded to encompass the state's southern region. As indicated by labor market projections, at present, the southern region of the state is anticipated to see job growth in the life sciences, though this growth is not on par with the growth anticipated in other areas of the state. For this reason, the state could consider how to expand the impact of the life sciences sector to southern New Jersey. This expansion could be achieved through targeted business attraction incentives, including but not limited to the implementation of a tax credit. NJEDA and other relevant stakeholders could weigh key considerations to examine the feasibility of this approach.

As mentioned previously, NJEDA offers a variety of financing and incentive programs designed to help and support businesses of all sizes grow and invest in New Jersey (NJEDA, n.d.). These programs include job-based tax credits, real estate and redevelopment incentives, community development initiatives, low-interest business loans, and more. Given this, a worthwhile consideration could be to explore the implementation of a tax credit program specifically for life sciences employers in southern New Jersey. Such a program could provide targeted incentives to attract and retain companies in the life sciences sector and encourage

them to relocate or set up new operations in the region. This could help further frame southern New Jersey as an appealing location for life sciences enterprises, driving job creation, innovation, and economic growth in the area.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The New York's Life Sciences Research and Development tax credit initiative is designed to support the establishment, innovation, commercialization, and production of new life sciences enterprises within New York (New York State Empire State Development, n.d.). The program is open to businesses at various stages of growth, from small start-ups with fewer than 10 employees to more established, larger businesses and companies.

A sector-specific tax credit program is one mechanism by which targeted business attraction incentives could be deployed in the state. New Jersey, in collaboration with entities such as NJEDA, Choose New Jersey, and the New Jersey Business & Industry Association, could consider exploring the adoption of a tax credit initiative similar in focus and design to the one deployed in New York. This initiative could help stimulate the growth of the life sciences sector in New Jersey, with a particular focus on supporting the state's southern region.

> *RECOMMENDATION 3.3: PRIORITIZE EFFORTS THAT STRENGTHEN PARTNERSHIPS WITH EDUCATION AND TRAINING PROVIDERS IN SOUTHERN NEW JERSEY.*

The two recommendations presented above focus on bringing life sciences enterprises to the region; however, even with such initiatives, the southern region of New Jersey may still face challenges in retaining local talent. While there are some employers in the state's southern region, talent in this region may be lost to other job markets and/or may have to relocate, either within or outside the state, for greater opportunities. Although relocation for life sciences employers to the southern region may not be feasible or could take time, there is a significant opportunity to develop local talent by expanding education and training programs that equip the workforce with the necessary skills for the sector.

State agencies could prioritize strengthening partnerships with the region's postsecondary education institutions and/ or training providers to develop specialized programs, certifications, and vocational training aligned with the needs of the life sciences sector similar to other recommendations mentioned earlier. For instance, state agencies and key stakeholders can partner with the three four-year public institutions in the region — Rutgers–Camden, Rowan

University, and Stockton University — as well as several two-year colleges, including Atlantic Cape Community College and Rowan College of South Jersey, which have multiple campuses across southern New Jersey (Higher Education Student Assistance Authority, n.d.). By enhancing and strengthening partnerships with postsecondary institutions and training providers, the southern region can create specialized pathways that equip workers with the skills necessary for the life sciences sector, even if immediate employment opportunities are limited.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The Southern California Biotechnology Center, based at San Diego Miramar College, is a regional hub for economic and workforce development. It acts as a gateway to life sciences and biotechnology education, collaborating with community colleges to equip students with the skills needed to meet industry workforce demands. The center aims to offer clear program pathways for life sciences and biotechnology students, enhancing both accessibility and success while aligning with state, regional, and institutional objectives (San Diego Miramar College, n.d.).

Establishing a regional hub for life sciences in southern New Jersey, inclusive of more aligned partnerships and expanded education and training pathways, would offer significant resources to retain talent and further develop and diversify the region's economy.

WORKFORCE STRATEGY 4.0: DEVELOP GUIDANCE AROUND SKILLS-BASED HIRING AND COMPETENCY TO STRENGTHEN TALENT ACQUISITION AND WORKFORCE DIVERSITY.

As previously noted, many employment opportunities in the life sciences sector require degrees and/or other credentials, signifying a highly educated workforce. As the Heldrich Center's analysis of the life sciences sector employment dynamics showed, with 48% of the life sciences workforce holding a bachelor's degree or advanced degree, there is concern that this higher education barrier to entry keeps people out of the workforce, particularly individuals from historically underserved and underrepresented communities. This dynamic is further exacerbated by a proliferation of increasing credentials and requirements in job postings, observed across all sectors. For example, in 2023, data analysis was listed as a required skill in 3,005 job postings within the life sciences sector. According to the Heldrich Center's previous examination of Lightcast data, demand for data analysis, a skill that often requires specific degrees or credentials, is projected to grow by 26% over the next two years. However, it is unclear whether data analysis is genuinely essential for all the positions advertising this requirement. Further research is needed to assess whether job postings accurately reflect the skills truly required for these roles. Misalignment between job qualifications and the credentials listed in postings can exacerbate workforce disparities, unnecessarily excluding certain populations from employment opportunities.

RECOMMENDATION 4.1: IMPLEMENT THE SKILLS-BASED HIRING GUIDANCE AND COMPETENCY MODEL TAILORED SPECIFICALLY TO THE LIFE SCIENCES SECTOR.

To intentionally broaden the population that can access employment opportunities in the life sciences sector, the state could develop a model that provides guidance around skills-based hiring and competency. New Jersey's development of a skills-based hiring guidance and competency model can be inspired by the framework established by the U.S. Office of Personnel Management (2022), which emphasized the importance of skills-based hiring practices. By adopting a similar skills-based framework, New Jersey's life sciences sector could better identify and recruit diverse talent, ensuring that candidates from various backgrounds are evaluated based on their relevant skills and experience.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> The U.S. Office of Personnel Management's skills-based hiring guidance highlighted the need to prioritize applicants' capabilities over their educational backgrounds, aiming to broaden talent pools and reduce barriers for historically underrepresented groups. This approach enables the federal government to compete more effectively for top talent in an evolving labor market, with agencies such as the U.S. Department of the Interior and the National Aeronautics and Space Administration (NASA) endorsing the initiative to enhance workforce diversity and improve agency performance by focusing on competencies relevant to their missions (U.S. Office of Personnel Management, 2022). A critical aspect of this initiative is its emphasis on DEIA. This DEIA-focused approach would not only enhance the state's competitiveness in attracting top talent but also foster innovation and adaptability within the sector.

> In 2024, the U.S. Office of Personnel Management's further expanded its efforts by introducing a skills-based hiring guidance and competency model for AI positions, which aims to help agencies identify critical skills and competencies required for AI professionals while increasing access to these technical roles for individuals with nontraditional academic backgrounds (U.S. Office of

Personnel Management, 2024). New Jersey could similarly draw inspiration from this guidance to incorporate an AI lens into its skills-based hiring guidance and competency model for the life sciences sector. By integrating AI-related competencies, the state can effectively respond to technological advancements that are shaping the industry. As the sector increasingly leverages AI for drug discovery, patient diagnostics, and personalized medicine, among other purposes, having a trained and skilled workforce equipped with both traditional scientific expertise and AI competencies will be crucial to the continued development of the life sciences sector in New Jersey and beyond.

A skills-based hiring guidance and competency model would help to diversify prospective talent in the life sciences sector and help current and future workers prepare for the changes that will result from the growing integration of AI in the workplace.

TECHNOLOGY SECTOR WORKFORCE STRATEGIES

This section of the report outlines three workforce strategies, containing six recommendations with supporting evidence, for the technology sector (see Table 7). These strategies and recommendations have been derived from the research conducted for this study. While this is not an exhaustive list of potential workforce strategies that could be deployed in the technology sector, it represents researchers' evidence-based suggestions for consideration. The workforce strategies delineated in this section serve to further supplement the recommendations offered in the New Jersey AI Task Force's report to the Governor.

Table 7: Summary of Workforce Strategies, Recommendations, and Evidence for the Technology Sector

#	Workforce Strategy	#	Recommendation	Evidence
1.0	Identify strategies and initiatives to promote DEIA for the workforce in the technology sector.	1.1	Strengthen and expand existing programs, such as the P-TECH model, that specifically address gaps in DEIA in the technology sector.	> P-TECH
		1.2	Invest in targeted recruitment efforts that specifically engage underserved and underrepresented communities across the workforce development cycle, including career awareness, training, and employment.	> Princeton AI4ALL > Cybersecurity Workforce Development and Training, Cybersecurity & Infrastructure Securty Agency
		1.3	Expand access to entry-level positions and reduce barriers that may hinder equitable access to such opportunities.	> NJDOL's Fund My Future grant
2.0	Expand and strengthen key partnerships to better align goals across industry, educational institutions, and employers.	2.1	Consider the strategic development of targeted public-private partnerships for the technology sector in New Jersey.	> Ohio's TechCred program
3.0	Develop programs or initiatives that enhance domain knowledge and technical proficiency skills that allow participants to develop deeper understanding and practical application of AI.	3.1	Develop and implement training programs that offer an introduction to AI for New Jersey residents employed in the technology sector.	> AI4ALL at Worcester Polytechnic Institute
		3.2	Adapt the New Jersey AI Task Force's "Your Future of AI" survey of public-sector workers to reach broader audiences.	> Perceptions of Artificial Intelligence Among Healthcare Staff: A Qualitative Survey Study

WORKFORCE STRATEGY 1.0: IDENTIFY STRATEGIES AND INITIATIVES TO PROMOTE DEIA FOR THE WORKFORCE IN THE TECHNOLOGY SECTOR.

Advancing DEIA in New Jersey's technology sector workforce is critical to driving innovation. Given the demographics of the population in New Jersey, embracing DEIA strengthens the talent pool and ensures that technological advancements are more inclusive, equitable, and reflective of diverse perspectives. The findings of this study indicate that women, Black, and/or Latino workers are significantly underrepresented in the technology sector in New Jersey, reflecting broader national trends (New Jersey Business & Industry Association, 2024). As AI continues to reshape the skills needed to work in the technology sector, there is growing concern that underserved communities may face a new digital divide, exacerbated by AI's expansion (Trucano, 2023). Experts warn that without intentional efforts to address these disparities, marginalized groups could be further excluded from the technological advancements shaping the future workforce (Bentley et al., 2024). Stakeholders and experts interviewed for this study expressed similar concerns, highlighting both uncertainty and apprehension about historically underserved and underrepresented groups being left behind as AI becomes more widespread.

RECOMMENDATION 1.1: STRENGTHEN AND EXPAND EXISTING PROGRAMS, SUCH AS THE P-TECH MODEL, THAT SPECIFICALLY ADDRESS GAPS IN DEIA IN THE TECHNOLOGY SECTOR.

The state could address this disparity by taking intentional and proactive steps to integrate diversity considerations at every stage of workforce development planning and throughout the allocation and implementation of state funding resources. One effective strategy for addressing underrepresentation and fostering greater diversity in New Jersey's technology sector workforce is expanding equitable access to programs.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> [P-TECH](#) is a six-year high school model that combines secondary school with early college coursework, allowing students to graduate with a high school diploma and an associate degree in a STEM field. This program aims to prepare students for college and career success by integrating academic learning with practical, industry-aligned skills, and it includes strong partnerships with local businesses that offer mentorships, internships, and potential job placements upon graduation. Currently, P-TECH is offered in only four high schools across New

Jersey: Burlington City High School, New Brunswick High School, Panther Academy in Paterson, and Trenton City High School (P-TECH, n.d.). Expanding P-TECH to additional schools across the state would increase access to these valuable dual-degree pathways, particularly in underserved communities. By scaling the program, New Jersey could provide more students with direct pathways into high-demand fields, improve diversity in STEM industries, and support the development of a skilled workforce.

Expanding programs like P-TECH across the state would open more opportunities for underserved and underrepresented groups, which can help close DEIA gaps in the technology sector.

RECOMMENDATION 1.2: INVEST IN TARGETED RECRUITMENT EFFORTS THAT SPECIFICALLY ENGAGE UNDERSERVED AND UNDERREPRESENTED COMMUNITIES ACROSS THE WORKFORCE DEVELOPMENT CYCLE, INCLUDING CAREER AWARENESS, TRAINING, AND EMPLOYMENT.

Another strategy for addressing gaps in DEIA for the technology sector in New Jersey is investing in targeted recruitment efforts that specifically engage underserved and underrepresented communities. This may include identifying and engaging underrepresented communities, as highlighted in this report's findings, to expand access and encourage talent pipelines in this sector. A critical first step to engaging underserved and underrepresented communities is to gain clarity, through research, on the extent of the digital divide and/or digital skills gap within these communities, starting with levels of access to reliable high-speed Internet, computers, and smartphones (Haigh, 2024). Advocates in Connecticut identified the accessibility of Internet service and technology equipment as an important, and often affordable, first step in ensuring workers of all kinds are able to attain the skills needed to participate in an AI-driven world (Haigh, 2024). This DEIA-focused strategy could further involve mapping underrepresented communities across the state, using data sources like Asset Limited, Income Constrained, Employed (ALICE). Using this tool, the state can pinpoint areas with significant populations facing economic disadvantage. For instance, targeted recruitment efforts can be directed to counties such as Cumberland, Ocean, and Passaic, where at least 35% of residents are identified as ALICE (United for ALICE, 2024). Leveraging this information can optimize outreach and foster partnerships with local schools and organizations to create pathways for inclusive growth in the technology sector.

> [Princeton University's AI4ALL program](#) provides low-income rising 11th graders across the United States and Puerto Rico with education on AI. Through lectures, hands-on research, field trips, and mentorship, AI4ALL seeks to inspire the next generation of leaders to engage with AI ethically. Expanding and replicating initiatives like AI4ALL can provide early exposure to technology and encourage underrepresented students to consider careers in the technology sector.

> [Cybersecurity Workforce Development and Training](#) by the Cybersecurity and Infrastructure Security Agency. The Cybersecurity and Infrastructure Security Agency partners with nonprofit organizations to provide cybersecurity education, training, and career programs to underserved and diverse communities with limited resources. The initiative targets women, minorities, and veterans, helping them develop the skills needed to enter the rapidly growing cybersecurity field. By offering certifications, mentorship, and career support, the program helps close the skills gap and contributes to meeting the increasing demand for cybersecurity professionals (National Initiative for Cybersecurity Careers and Studies, n.d.). This model could be replicated and adapted across other subsectors of technology, offering a scalable approach to addressing DEIA gaps in the industry.

Promoting DEIA within New Jersey's technology sector is essential for fostering innovation and ensuring that the workforce reflects diverse perspectives. By strengthening and expanding state programs such as P-TECH and investing in targeted recruitment efforts for underserved and underrepresented communities, New Jersey can create pathways for a more inclusive and skilled workforce. Such efforts can increase awareness and access to critical education, training, and employment pathways for populations that might not otherwise have the knowledge and/or opportunity to participate.

RECOMMENDATION 1.3: EXPAND ACCESS TO ENTRY-LEVEL POSITIONS AND REDUCE BARRIERS THAT MAY HINDER EQUITABLE ACCESS TO SUCH OPPORTUNITIES.

Simply recruiting individuals from historically underserved and underrepresented groups is not a sufficient, standalone strategy. Efforts from the state could also be made to expand access to entry-level positions and reduce barriers that may hinder underserved groups from having equitable access to employment opportunities in the technology sector. The state could work with employers within the sector to offer mentorship programs, tailored training, and accessible

resources to empower new hires to thrive. For instance, the state could enhance its efforts by promoting existing resources, grants, and support services.

It is also important to consider **who** conducts recruitment for these entry-level positions. Efforts to raise awareness about these opportunities — entry-level or otherwise — must come from trusted members of the community. Nonprofits (e.g., community-based organizations), faith-based organizations, local leaders, and community members can play an important role in generating good faith around recruitment opportunities for the technology sector. As such, education and training providers could meaningfully engage these stakeholders. One way to build trust is to meet people where they are. Employers and other leaders in the technology sector can show up in spaces where people are familiar and comfortable. Those in the technology sector can, for example, host job fairs in local community centers or parks and/or post flyers where communities congregate.

> A key program is NJDOL's [Fund My Future](#) grant, which aims to promote equal opportunity, upward mobility, and economic fairness (NJDOL, 2024). This initiative empowers participants to take charge of their career development with job coaching, training, and employment support provided by grantees. The program is specifically designed for unemployed or chronically unemployed New Jersey residents. Through these resources, individuals are better equipped to overcome employment barriers and advance their careers.

> Encouraging greater access to entry-level opportunities can be further aided by meeting people where they are and addressing the barriers that may keep them out of the workforce. Targeted multifaceted efforts such as this are critical to advancing equitable access to employment opportunities that yield good-quality jobs.

WORKFORCE STRATEGY 2.0: EXPAND AND STRENGTHEN KEY PARTNERSHIPS TO BETTER ALIGN GOALS ACROSS INDUSTRY, EDUCATIONAL INSTITUTIONS, AND EMPLOYERS.

As highlighted in the SWOT analysis of this study, New Jersey is already home to a robust network of partnerships that are pivotal to the growth and development of its technology sector workforce. Among the most notable initiatives is the NJ Pathways Initiative, a collaboration between the New Jersey Council of County Colleges and the New Jersey Business & Industry Association. This initiative aims to strengthen workforce development across multiple sectors,

including technology, by creating clear education and training pathways. Additionally, the New Jersey Innovation and Technology Hub in New Brunswick serves as a catalyst for innovation, bringing together researchers, entrepreneurs, and tech start-ups to drive the state's technological advancement. Another key player, the Research & Development Council of New Jersey, facilitates a collaborative environment between industry, academia, and government to accelerate STEM education, innovation, and economic development. These existing initiatives form a solid foundation for New Jersey's technology ecosystem.

RECOMMENDATION 2.1: CONSIDER THE STRATEGIC DEVELOPMENT OF TARGETED PUBLIC-PRIVATE PARTNERSHIPS FOR THE TECHNOLOGY SECTOR IN NEW JERSEY.

Building on these partnerships, the state has a unique opportunity to further align its education and workforce development efforts with the evolving needs of the technology sector. As previously noted, NJDOL's NJIP plays a critical role in bringing together stakeholders to support sectors like the life sciences. NJIP highlights that public partners help establish industry agendas while staying responsive to business-defined priorities, ensuring long-term workforce development. However, there is currently no specific industry partnership dedicated solely to the technology sector. Moreover, NJIP predominantly emphasizes public-sector collaboration, which presents an opportunity to bring private partners into the fold, creating a more inclusive dialogue. NJIP can expand to include the technology sector and has the potential to amplify its impact, especially in addressing emerging challenges, such as the advancement of AI. By extending NJIP to the technology sector, the state could better respond to the unique demands of the sector, ensuring that workforce development remains aligned with AI advancements and industry needs. This expansion would also foster greater collaboration between public and private entities, strengthening the state's ability to navigate the evolving technology sector workforce landscape.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> An example of this is the TechCred program in Ohio, which aims to help businesses develop a skilled workforce by offering financial support for employee training in technology-related fields. Employers can apply for funding to cover up to $2,000 per employee for completing eligible, industry-recognized credentials that help close skills gaps in the state. The program is designed to make it easier for businesses of all sizes to upskill their workers with technology-focused qualifications. The training programs are short-term, and the credentials earned can help employees pursue

better job opportunities in Ohio's technology economy. Through Ohio's TechCred program, the state can partner with private employers to offer credentials and training programs in high-demand technological occupations. These public-private partnerships have created a model that allows employers to directly shape the training curriculum, ensuring that workers are equipped with the skills most needed by the technology sector (Ohio TechCred, n.d.). This model could be adapted by New Jersey to extend NJIP to the technology industry.

Cultivating strategic public-private partnerships for the technology sector in New Jersey will help ensure that the sector and its workforce can readily adapt to the emerging changes emanating from the continued proliferation of AI.

WORKFORCE STRATEGY 3.0: DEVELOP PROGRAMS OR INITIATIVES THAT ENHANCE DOMAIN KNOWLEDGE AND TECHNICAL PROFICIENCY SKILLS THAT ALLOW PARTICIPANTS TO DEVELOP DEEPER UNDERSTANDING AND PRACTICAL APPLICATION OF AI.

A central theme that emerged from discussions with stakeholders and experts for this study was the need for the workforce in both the life sciences and technology sectors to stay ahead of AI developments by maintaining deep domain expertise. Workers must be equipped to engage with AI systems in the appropriate technical language. Several stakeholders stressed that a strong conceptual understanding of AI's capabilities is essential for effective usage. Furthermore, they emphasized the critical need to contextualize AI-generated outputs with industry-specific knowledge and data analytics skills. These sentiments reflect ongoing efforts in New Jersey, particularly with the creation of the AI Task Force by Governor Phil Murphy in October 2023. The Task Force was established to assess the potential societal impacts of AI and to develop recommendations for promoting the ethical use of AI technologies. Building on this initiative, in July 2024, Governor Murphy collaborated with InnovateUS and announced the launch of the NJ AI Assistant, a generative AI-powered platform for state employees, alongside the rollout of one of the nation's first comprehensive GenAI training programs for public-sector workers. This collaboration's goal was to help state employees better understand how GenAI can be responsibly incorporated into their day-to-day work.

While the availability of the NJ AI Assistant tool and GenAI training programs are currently exclusive to state government employees, a similar model could be adapted and tailored for the technology sector. A generalizable AI training curriculum could be developed, offering a flexible framework that can be customized for different industries, enhancing AI literacy and application across various sectors.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION:

> The [AI4ALL program at Worcester Polytechnic Institute](#), supported by Melinda Gates' Pivotal Ventures, offers free five-week virtual courses for college students (coding experience is not needed). Students learn about AI ethics, gain mentorship from industry leaders (e.g., Google, Facebook), and receive a certificate upon completion. The program provides an introduction to AI, with the option to continue into a second course, "Apply AI," to develop technical skills and build an AI portfolio. Though designed for students, the program can also be adapted for individuals seeking to enter or advance in the life sciences and technology sectors, including current professionals looking to upskill.

The AI4ALL program serves as an exemplary model of accessible, impactful training that could be scaled to reach a broader audience across New Jersey. The development of new course offerings and/or the expansion of New Jersey's current tools are key areas of investment and expansion for the state to consider.

While several states are exploring the impact of AI (multistate.ai, n.d.), New Jersey is the first state to launch a comprehensive survey to assess public-sector employees' knowledge, attitudes, and interest in AI. This survey was designed by the Heldrich Center, in coordination with the New Jersey Office of Innovation, and deployed by the New Jersey Civil Service Commission, reaching 64,000 state employees. This survey can be adapted to gather insights from workers in both the public and private sectors, thereby assessing their knowledge and other relevant factors that can help key stakeholders in the technology sector (and if developed broadly enough, across other sectors that

NJEDA is interested in exploring). The technology sector is challenging to define, with software developers and architects falling under the same broad categorization of sector employees. With such a variety of subsectors within the technology sector, individuals' experiences with and use of AI and GenAI technologies are likely to be vastly different. With this in mind, more research could be done to understand AI's perceptions and impacts at a more granular level.

EVIDENCE: PROGRAM(S) AND MODEL(S) IN ACTION

> *[Perceptions of Artificial Intelligence Among Healthcare Staff: A Qualitative Survey Study](#)* by Castagno and Khalifa (2020) examined NHS Foundation Trust healthcare professionals' awareness and perceptions of AI. The online survey included responses from medical doctors, nurses, and managers. Findings indicated that while 79% of respondents saw AI as potentially beneficial in healthcare, most lacked a clear understanding of AI concepts — 87% could not differentiate between machine learning and deep learning, and 64% had no exposure to AI applications at work. Privacy concerns were significant, with 80% of respondents worried about privacy risks, and 40% viewing AI as potentially more dangerous than nuclear weapons. However, only 10% feared AI could replace their jobs (Castagno & Khalifa, 2020).

Conducting a similar qualitative survey within the technology sector could offer valuable insights into workers' perceptions and preparedness regarding AI. This information would enable NJEDA to identify knowledge gaps and address potential concerns or fears related to AI adoption among technology professionals and/or targeted specific subsectors of interest (i.e., architecture and engineering). Leveraging the existing framework that the state used for public-sector employees, NJEDA could adapt and expand this approach to develop a targeted strategy for supporting AI readiness and informed adoption in the technology sector.

WORKFORCE IMPLICATIONS OF AI AND GENAI

In November 2024, the Governor's AI Task Force released a report with 18 key recommendations to guide New Jersey's approach to advancing AI. The report focused on four critical domains:

> Safety, security, technology, and privacy for AI use cases;

> Workforce training, jobs of the future, and training public professionals;

> AI, equity, and literacy; and

> Making New Jersey a hub for AI innovation.

These domains share expert insights and practical recommendations to help the state integrate AI with both purpose and care, for the benefit of New Jersey residents and workers. The Heldrich Center's independent research on the life sciences and technology sectors aligns closely with the Task Force's recommendations, while also offering additional insights. Together, the strategies proposed by the Heldrich Center and the Governor's AI Task Force report create a unified and practical blueprint for New Jersey. This blueprint is designed to strengthen the state's talent pipeline and ensure a diverse workforce is equipped with the skills and knowledge needed to work effectively with AI across various fields. Below, the Heldrich Center highlights the synergies between its research and the findings of the Task Force's report, demonstrating how these combined efforts provide a deeper and comprehensive understanding of the challenges and opportunities in AI and workforce development.

The Heldrich Center study revealed that stakeholders in the life sciences and technology sectors largely share similar views and recommendations regarding the integration of AI and its effects on the workforce. A consistent theme was the need for human oversight and the establishment of safeguards in the application of AI, as emphasized under the domain of **safety, security, technology, and privacy for AI use cases.** Within the chapter focused on **workforce training, jobs of the future, and training public professionals,** Heldrich Center researchers similarly suggest that more efforts could be placed in updating curricula for K–12 students, with a greater focus on skill development and exposure to career pathways. Moreover, researchers are aligned with the need for targeted training opportunities for skill development and continued education for incumbent workers to ensure New Jersey's talent pool is trained and ready for the

changes that may emanate from the continued emergence of AI. Regarding the **AI, equity, and literacy** domain, the Heldrich Center underscores the importance of directing resources and opportunities to historically underserved and underrepresented communities to ensure equitable access to education and good-quality professional opportunities. The need for greater partnerships to reach these communities with dedicated opportunities and resources is also echoed by the Heldrich Center's research. Lastly, for the chapter focused on **making New Jersey a hub for AI innovation,** the Heldrich Center also suggests an expansion of programs and pipelines to foster talent and attract employers, to increase education, training, and professional opportunities for residents across the state. The Heldrich Center's SWOT analyses further underpin the recommendation to foster a collaborative ecosystem for AI innovation, with NJEDA's current program offerings serving to drive New Jersey's reputation as an inclusive hub of innovation.

The synergies between the Task Force's report and the Heldrich Center's research highlight key areas of attention and investment for the state to consider, particularly emphasizing workforce strategies to ensure that multifaceted supports are in place to guide residents, students, and workers to the education and training needed to effectively work with AI in the future. Both bodies of research emphasize the need for collaboration and the joint development of programs and solutions across state agencies. Given that AI's effects will span multiple domains — such as education, workforce development, and policy — greater collaboration is needed to operationalize the necessary interdisciplinary supports and investments to ensure New Jersey remains on the cutting edge of innovation. Relatedly, the Task Force's report further highlights the extent of research and initiatives under way across New Jersey's numerous state agencies. With 25 state agencies across the state working on and contributing to the growing body of research on AI and GenAI, a future iteration of the Task Force, or similar collaborative entity, could foster greater AI interagency communication. This entity, working within and across state government, could also take inventory of all AI-related initiatives and efforts in the state for the purposes of greater alignment and interdisciplinary program development.

The Governor's AI Task Force report indicated that the rapidly evolving AI landscape requires continued attention and adaptation, with some policy questions and considerations still unknown (New Jersey AI Task Force, 2024). For this reason, it is essential to continue to conduct research and gather evidence to inform and guide future programs and policy decisions about the role and parameters of AI in New Jersey. The Heldrich Center echoes this sentiment and proposes four potential research studies to further examine AI's impact and integration in New Jersey as detailed in the next section of this report.

SUGGESTIONS FOR FUTURE RESEARCH

Based on the learnings derived from this research study, the Heldrich Center offers four potential topics for further exploration. The Heldrich Center is equipped to investigate these topic areas in conjunction with NJEDA. These suggestions can be further developed and adapted to suit the specific needs and priorities of NJEDA to ensure that future research is timely and produces actionable recommendations for the betterment of the New Jersey business landscape at large.

> **Conduct a research study focused on AI and small businesses, minority-owned businesses, and women-owned businesses.**

A key opportunity for future research is to examine the role of AI in small businesses, with a particular focus on minority- and women-owned enterprises in New Jersey. The findings from this study highlight the importance of understanding the diverse experiences of both large and small businesses, given the significant economic role of small businesses in the state. Small businesses, especially those owned by minorities and women, are often underrepresented in research, making it essential to explore how AI is impacting these enterprises specifically. Stakeholders and experts interviewed for this study were predominantly from larger, male-dominated businesses. While this was not intentional, additional efforts to include more representation from the small business community, including minority- and women-owned businesses, were not possible given the parameters and timeline of the study. Future studies could prioritize the broader small business community, particularly minority- and women-owned businesses, to address this gap in understanding AI's impact. By doing so, future research could generate valuable insights into the unique challenges and opportunities these enterprises face, ensuring their voices are included in future policy and program development.

> **Replicate the Heldrich Center's study with additional key sectors and/or subsectors of focus in New Jersey.**

Another suggestion for future research would be to conduct a deeper exploration of the subsectors within New Jersey's life sciences and technology sectors. While these two sectors are recognized as critical to the state's economy, they consist of multiple subsectors, each with its own unique workforce needs, challenges, and opportunities. For example, the life sciences sector encompasses various industries, including pharmaceuticals, biotechnology (research and development), and medical devices, while the technology sector incorporates industries like information and professional, scientific, and technical services. From pharmaceuticals to medical equipment, manufacturing plays an important role in the life sciences sector in New Jersey. In addition to software publishers and telecommunications, the technology sector has several service-based subsectors, including data processing and related services, computer system design and related services, and more. Each industry and/or subsector may experience the impact of AI differently, face distinct challenges, or require specialized talent pipelines.

Future studies could build on the Heldrich Center's multimodal research methodology to combine qualitative insights from industry stakeholders, quantitative labor market data, and the AIOE (or similar emerging dataset) to identify and assess the specific needs and growth potential within each subsector. By conducting a subsector-level deep dive, future research could offer more granular insights into the effects and influences of AI, workforce trends, and talent gaps that are not fully captured by this broader sector-level study. This deeper exploration would provide NJEDA, policymakers, and other relevant stakeholders with detailed data to shape more targeted workforce strategies and policies that support AI integration. Additionally, adopting a multimodal approach similar to what the Heldrich Center employed could be replicated across other sectors that NJEDA is interested in exploring. Such studies would provide valuable insights into the impact of AI adoption on various industries throughout the state.

> **Develop a refined measurement of AIOE.**

The state could invest in developing a tailored AIOE measure to effectively assess and track AI's impact on New Jersey's workforce. In this study, Heldrich Center researchers applied Felten et al. (2021)'s AIOE model (see the methodology section on pages 6 and 7 and Appendix B for greater detail). To continue evaluating AI's evolving influence on these sectors, there is an opportunity to expand and refine this framework for broader applications in future research on the effects of AI on New Jersey's occupations, skills, and industries. This enhanced model could build on the Heldrich Center's approach, integrating findings from other key studies (Webb, 2019; Meindl et al., 2021; Brynolfsson et al., 2018) that examine AI's workforce impact. For example, the Wisconsin Department of Workforce Development successfully combined multiple studies to create a composite AI exposure measure, utilizing both manual evaluations and natural language processing techniques to analyze how AI overlaps with occupational tasks. By following a similar approach, New Jersey could create a more comprehensive AI exposure tool that would not only benefit the targeted sectors included in this study but also be adaptable to assess AI's impact on the state's broader workforce. This investment would help identify which occupations are most vulnerable to

AI-driven changes, guiding workforce strategies and policies aimed at mitigating negative impacts while maximizing opportunities for AI augmentation.

> **Conduct a research study on sector stakeholders' perceived impacts of specific regulations (Inflation Reduction Act, forthcoming AI regulation, etc.).**

As part of the Heldrich Center's research, sector stakeholders (both from the life sciences and technology sectors) and AI experts shared their opinions on current and forthcoming policy and/or regulations that will likely impact their day-to-day operations. Many stakeholders noted their concerns about AI regulations in New Jersey, noting the need for an ethical and flexible policy that does not take a one-size-fits-all approach, but rather considered sector-specific needs and does not stifle innovation. Stakeholders spoke of their current testing of use cases and the potential of innovation stemming from AI and GenAI in their business practices and workflows. Additionally, the impacts of the Inflation Reduction Act were noted by some stakeholders as having profound projected impacts on life sciences sector employees in particular. While these concerns were noted and documented, more research can be done to systematically capture the perceived impacts of specific regulations (not limited to the Inflation Reduction Act and AI-related regulations) for New Jersey's business community, including small businesses, minority-owned businesses, and women-owned businesses. The Heldrich Center could work with NJEDA and/or other relevant stakeholders to identify policies and/or regulations of interest and conduct a qualitative research study to capture a diversity of perspectives on the perceived impacts of the specific policy and/or regulation of focus.

CONCLUSION

This research sought to highlight the workforce characteristics and changing dynamics of the life sciences and technology sectors in New Jersey, as well as understand how AI currently affects and is predicted to affect occupational demand and skill requirements for occupations in these sectors. This study's multi-modal research approach utilized a diversity of data and captured relevant stakeholder perspectives to guide the learnings and recommendations emanating from this research. Through the analysis of these varied quantitative and qualitative data points, the Heldrich Center offers a series of targeted workforce strategies and recommendations for the life sciences and technology sectors in New Jersey. These recommendations seek to build off of programs and investments currently under way in New Jersey, as well as emulate program design perceived to be working well in other localities.

The Heldrich Center offers 7 workforce strategies and 15 recommendations to operationalize these strategies for the consideration of NJEDA and other key sector stakeholders. These strategies consider the current landscape of the life sciences and technology sectors, building off the sectors' existing composition, assets, and programs, as well as suggests interventions to increase workforce diversity, expand the talent pipeline, create greater synergies between relevant stakeholders, and extend the footprint of the sectors within the state. These workforce strategies address perceived weaknesses and/or threats to the sectors, constituting gaps where greater investment and intervention may be needed to foster a more robust and aligned talent pipeline. This work builds off a large portfolio of programs and investments currently under way to make New Jersey a hub of innovation, one led with intentionality to be inclusive and ensure that all New Jersey residents and workers have opportunities to benefit from the development of key sectors in the state. Fostering a more inclusive and resilient talent pipeline will help to ensure that the state's workforce is trained and prepared for the anticipated impacts of AI.

The research team also acknowledges that New Jersey currently maintains a robust landscape of AI-focused projects, with many entities in the state collaborating and co-creating to understand the impacts of AI on residents and workers. For instance, the NJ AI Hub seeks to unite AI researchers, industry leaders, start-ups, and collaborators for the shared purpose of advancing research, hosting accelerators, promoting ethical AI use, and supporting workforce development (NJ AI Hub, 2024). The New Jersey State Bar Association recently convened a task force on the intersection of AI and the law that produced a report serving as practical guidance for attorneys navigating a new legal landscape. That report emphasized the importance of

prioritizing AI education; establishing baseline procedures and guidelines; and the need for collaboration with data privacy, cybersecurity, and AI professionals (Eisenstein et al., 2024). The report further highlights key social justice concerns in relation to the use of AI, including "the importance of transparency in AI software algorithms, bias mitigation, and equitable access to AI tools" (Eisenstein et al., 2024). The Governor's AI Task Force brings together numerous stakeholders to collaborate on AI's workforce impacts, as well as key equity, security, and privacy considerations, in order to offer recommendations for the state to encourage the ethical use of AI technologies (State of New Jersey, 2023). Lastly, as previously mentioned, the November 2024 release of the Governor's AI Task Force report offers the state a roadmap for a path forward, guiding responsible AI use in New Jersey, and the foundation for a plan to maximize the use of emerging technologies to become a hub of inclusive innovation, grow the economy, and support workers throughout the state. These three initiatives, while informative and instructive, do not represent an exhaustive list of AI-focused work in the state. Rather, they provide a snapshot of the learnings being derived from ongoing efforts to understand AI and its impacts. The Heldrich Center's report adds to this growing body of research to guide New Jersey's approach to AI integration, particularly as it intersects with the life sciences and technology sectors in the state.

New Jersey is poised to continue to build upon its reputation as a hub of innovation, particularly with the projected growth of the life sciences and technology sectors and the burgeoning developments of AI's application within these key sectors, amongst many others. This study showcases the intentional way in which stakeholders in the state seek to use evidence-based learning to guide investments and developments for the benefit of the state's workforce. While 33 states[7] engage in AI-focused work, via the convening of committees, task forces, and working groups, New Jersey is advancing AI policy issues and public perceptions through multifaceted touchpoints with residents and workers, systematically gathering evidence-based research to formulate an equitable and responsible AI strategy (multistate.ai, n.d.). With this research-driven approach, capturing the direct feedback of relevant sector stakeholders, New Jersey's inclusive and intentional development of the life sciences and technology sectors, as they intersect with developments in AI and GenAI technologies, is poised to continue to expand and flourish.

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[7] Data from multistate.ai as of September 20, 2024.

APPENDIX A: DEFINITIONS

The Heldrich Center relied upon key definitions to inform researchers' understanding and use of key concepts in this study. The definitions and sources are highlighted below.

Artificial intelligence (AI), defined as "a machine's ability to perform the cognitive functions we usually associate with human minds" (McKinsey & Company, 2024).

Generative artificial intelligence (GenAI), defined as, "a subset of AI that utilizes machine learning models to create new, original content, such as images, text, or music, based on patterns and structures learned from existing data. A prominent model type used by generative AI is the large language model" (Cornell University Center for Teaching Innovation, 2024).

The **life sciences sector**, defined by three primary industries and four subsectors in New Jersey (NJDOL, 2022). The pharmaceutical and medicine manufacturing and soap, cleaning compound, and toiletry manufacturing subsectors fall under the pharmaceutical industry. For the biotechnology (research and development) industry, there is the scientific research and development services subsector. Finally, the medical devices industry has the medical equipment and supplies manufacturing subsector.

The **technology sector,** defined by two primary industries and six subsectors in New Jersey (NJDOL, 2022). There are three subsectors under the information industry: software publishers, telecommunications, and data processing and related services. The professional, technical, and scientific services industry also has three subsectors: architectural and engineering services, computer systems design and related services, and scientific research and development services.

APPENDIX B: ARTIFICIAL INTELLIGENCE OCCUPATIONAL EXPOSURE SCORE

The Artificial Intelligence Occupational Exposure (AIOE), AI Industry Exposure, and AI Geographic Exposure scores are measures that help quantify the exposure of AI on specific occupational groups, industries, and geographic regions. Felten et al. (2021) developed the AIOE score, which illustrates the extent to which skills/tasks for specific occupations are at risk of becoming automated by AI.

AIOE represents a standardized score. Positive scores (x > 0) indicate stronger linkage between tasks/skills and AI applications, while negative scores (x < 0) demonstrate weaker connections. For example, financial examiners have an AIOE score of 1.5, whereas dancers have around -2.7, indicating that the latter occupation has lower exposure to AI. It should be noted that AI scores do not indicate projections or predictions of future exposure but rather focus on the current risk of AI exposure. Moreover, AIOE scores do not indicate whether AI substitutes or complements specific skills/tasks, and the methodological approach only allows for assessments of specific applications of AI and how they relate to specific skills/tasks. As such, AIOE scores generally cannot determine the impact of automation or AI.

The Heldrich Center linked AIOE scores, as provided by Felten et al. (2021), with labor market information using six-digit Standard Occupational Classification codes. Researchers created three categories of AI exposure: low (x < -1), moderate (-1 < x > 1), and high (x > 1). To assess AI exposure, researchers analyzed the percentage of people employed within 20 occupational groups for the life sciences and technology sectors.[8] For example, the architectural and engineering services occupational group has 24,000 jobs in New Jersey, representing 11% of all jobs in the technology sector. Around 56% of jobs associated with architectural and engineering services have high exposure to AI.

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[8] The 20 occupational groups include: architecture & engineering; arts, design, and entertainment; building and grounds cleanings and maintenance; business and finance; computer and mathematics; construction and extraction; education, training, and library; farming, fishing, and forestry; food preparation and services; healthcare practitioners and technicians; healthcare support; installation and maintenance; legal professions; life, physical, and social sciences; management; office and administration; personal care and services; production; sales and related; and transportation.

APPENDIX C: SECTOR STAKEHOLDER INTERVIEW PROTOCOL

The Heldrich Center customized an interview protocol for all study participants. This is the research team's general interview protocol.

BACKGROUND AND EXPERTISE

> Could you share a bit about your background and expertise in the field of AI?

> What projects or initiatives are you currently involved in within the realm of AI, particularly (if any) in the life sciences and technology sectors?

> How do you stay updated on the latest developments and trends in AI?
  • [Probe: Are there specific resources or communities that you find valuable for staying informed?]

GENERAL AI TRENDS

> How would you define generative AI?

> What are the current trends in AI and how have they evolved in recent years?
  • [Probe: Can you highlight any breakthroughs or advancements that have significantly impacted the AI landscape?]

> Are there other types of AI that you foresee having a substantial impact on the workforce?

WORKFORCE IMPACT

> From your perspective, how is AI currently influencing the workforce, and what are the expected future implications?
  • Broadly speaking, how would you characterize AI's impact on the workforce (adaptive, replacement, competitive, etc.)?
  • What are the greatest risks to the workforce that you anticipate because of the emergence of generative AI?

> Are there specific industries or sectors where AI is having a more pronounced impact on employment?
  • What are the most common applications of generative AI?
  • What are the sectors most at risk for change?
  • What are the occupations most at risk for change?

> Looking at life sciences specifically, how do you foresee generative AI impacting sector employment?
  • Provide definition of life sciences sector in New Jersey.

> Looking at technology specifically, how do you foresee generative AI impacting sector employment?
  • Provide definition of technology sector in New Jersey.

> How do you see AI impacting job displacement and job creation in the life sciences sector? Technology sector?
  • [Probe: Provide overview of type of occupations in the life sciences and technology sectors if needed.]

> What are your predictions for the next 5 to 10 years regarding the integration of AI in the workforce, particularly in life sciences and technology?

SKILLS AND EDUCATION/TRAINING

> Are there specific skills or competencies that employees should focus on to remain relevant in an AI-driven environment?
  • [Probe: What skills are becoming increasingly valuable for individuals seeking careers impacted by AI and/or AI-related fields?]

> In light of AI's impact on job roles, what strategies should employers adopt for the training and development of their workforce?
> How should educational institutions adapt to prepare students for the changing demands of the workforce influenced by AI?
> What job functions and/or skills are the most at risk for automation?

DIVERSITY AND INCLUSION IN AI

> How can employers ensure diversity and inclusion in AI development teams, particularly in sectors like life sciences where diverse perspectives are crucial?
> Are there specific challenges or opportunities related to diversity in AI that employers should be aware of?

RECOMMENDATIONS FOR EMPLOYERS

> What recommendations do you have for employers in the life sciences and technology sectors when formulating an AI adoption strategy?
   • [Probe: How can organizations effectively identify and prioritize areas where AI can bring the most value?]
> What advice do you have for employers in terms of long-term planning when it comes to AI integration? How can organizations future-proof their AI strategies?
> In the face of rapid technological changes, how can employers foster an organizational culture that is adaptable and open to innovation, particularly with AI?
> What steps can employers take to ensure the ethical use of AI in their organizations, especially in sensitive sectors like life sciences? Technology?
> Are there specific guidelines or frameworks that you recommend for integrating AI ethically?

OTHER AND FUTURE CONSIDERATIONS

> Are there emerging AI technologies that could revolutionize specific industries (specifically life sciences and technology)?
> What factors impact the rate of new technologies adoption?
> In one sentence, how would you define the future of work in an AI context and/or with an AI lens?
> What advancements can we expect in AI over the next decade?
> Have you seen any good tools to estimate the risk and/or vulnerability of certain occupations and/or sectors to AI's influence?
> Some research suggests that trying to anticipate AI's influence is guess work. What are your thoughts on the subject?
> What ethical concerns are associated with the use of generative AI in decision-making?
> Who else in the field should we be talking to?

POLICY CONSIDERATIONS

> What role can policymakers play in ensuring responsible AI deployment?
> What are the current regulatory challenges and considerations related to the use of AI in the life sciences industry?
> How might regulatory frameworks evolve to address the dynamic nature of AI?

APPENDIX D: SECTOR STAKEHOLDER FOCUS GROUP PROTOCOL

AWARENESS AND UNDERSTANDING

> How familiar are you with the concept of AI and its applications to your work and/or your organization?

> Based on the data presented (labor market information and interview findings), what are your initial thoughts/reactions?

- [Probe: Did anything surprise you? Was there something that we should have covered and missed?]

IMPACT ON WORKFORCE AND SKILLS

> What do you anticipate will be the primary effects of AI adoption on job roles and skill requirements within the life sciences/technology sectors?

> How do you think AI will influence the demand for specific skill sets in the life sciences/technology workforce?

WORKFORCE ADAPTATION AND TRAINING

> From your perspective, how can life sciences/technology employers prepare their workforce to effectively utilize AI tools and technologies?

> What types of training or professional development programs do you believe will be most beneficial for your respective workforce to enhance AI-related competencies and remain competitive in the industry?

- [Probe: Do you currently have any in place or have plans to implement such programs? Do you know where you would go/send employees to for training programs?]

EMPLOYMENT OPPORTUNITIES AND CHALLENGES

> What opportunities do you foresee emerging from the integration of AI in the life sciences/technology sectors?

> Conversely, what challenges or concerns do you have regarding potential workforce disruptions, skills mismatches, or ethical considerations associated with AI integration?

- [Probe: What should be prioritized?]

> How might AI adoption impact issues such as diversity, equity, and inclusion within the life sciences/technology sectors?

- [Probe: What steps can employers take to ensure equitable access to AI-related opportunities and advancements?]

FUTURE CONSIDERATIONS

> How can employers collaborate with educational institutions, address talent gaps, and navigate the evolving landscape of AI in the life sciences/technology sectors?

> In your opinion, what strategies should life sciences/technology companies/organizations adopt to leverage AI effectively while maintaining a skilled adaptable workforce?

APPENDIX E: SUMMARY OF THEMES FROM QUALITATIVE DATA COLLECTION

AI'S IMPACT ON THE TECHNOLOGY AND LIFE SCIENCES SECTORS IN NEW JERSEY: A SUMMARY OF STAKEHOLDER INTERVIEWS AND FOCUS GROUPS

An integral component of the Heldrich Center's research study is to gain real-time insights into the potential impacts and influence of AI and GenAI on the life sciences and technology sectors in New Jersey. The Heldrich Center engaged in 19 individual, semi-structured interviews and two focus groups with a total of 39 essential stakeholders captured in the research. Stakeholder outreach occurred between February and July 2024. Stakeholders were selected for their subject-matter expertise and/ or employment in or familiarity with the life sciences and technology sectors in New Jersey. The Heldrich Center's discussions with stakeholders centered on workers, leaders, and use cases of AI, as well as captured the early deployment and adoption of AI in these sectors. The research team captured diverse perspectives through qualitative research methods and reached saturation with the protocols employed in this study. Interview subjects participating in the research represented academia, large and small business enterprises, state agencies, nonprofit organizations, sector-focused associations, and community-based organizations. Interview participants were primarily directors, senior project officers, senior advisors, vice presidents, presidents, and chief executive officers representing their respective companies. Presented below are the preliminary themes from these interviews and focus groups.

INDIVIDUAL AI EXPERTS AND SECTOR STAKEHOLDERS SUMMARY THEMES

The following section highlights the themes most prevalent in the qualitative research conducted by the Heldrich Center team. Table E-1 provides high-level findings for each theme.

Table E-1: Themes, Topics, and Preliminary Findings for Interviews

Themes	Topics	Findings
Evolution and Impressions of AI	Historical progression	Technological advancements allow AI to handle increasingly complex tasks, with enormous potential and transformative power.
Integration Approach, Worker Perception, and Societal Impacts	Augmenting workers' capabilities	People perceive AI as a powerful tool to increase efficiency and productivity on the job.
	Workforce impacts	People expect changes to the workforce, but stakeholders are uncertain if they will be reductive or intended to augment capacity.
	Fear and misunderstanding AI	News media contributes to fear and misunderstanding of AI; the focus should be on potential benefits and growth opportunities.
Cultural Shifts with Adaptation and Adoption	Organizational adaptation and cultural shifts of AI	Adapting to new workflows and shifts in workplace culture requires strong leadership and communication skills; AI is an additive tool that can be integrated into workflows with specific use cases.
	Integration and adoption	Mid-level managers drive AI adoption, but executive buy-in is essential.
Diversity, Equity, Inclusion, and Ethical Use	Role of leadership	Leadership must commit to addressing and correcting discrimination and bias, as well as foster workplace cultures where employees feel safe to discuss issues that arise from using AI.
	AI impacts on disadvantaged groups	There are uncertainties and concerns that pre-existing knowledge and skills gaps among disadvantaged groups will become exacerbated with AI adoption.
	Bias	People need clear guidelines and transparency to minimize and address bias in AI tools.
Education and Training Considerations	AI skill shift	Domain knowledge and conceptual understanding of AI will become increasingly important for a larger population of workers and students.
	Securing and maintaining pipelines	Stakeholders felt that educational programs should offer students opportunities to build knowledge, skills, and awareness of AI on the job, while employers should encourage employees to use free resources to build AI competencies.
Policy, Regulation, and Future Outlook	Policymaking and future implications	Stakeholders felt that it is important for policymakers to get stakeholder input to ensure regulation is informed while putting transparency and "explainability" at the forefront.

SECTOR STAKEHOLDER FOCUS GROUP SUMMARY THEMES

The aforementioned interview themes were also prevalent in conversations with stakeholders during the focus groups. This appendix presents the focus group themes separately to highlight the prevailing discussions when stakeholders interacted with one another. Researchers find that when stakeholders are given the opportunity to interact and learn from their peers in collaborative sessions, the resulting learnings and insights are invaluable. Table E-2 summarizes the findings for each theme from the focus groups.

Table E-2: Themes, Topics, and Findings for Focus Groups

Themes	Topics	Findings
Workforce Impacts, Public Perception, and Impact on Society	Impact on jobs	People should expect job displacement and job creation, with new roles emerging from AI integration.
	Need for validation and quality control	Data validation and quality control are critical to public perception and trustworthiness.
	Health equity	AI has the potential to improve health equity by facilitating balanced, representative datasets.
Education and Training Considerations	Need for reskilling	Employers and educational institutions should focus on upskilling and/or reskilling current workers and the future workforce to ensure they have the knowledge and skills required to use AI tools on the job.
AI Adoption Factors	Company size and available resources	Small- and medium-sized companies face unique challenges adopting AI because of resource and funding constraints.
	Risk of AI adoption	Risk tolerance greatly impacts an organization's adoption of AI.

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ABOUT THE HELDRICH CENTER

The Heldrich Center for Workforce Development is one of the nation's leading research and policy organizations dedicated to transforming the workforce development system at the local, state, and federal levels. Based at the Edward J. Bloustein School of Planning and Public Policy at Rutgers, The State University of New Jersey, the Heldrich Center provides an independent source of analysis for reform and innovation in policymaking. The Heldrich Center employs cutting-edge research and evaluation methods to identify best practices in workforce development, education, and employment policy. It is engaged in partnerships with government, the private sector, workforce organizations, and educational institutions to design and evaluate workforce, education, and training programs. The Heldrich Center is deeply committed to assisting job seekers and workers attain the information, education, and skills training they need to move up the economic ladder.

The Center aims to accomplish its mission through four activities:

> Transforming the workforce through research,
> Empowering job seekers through technology,
> Assessing and identifying workforce best practices, and
> Strengthening public programs that promote financial stability and economic mobility.

ABOUT NJEDA

The New Jersey Economic Development Authority (NJEDA) grows the state's economy and increases equitable access to opportunity by supporting high-quality job creation, catalyzing investment, and fostering vibrant, inclusive community development. NJEDA works in partnership with a diverse range of stakeholders to implement programs and initiatives that improve quality of life, enhance economic vitality, and strengthen New Jersey's long-term economic competitiveness.