

Disrupting the Tech Industry Through Apprenticeships

Lessons on Improving Diversity in Recruitment from Small and Medium Businesses

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Artificial intelligence and similar innovations are driving a profound transformation in the tech sector (Yee et al. 2025), intensifying global competition and economic disruptions. This evolution brings enormous potential, but also exposes two critical vulnerabilities in the workforce that threaten the industry's ability to sustain growth and foster equity.

First, the tech sector is expected to outpace all other industries in employment over the next decade, with more than 300,000 annual openings driven by both new growth and workforce replacement needs.¹ Yet the traditional talent pipeline falls short: only 100,000 computer science majors graduate in the US every year.² Although unmet demand has been partially offset for the short term by a recent round of widespread layoffs, particularly among major tech firms,³ this neither fully addresses short-term needs nor balances the need for talent with the pipeline over the long term.

Second, the tech field faces persistent challenges in diversity and inclusion. Most IT degree holders are white men, and underrepresented groups consistently earn lower wages and struggle with workplace belonging.⁴ These challenges are interconnected—and so are the solutions. Abundant positions and a narrow pipeline present an opportunity to reimagine IT workforce development and build a more inclusive tech ecosystem. Small and medium businesses (SMBs), which consistently outpace larger firms in job creation, can advance registered apprenticeship as a tool for developing in-demand tech skills and recruiting talent. By realizing this potential, the tech industry can strengthen the talent pipeline, stabilize employment, and advance equity across the industry.

This brief compares tech workforce and apprenticeship data and incorporates insights from SMBs in North and South Carolina to highlight how recruitment practices can be strategically leveraged to improve diversity and build a talent pipeline in the tech sector. To close gaps between openings and candidates, we recommend four strategies: (1) build strategic education and community partnerships to expand awareness of tech career opportunities among underrepresented talent, (2) use intentional screening methods that mitigate bias and promote equity, (3) support applicants' readiness through short-term training programs that build tech skills, and (4) improve representation across all levels of an organization to reflect the communities they serve.

Making the Case for Apprenticeships

Registered apprenticeships are structured workforce development initiatives that benefit employers through an infusion of workers who can gain new skills and valuable work experience. By offering paid on-the-job training, mentorship, and clear career pathways, apprenticeships remove barriers to employment within a sector. Apprenticeships are also linked to higher earnings and improved job satisfaction for participants,⁵ while employers gain from stronger employee retention.⁶

Although historically registered apprenticeships have been associated with the construction trades, over the last decade apprenticeships have expanded significantly into emerging sectors such as health care, advanced manufacturing, and, more recently, tech. As tech employers seek new ways to broaden talent pipelines to fill critical roles, apprenticeships can be a promising entry point for women and other underrepresented populations, leading to higher earnings and long-term career growth. Despite the well-documented benefits, participation in registered apprenticeships remains uneven among women and people of color, underscoring the need for inclusive recruitment.

Bridging Gaps in the Tech Workforce

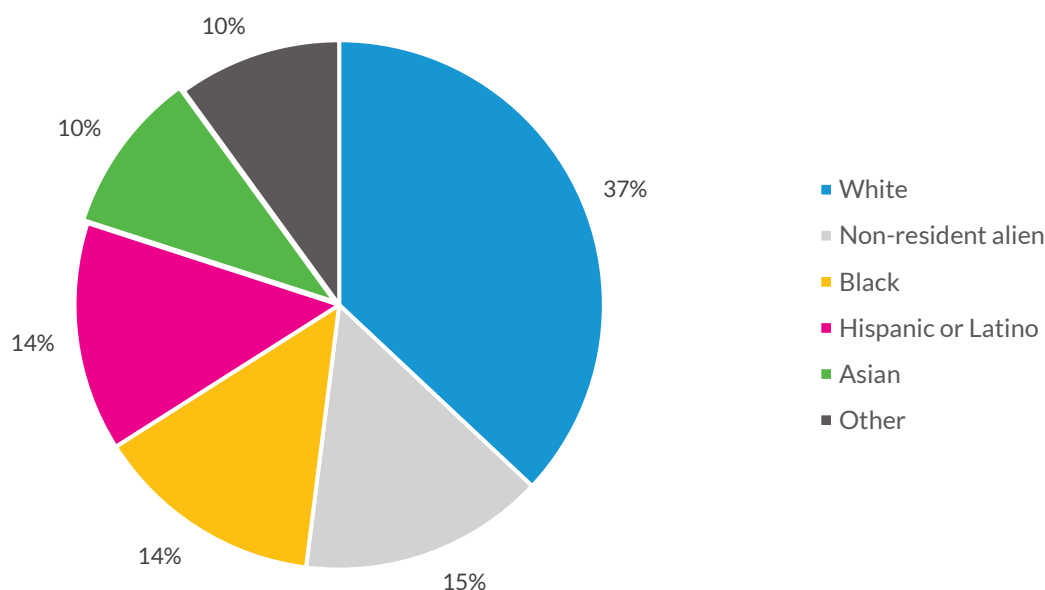
Small and medium businesses make up 99.9 percent of all US businesses and employ almost half (45.9 percent) of all US employees, playing a key role in creating jobs and sustaining the economy (US Small Business Administration 2025). SMBs need employees with multiple skills to stay competitive. But they often face recruitment challenges: 60 percent of small business owners listed hiring talent as their top concern in 2023.⁷ SMBs also encounter other specific challenges in hiring skilled workers, including lack of name recognition, tight financial resources, and time constraints.⁸ Engaging in registered apprenticeship offers SMBs a promising solution, helping businesses meet their talent needs while expanding access to apprenticeship opportunities.

Mismatches in Training and Location

The tech industry is shifting toward valuing skills over traditional degrees,⁹ creating new opportunities for workforce diversification. However, systemic barriers continue to limit access for people of color (figure 1), women, and nontraditional candidates. Extensive research indicates that these groups often

face challenges such as limited access to education, workplace bias, and socioeconomic constraints (Bertrand and Mullainathan 2004; Dutt et al. 2016; Rivera 2012; Purkiss et al. 2006). Further, the historical emphasis on four-year degrees disadvantages individuals who might have followed a nontraditional career path,¹⁰ and the lack of role models in the tech sector discourages women from pursuing tech career pathways (Hill, Corbett, and Rose 2010).

FIGURE 1
IT Degrees Earned in 2022 by Race and Ethnicity



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Source: Information Technology, Race and Ethnicity by Degrees Awarded, DATA USA, 2023, <https://datausa.io/profile/cip/information-technology>.

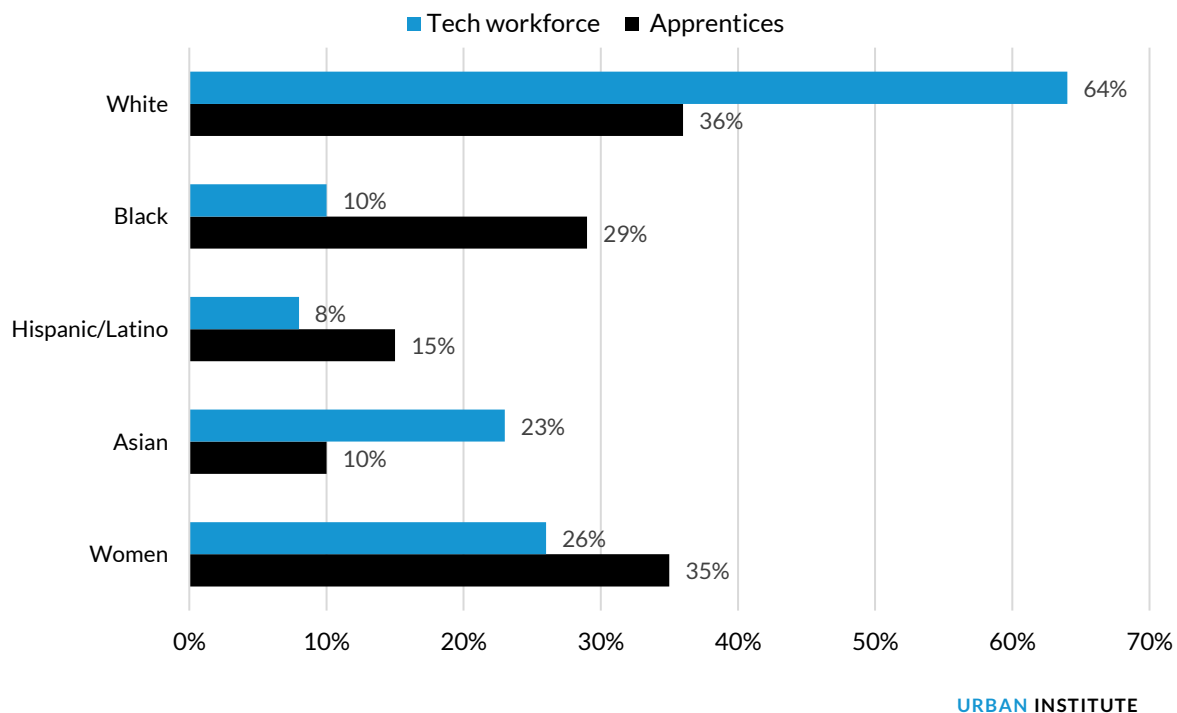
Further, tech jobs are still concentrated in geographical areas with the infrastructure to support technological innovation, such as New York, California, and Massachusetts. Unsurprisingly, 90 percent of the tech sector’s growth is limited to these areas.¹¹ The IT industry recognizes that it needs alternative workforce training routes and locations to attract new talent to the field. Our initiative in North and South Carolina demonstrates the significant potential and untapped talent available beyond traditional tech hubs.

Apprenticeships Expand Equity

Registered apprenticeships are emerging as a powerful tool to broaden participation in tech. The “earn and learn” model, built on the premise of removing traditional requirements for prior education and work experience, provides accessible pathways into high-demand, high-wage tech careers, especially for underrepresented populations. Additionally, apprenticeship standards require equitable selection

procedures and universal outreach. This model can expand equity in the tech workforce by recruiting and training a new talent pool of workers.¹² Data show that apprenticeships yield more equitable outcomes than those observed in the IT labor market. Analysis of data from the US Department of Labor Registered Apprenticeship Partners Information Database System (RAPIDS) finds that Black and Hispanic/Latino workers are better represented in apprenticeships than in the IT workforce. Women are also better represented in apprenticeships but remain underrepresented relative to the US population (figure 2).

FIGURE 2
IT Workers Compared with IT Apprentices by Race, Ethnicity, and Gender



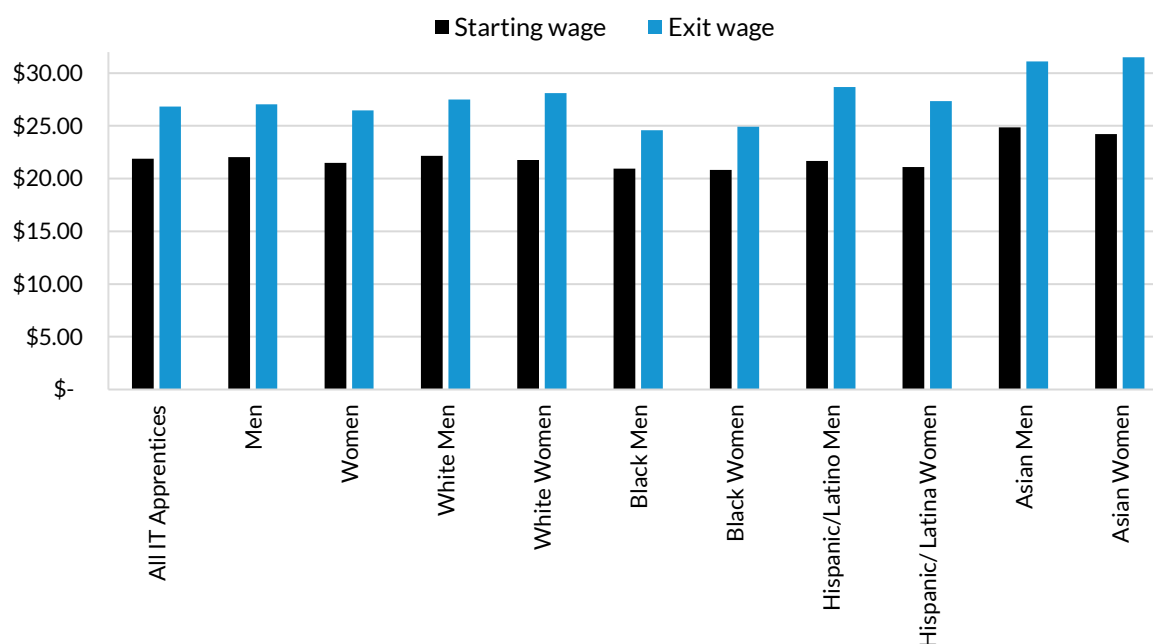
Source: Labor force statistics from Computer and Mathematical Occupations, Current Population Survey, Bureau of Labor Statistics, 2024, and authors' analysis of data for IT apprentices, Registered Apprenticeship Partners Information Database System, US Department of Labor, 2024.

Notes: Race and ethnicity percentages add to above 100 percent for the Tech Workforce because according to Bureau of Labor Statistics, people whose ethnicity is identified as Hispanic or Latino may be of any race. Apprentice percentages do not add to 100 percent due to other identities not represented, which comprise the 10 percent of apprentices not accounted for in this graph.

In addition to being underrepresented, women are underpaid in the tech sector.¹³ The ratio of women to men in tech roles has declined in the past 35 years, with the percentage of women in tech leadership positions falling from 35 percent in 1984 to 28 percent in 2023¹⁴ and half the women who go into tech dropping out by the age of 35.¹⁵ Women also earn fewer cents per dollar than men, even in high-skilled tech occupations. Available data suggest that some of these trends persist in tech apprenticeships, with women on average earning 50 cents less than men for hourly starting and exit

wages. However, for exit wages, white, Black, and Asian women earn exit wages slightly higher than their male counterparts' (figure 3).

FIGURE 3
Average Hourly Starting and Exit Wages for IT Apprentices by Gender, Race, and Ethnicity



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Source: Authors' analysis of Registered Apprenticeship Partners Information Database System, US Department of Labor, 2024.

Inclusive Apprenticeships in North and South Carolina

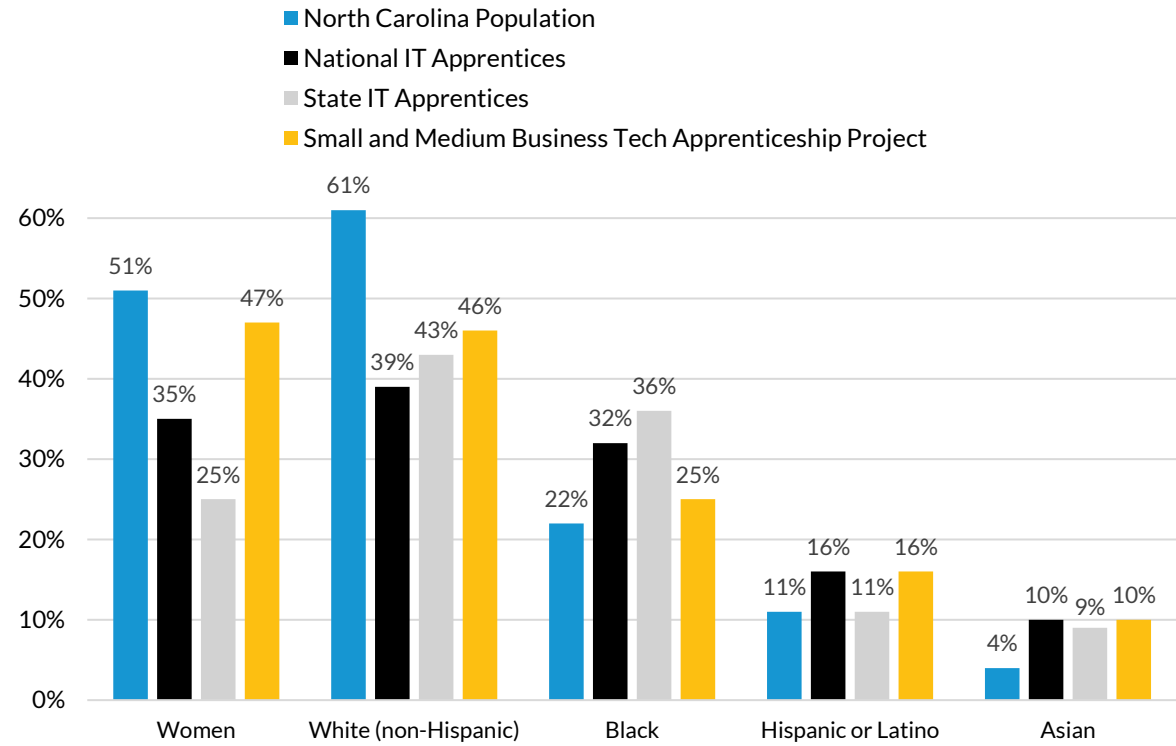
Growth of the tech industry in North and South Carolina has boomed in the past five years, with North Carolina ranking fourth nationally for tech talent growth¹⁶ and South Carolina seeing a 56 percent increase in tech employment since 2020.¹⁷ Since 2023, the Urban Institute Small and Medium Business Tech Apprenticeship Project¹⁸ has worked alongside Apprenticeship NC¹⁹ and Apprenticeship Carolina²⁰ to support 14 SMBs with technical assistance and employer incentive funding for building and expanding tech apprenticeship programs to fill their talent needs. This initiative, with its focus on recruiting diverse cohorts, has connected 258 individuals to tech careers.²¹

Figures 4 and 5 delineate racial and gender demographics for tech apprentices in North Carolina and South Carolina respectively. Both figures include state demographic information as a baseline comparison.

In North Carolina, women are almost twice as likely to be represented in SMB programs supported by Urban than in state IT apprenticeship programs, and 12 percent more represented than national

programs (figure 4). Hispanic/Latino apprentices are equally represented at the SMB project level compared with tech apprentices nationwide (16 percent) and better represented at the SMB project level relative to both the state’s apprentices and the baseline population (11 percent). Forty-six percent of SMB project apprentices are white, compared with 61 percent of the state’s total population.

FIGURE 4
IT Apprentice Demographics in North Carolina Across State, National, and Project Levels



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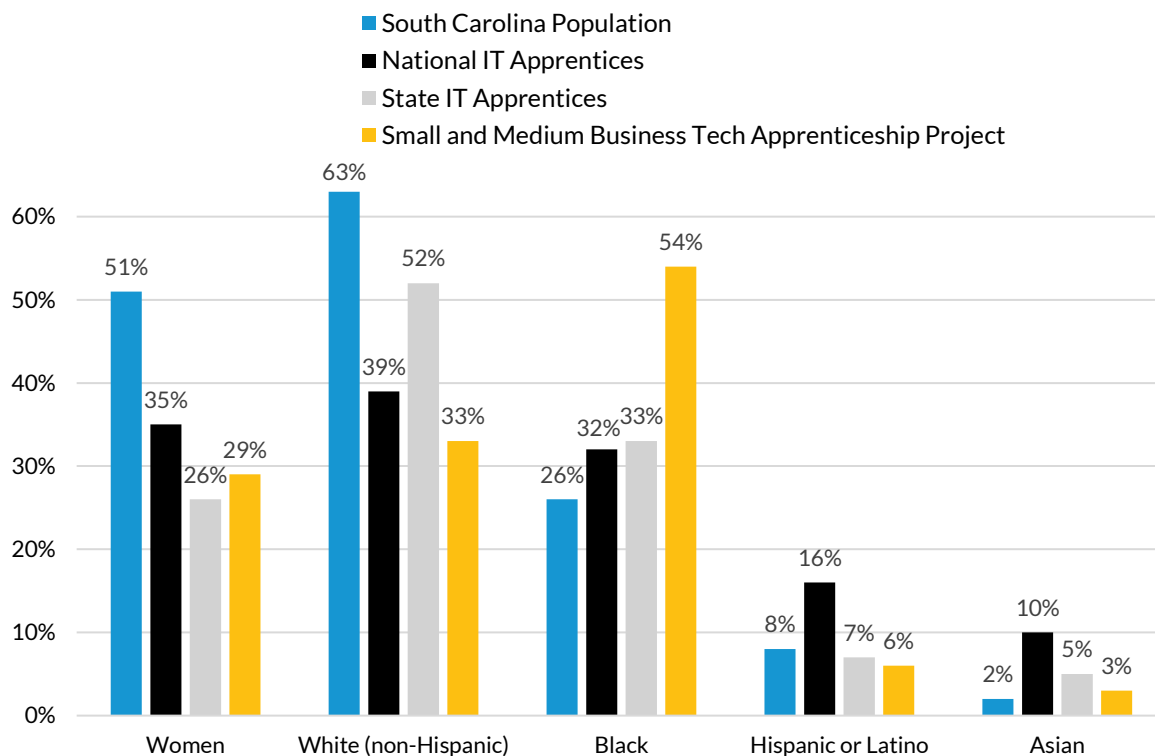
Source: Authors’ analysis of Registered Apprenticeship Partners Information Database System (RAPIDS), US Department of Labor, 2024, and US Census Bureau data, 2024.

Note: This analysis excludes apprentices who did not report on gender, race, and ethnicity indicators.

In South Carolina, women are underrepresented in tech apprenticeships at the SMB project and state levels (figure 5). By contrast, Black apprentices are overrepresented at the SMB project level, at a percentage double that of the state’s Black population and exceeding that of Black IT apprentices in national and state programs. White apprentices make up only 33 percent of SMB project participants versus 63 percent of the state baseline population level. Hispanic/Latino apprentices are comparably represented relative to the state’s IT apprentices and population but underrepresented compared with national IT apprentices.

FIGURE 5

IT Apprentice Demographics in South Carolina Across State, National, and Project Levels



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Source: Authors' analysis of Registered Apprenticeship Partners Information Database System, US Department of Labor, 2024, and US Census Bureau data, 2024.

Note: This analysis excludes apprentices who did not report on gender, race, and ethnicity indicators.

In both states, Black apprentices in the SMB project are better represented relative to the state's baseline population. While women are underrepresented in the SMB project in South Carolina, they are well represented in North Carolina. One potential reason is disparate sample sizes, with 79 of the project's apprentices registered in South Carolina at the time of analysis compared with 151 apprentices in North Carolina. These small sample sizes reflect the smaller cohorts that SMBs typically support (compared with large businesses) and their sensitivity to fluctuations in single-program participation, in addition to the Urban Institute's outcomes in engaging with employers and registering apprentices in North versus South Carolina. Three SMB sponsors in North Carolina that focus on hiring large and diverse cohorts accounted for a majority (127 out of 151) of SMB apprenticeships. For instance, Nehemiah Community Empowerment Center²² focused primarily on Black apprentices, while Cloud for Good²³ and Code the Dream²⁴ skewed toward recruiting more women apprentices.

These findings underscore the potential for apprenticeships to reshape the tech workforce with an intentional focus on fostering inclusion and expanding access to high-quality careers.

Insights from Sponsors, Employers, and Apprentices

We interviewed 12 sponsors and 25 apprentices who participated in the SMB Tech Apprenticeship Project in North Carolina and South Carolina to understand common challenges and effective strategies in attracting and hiring diverse candidates. Below, we share their insights.

Challenges with Inclusive Recruitment

Although the previous section compares data on race, ethnicity, and gender, we use a broader definition of inclusivity that also considers other populations that remain underrepresented in the tech workforce, namely individuals involved with the justice system and those from rural areas. Our goal was to understand which populations employers are actively seeking to hire and which they find challenging to recruit.

Lack of Women Applicants

Multiple SMB employers reported difficulty attracting women applicants. Women are more likely than men to avoid applying for jobs if they do not believe they meet all the qualifications.²⁵ Another major barrier to women's labor force participation is their disproportionate care responsibilities.²⁶ Respondents reported that women often self-select out of roles to prioritize responsibilities within the home and family.

“The biggest challenge with women is that they are the backbone of the family, so if something happens, they have to quit... They might be interested [in the tech position] but when life happens and when something happens to the children, they are usually the first ones to give up their dream.”

—Minority woman, business owner, and sponsor in South Carolina

Capacity and Justice-Involved Applicants

Some SMBs mentioned two major barriers to inclusive hiring. First, many struggle with the overwhelming number of applications and lack the capacity to manually review them. This could lead to reliance on AI-driven screening tools, which can perpetuate bias and exclude qualified candidates.²⁷ One SMB noted that their hiring algorithm excluded applicants with a criminal record, requiring them to conduct a second round of manual screening to ensure inclusivity.

Second, employers reported barriers in hiring justice-involved populations despite evidence that employment supports desistance from crime (Uggen 2000). These hiring barriers are especially high for people of color, who are overrepresented in the criminal justice system, and underrepresented in the tech sector (Augustine, Zatz, and Sugie 2020). Certain sectors of the industry, like cybersecurity, remain less accessible to populations involved with the justice system. Two SMB employers specifically expressed hesitation to hire justice-involved individuals for cybersecurity occupations and positions

requiring background checks, complicating placement of apprentices on contracts embedded in other organizations.

Lack of Transportation Infrastructure in Rural Areas

SMBs expressed that placing apprentices can be difficult when businesses are based in areas that lack the infrastructure to support programming. Thirteen percent of America's workforce lives in rural areas, but rural workers make up only about five percent of the tech workforce.²⁸ Apprenticeship programs in rural areas cited the lack of transportation infrastructure as a major barrier to recruitment (Boren et al. 2021). Lack of public transportation infrastructure creates systemic barriers for apprentices without transportation of their own who are unable to pursue opportunities that require in-person attendance.

Strategies for Reaching a Diverse Workforce

SMB sponsors and employers faced several challenges with recruitment, but they also devised successful strategies to overcome them. One SMB employer explained that their goal was not to hire diverse candidates *because* of their diversity, but to ensure that diverse candidates felt encouraged and able to apply. By making the application process more accessible, they created opportunities for all individuals to participate—naturally broadening the diversity of their talent pipeline. This section examines promising practices the sponsors in the project used to recruit a diverse workforce.

Partnerships with High Schools, Colleges, and Others

High schools can promote pathways for youth underrepresented in the tech field. Four SMBs used a high school recruitment approach, including outreach through virtual meetings and referrals from school representatives. One program noted efforts to recruit from high schools with low postsecondary matriculation rates, and another listed high schools as its primary recruitment pathway. Another program sought referrals for youth candidates from city council members and court officers. Overwhelmingly, SMBs noted using local networks and organizations to prioritize local talent and improve the diversity of its applicant pool.

Some SMBs discussed the importance of partnerships with higher education institutions to recruit apprentices from underserved backgrounds. While only one program noted relying heavily on recruitment from historically black colleges and universities in the area, others benefited from connecting with other institutions. For instance, one SMB established memorandums of understanding with five colleges, universities, and community-based organizations, using their logos to promote recognition and legitimacy for the apprenticeship program. One program focused recruitment on transitioning military personnel by partnering with local military institutions and the Transition Assistance Program.

To ensure that apprentice cohorts reflected the diversity of their communities, employers facilitated partnerships with other local entities, including local workforce development boards, food pantries, homeless shelters, and community-based organizations. One SMB emphasized the importance of grassroots recruiting efforts, such as outreach through unemployment services, departments of social services, food stamp offices, and child care centers. By contrast, another sponsor noted that their

program does not seek to recruit specific demographics, as the diversity of their candidates is a natural reflection of the community in which a business is located. Diversity can continue to expand as employers and community-based organizations launch and grow in more diverse communities.

Of the apprentices interviewed, most credited community-based organizations with making them aware of the apprenticeship opportunity. One apprentice explained that the community-based organization that supported them when they immigrated to the US connected them with their apprenticeship program.

Social Media and Word of Mouth

Social media and word of mouth can also yield positive recruitment outcomes. Evidence indicates that 79 percent of job seekers are likely to find potential work opportunities through social media platforms.²⁹ Based on Urban's analysis of RAPIDS data, the average age of IT apprentices in 2022 was 28 years old, suggesting potential tech apprentices fall into an age group likely to use social media in a job search.³⁰ Apprenticeship programs we interviewed regularly leveraged social media platforms, including LinkedIn, Instagram, and X, to promote apprenticeships. One SMB employer even found Black influencers on X to promote its apprenticeships with minority groups, using low-cost "swag" (socks, shirts, and mugs) as incentives. The employer reported this method of marketing to be effective, boosting the number of applicants, especially women apprentices. Over half of women apprentices in the SMB program too cited social media as the platform they used to discover their apprenticeship.

Almost half of the SMB employers also expressed success from word-of-mouth referrals. The low cost and high efficacy of word-of-mouth referrals make this a powerful recruitment strategy. Evidence also shows that 92 percent of consumers trusted recommendations from friends and family over all forms of advertising.³¹

Inclusive Assessment and Intake Strategies

Once SMB employers have identified avenues for reaching prospective apprenticeship candidates, they might consider common friction points for applicants throughout the assessment and intake phases of the hiring process. Adopting intentional screening methods, reflecting on company demographics, and preparing applicants can help businesses bring underrepresented candidates into tech apprenticeship programs.

Intentional Screening Methods

Automated screening methods, though time saving, often disadvantage nontraditional applicants. The sponsors we interviewed adopted intentional screening practices to measure applicants' talent, with special efforts to ensure that those who lacked an associate degree, a four-year undergraduate degree, or prior work experience were not at a disadvantage. SMBs also valued applicants' transferable skills, such as those from customer service or other past employment, alongside their unique backgrounds and experiences.

One example of intentional screening practices is technical interviewing. Rather than focusing on college degrees, many sponsors we spoke with only required a high school diploma. They found that candidates without college degrees performed comparably to those with a college degree, both in technical interviews and throughout the apprenticeship. One sponsor noted that the IT industry has transitioned from an emphasis on college degrees, to becoming increasingly skills-focused.

“Those skills-based certifications are what actually land the jobs. The degrees actually, believe it or not, don’t really come in very handy until after they’re in the field and want to advance in different areas.”

—IT apprenticeship sponsor, South Carolina

The apprentices we spoke with had widely varying educational backgrounds, ranging from high school diplomas to PhD candidacy. Although a degree was not a prerequisite for the programs we interviewed, the majority of apprentices possessed a degree in another field and wanted to change careers without pursuing an additional degree. Regardless of their educational backgrounds, most apprentices told us that sponsors treated them as equals and that working in cohorts representing diverse educational experiences was a benefit of the apprenticeship program.

Representation

Some programs recruited from specific demographics of candidates. One SMB employer said that over 50 percent of its apprentices were immigrants or refugees, as the organization’s founding mission was to create alternative pathways to success and opportunity for individuals from diverse immigrant backgrounds. Another SMB prioritized outreach to Black and Latina women, who are underrepresented in the tech space. Yet another SMB highlighted the role of representation in recruiting diverse apprentices, expressing that it’s both disheartening and encouraging that some apprentices had never seen a Black woman in the tech space until joining their apprenticeship. An apprentice noted that their program openly discussed its goal of recruiting more women into IT apprenticeships and encouraged participants to share information with women in their personal networks.

Studies find that representation in organizational leadership reflects the diversity—or lack thereof—within professional IT occupations as well (Han and Tomaskovic-Devey 2024). This sentiment was echoed by an apprentice: “You don’t even think that this is an option for [Black women] because of where you’re from and what you look like, and you don’t see somebody like you or you don’t even know anybody [in this role].”

Preparation for Applicants

Openness in hiring can help companies reduce unconscious biases and signal commitment toward inclusive practices for those from underrepresented backgrounds.³² Proactively ensuring transparency in the application process can help SMB sponsors prepare applicants for success. Clear communication about the steps of the hiring process, the timeline, and expectations upon entering the apprenticeship

can help candidates get hired and succeed. One apprentice we spoke with valued transparency in the hiring process because they knew what to expect during the interview. In contrast, another apprentice wished their hiring process better communicated next steps.

In addition to setting clear expectations throughout the hiring process, some programs offered brief training to expose applicants to the tech field and prepare them to apply. One SMB provided free intensive training in software development and accepted apprenticeship applications from the pool of training participants.

The success of short training in preparing IT apprentices aligns with evidence from the field. In a 2021 BestColleges study, 33 percent of the 1,000 employers interviewed found that boot camps provide an amount or level of training comparable with an undergraduate degree, equipping participants with the skills necessary for success in the industry (Venable 2021).

“A lot of people want to get into IT, but they don’t realize what it involves. We train them in basics for eight weeks, and then when they go to Phase 2, we give them incentives and things of that nature. After Phase 1, 40 percent [of potential apprentices] decide it’s not for them.”

—Apprenticeship sponsor, North Carolina

One program created a pre-apprenticeship training phase to expose applicants to IT. Provision of such basic training allows applicants to determine whether a career in IT is the right fit for them. According to sponsors, those who choose to advance to apprenticeship after preliminary training have a better foundation for success, feeling empowered to dive into the full program. Evidence shows that such preliminary exposure increases participants’ feelings of readiness for real-world jobs.³³ Another organization required candidates to complete at least one free advanced boot camp class and a two-month software development practicum before applying for the apprenticeship program. Apprentices similarly cited this system as helping them develop foundational skills necessary for the technical assessment portion of the interview.

Conclusion and Key Takeaways

Inclusive recruitment strategies are essential for expanding access to higher-paying, male-dominated tech occupations and for ensuring that apprenticeship programs serve as genuine pathways to economic mobility. Findings from interviews with SMB employers and apprentices highlight that recruitment challenges are not driven by a lack of interest among diverse candidates, but rather by structural, informational, and logistical barriers that shape who learns about and can realistically pursue apprenticeship opportunities. Table 1 summarizes challenges in establishing inclusive recruitment strategies and potential ways to overcome them. Each of the barriers includes lessons drawn from SMB employers that can be addressed at the program level, as well as system-level considerations.

TABLE 1

Barriers to Tech Apprenticeship Recruitment and Strategies to Overcome Them

Barrier	Program-level strategies	System-level considerations
Lack of diverse applicants	• Strategic partnerships with community-based organizations, community colleges, unemployment services, and workforce boards to build a network of support for and a pipeline to apprenticeship programs • Create a social media presence for the business and the apprenticeship program to highlight how apprenticeships can help individuals • Make information easily accessible through an easily readable website, informational meetings, word-of-mouth referrals, and job postings in grocery stores, churches, and other gathering places. • Visible women leadership within the organization	• Funding for community outreach • Regional or statewide talent pipeline initiatives to coordinate around needed skills • K–12 STEM and career-awareness programs • Data systems to track workforce diversity trends and identify gaps
Assessment and intake	• Skills-based screening (technical interviews and assessments), pre-apprenticeships or short training • Practice transparency with applicants. Make clear all steps in and expectations for the apprentice selection process and the early stages of the apprenticeship.	• Standardized, validated skills assessments, accessible testing environments, accreditation/credential frameworks • Policies encouraging skills-first hiring among employers to make pathways more inclusive
Justice-involved hiring	• Partnerships with community-based organizations to identify roles without strict clearance	• Background-check policies, client contract constraints
Transportation	• Stipends, carpooling, or remote learning where feasible	• Regional transit investments

Source: Authors' interviews with sponsors and apprentices from the Urban Institute Small and Medium Business Tech Apprenticeship Project.

These findings suggest that SMBs can implement meaningful program-level strategies to broaden recruitment, but their efforts are constrained without complementary system-level investments. Sustainable progress requires coordinated action across employers, workforce systems, education providers, and policymakers to fund outreach, standardize accessible skills assessments, reform background-check practices, and address regional transit gaps. The apprenticeship model alleviates applicants' burden to possess traditional education and work requirements, which can empower individuals to utilize apprenticeships as an entry point to the tech field. However, greater systemic change is needed beyond what SMBs can offer to build inclusive, scalable career pathways for all.

Notes

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- ¹² “Equal Employment Opportunity in Apprenticeship,” US Department of Labor, accessed September 4, 2024, <https://www.apprenticeship.gov/eoo>.
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- ¹⁸ To learn more about Urban Institute’s Small and Medium Business Tech Apprenticeship project, see <https://www.urban.org/projects/small-and-medium-business-tech-apprenticeship-project>.
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