



Stakeholders in Secure Software Development Apprenticeship

A Case Study for the HBCU Consortium-Driven Degree-Based Apprenticeship

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August 2022

Despite the tech industry's innovative and forward-thinking reputation, its workforce is only 25.2 percent women and 17.5 percent Latinx or Black, and leaders in tech are eager to adopt solutions to diversify their workforce.¹ Additionally, businesses are operating in an economic environment with historically low unemployment rates,² which is making it more difficult to recruit and retain needed tech talent.³ As such, industry leaders have strong incentives to broaden their approaches to identifying and developing the skilled workforce they need to innovate and grow.⁴

Partnering with historically Black colleges and universities (HBCUs) on a degree-based apprenticeship program is one way for tech employers to increase diversity. Degree-based apprenticeships are distinctive because they offer apprentices exceptionally high-quality academic training and applied on-the-job learning that culminate in a two- or four-year degree that both students and employers value. It is also a way to connect talented students to paid employment before their degrees are completed. HBCUs are producing high-caliber computer science and information technology (IT) students eager to excel in their chosen field, and firms need help finding talent for potential employment. Already, one in four Black students who graduate with a STEM degree earns it from an HBCU.⁵ An HBCU-led degree-based apprenticeship consortium model addresses these pipeline issues by connecting a pool of talented students with interested employers. Further, diversity and inclusion in the tech field is enhanced by engaging talented computer science and IT majors at HBCUs in high-demand IT occupations.

Since 2020, the Urban Institute has been working with partners at South Carolina State University (SCSU) to launch a degree-based apprenticeship program with a consortium of schools. SCSU leads the

consortium and provides academic training to students along with Voorhees College and Benedict College. While students are enrolled in courses they will receive on-the-job training and professional mentorship from an employer. Thus, the program enables students to gain meaningful, paid work experience while they advance toward a degree. It also helps to close the gap between employers and a diverse, often-overlooked pool of promising talent.

Apprenticeship programs include collaboration between employers and instructional providers, and the consortium-driven degree-based apprenticeship program described in this brief is no different. This brief describes how these partnerships were established through the HBCU degree-based apprenticeship consortium at SCSU. Urban interviewed the partners in the Secure Software Developer program to learn more about why they were interested in launching the program. This brief provides background on the program, summarizes the roles and responsibilities of each partner, and shares the themes and lessons from our interviews.

Why Was a Degree-Based HBCU Apprenticeship Consortium Needed?

The Urban Institute and partners at SCSU began laying the foundation for a degree-based apprenticeship program in 2020 to address the lack of workforce diversity in tech and low recruitment of students from HBCUs into the industry. The resulting HBCU consortium-driven apprenticeship program creates a pipeline for talented computer science and IT majors in HBCUs to enter fast-growing tech occupations.

Officially launched in late 2021, the HBCU apprenticeship consortium is innovative on several fronts. First, this apprenticeship program culminates with a computer science–related bachelor’s degree for apprentices. Second, the earnings apprentices make during their apprenticeship program, as well as the potential for tuition help from their employers, can counter financial pressures that many underrepresented students face. Data show that 72 percent of Black students take on debt as they seek their degrees, as opposed to 56 percent of their white peers, which means that an apprentice’s earnings can make a real difference in their future financial well-being (Musu-Gillette, Robinson, and McFarland 2016). Finally, this model is a joint employer-college partnership, meaning that the training students receive—called related technical instruction (RTI) in registered apprenticeship programs (RAPs)—is based on a rigorous competency-based academic and on-the-job training (OJT) plan vetted by multiple computer science and IT departments as well as employers. (The RTI and OJT combined make up the Work Process Schedule, or WPS.) This partnership has produced a high-quality training program.

BOX 1

What Is the Apprenticeship Expansion and Modernization Fund Initiative?

The US Department of Labor (DOL) launched the Apprenticeship Expansion and Modernization Fund (AEMF) initiative to support national intermediaries that provide foundational and tailored outreach and technical assistance to prospective and current registered apprenticeship program sponsors and other stakeholders to facilitate the development, implementation, and growth of registered apprenticeship programs.^a The Urban Institute was one of three awardees selected to implement innovative AEMF efforts. Urban's AEMF project has provided employers with important services to prepare them for hosting registered apprenticeship programs.

Technical assistance ranges from answering intermittent questions to longer-term, one-on-one work, including working with employers to select occupations and develop the training plans, connecting employers with community colleges and other organizations for recruiting and training apprentices, supporting employers in registering programs, and providing modest funding to help employers offset costs related to training and mentoring apprentices.^b Since 2019, Urban's efforts on the AEMF project have helped more than 2,000 apprentices enter programs, supported the launch of 21 new programs, and provided more than 400 distinct technical assistance activities to employers, sponsors, and other stakeholders.

^a "Apprenticeship Expansion and Modernization Fund," US Department of Labor, accessed April 25, 2022, <https://www.apprenticeship.gov/investments-tax-credits-and-tuition-support/apprenticeship-expansion-and-modernization-fund>.

^b "Apprenticeship Expansion and Modernization Fund Project," Urban Institute, accessed April 25, 2022, <https://www.urban.org/apprenticeship-expansion-and-modernization-fund-project>.

Key Partners in the Initiative

SCSU collaborated with Urban staff members to develop a degree-based RAP in secure software development and submit it for registration to the US Department of Labor's (DOL's) Office of Apprenticeship (OA) in South Carolina. Overall, three schools (SCSU, Vorhees College, and Benedict College) have formally signed on to be a part of the consortium. They have all worked together to align apprenticeship standards to their existing curricula, participate in recruiting students, and work with their institutions to share program information with employer partners. Integer Technologies, an applied research and product development company, was the first employer to formally sign on to participate in the program. The consortium recently added a talent sourcing and consulting firm and is recruiting more employers to hire apprentices from future cohorts.

Partners' Roles and Responsibilities

A degree-based consortium-driven apprenticeship program requires engaging with other schools with similar programs of study, employers, and apprentices. Below, we describe the four main roles in the apprenticeship program: sponsor, training providers (related technical instruction, or RTI, providers), employers, and student apprentices.

SPONSOR

Although a school serving as the program sponsor is not mandatory, it can be helpful for advancing the initiative. In the HBCU degree-based apprenticeship, SCSU is the program administrator and sponsor and bears responsibility for ensuring the RAP stays in compliance with the state or national apprenticeship office. The roles for other schools participating in the consortium have less responsibility overall but should be documented and clarified in a formal agreement—like a memorandum of understanding (MOU).

RTI PROVIDERS

Every RAP requires an established curriculum or RTI that supports, builds on, and aligns with the occupation and OJT outline. There is no requirement to use only one RTI provider or curriculum, as long as each RTI provider's curriculum aligns with the learning objectives in the WPS and the educational sequence fits with the RTI provided across the program. In the HBCU consortium, SCSU, Benedict College, and Voorhees College are the RTI providers.

EMPLOYERS

Employers are responsible for reviewing and agreeing to the RAP standards, which is the paperwork submitted to the DOL or SAA to register an apprenticeship program. The standards include the WPS, and employers agree to hire apprentices and follow program requirements by signing an Employer Acceptance Agreement and returning this to the sponsor (in this case, SCSU). These agreements become appendixes to the registered program standards. Employers also develop internal policies related to apprentice recruiting and hiring and support the program sponsor with tracking and reporting the apprentices' progress. As of June 2022, Integer Technologies and the staffing firm are the employers in this apprenticeship program.

STUDENT APPRENTICES

The student apprentices are responsible for taking courses specified in the WPS—the document defining the apprenticeship's learning objectives. They are also responsible for working the hours specified by their employer and necessary to achieve competency in the skills defined in the WPS. When apprentices complete this program, they will have a degree, real work experience, and the potential for continued employment with the company that provided their OJT. Further, some apprentices may find that their employers' tuition reimbursement benefits cover some or all of their academic training costs.

Schools Participating in the HBCU Degree-Based Apprenticeship Consortium

SOUTH CAROLINA STATE UNIVERSITY

SCSU is an accredited land-grant HBCU located in Orangeburg, South Carolina. Originally established on March 3, 1896, through an act passed by the General Assembly of the South Carolina Legislature, the institution has grown to become a comprehensive teaching university with a strong legacy in its land-grant mission of teaching, research, and community service. SCSU is one of 12 senior, public,

postsecondary educational institutions in South Carolina and the state's only historically Black, public, four-year institution. Fall 2021 student enrollment was approximately 2,374 students and 186 instructional faculty members, and the student population is predominately Black. SCSU is consistently among the national leaders in producing Black students with bachelor's degrees in English language or literature, biology, education, business, engineering technology, and computer science or mathematics. SCSU is also a National Center of Academic Excellence in Cyber Defender Education through its Computer Science with Cybersecurity program and is the only HBCU in South Carolina with this designation.

Dr. Nikunja Swain, chair of the Computer Science and Mathematics Department at SCSU, helped spearhead the RAP and consortium. He developed the curriculum for the RTI and mapped it against the National Initiative for Cyber Education's (NICE) Framework to make sure the courses aligned with employer needs. Dr. Swain notes that HBCU students do not always have access to the latest technology and was motivated to start this program "to provide students with practical hands-on experience in secure software development and Cybersecurity."

Dr. Swain thinks program success will be based on three things: getting all the HBCUs to join the consortium; increasing the number of employers participating; and having students succeed both on the job and in the classroom. In addition to increasing the number of schools, employers, and apprentices, Dr. Swain and Urban are adding a new occupation (cybersecurity analyst) to attract more employers and provide opportunities for a broader range of students.

BENEDICT COLLEGE

Founded in 1870 by Bathsheba A. Benedict, Benedict College is an accredited, private coeducational liberal arts institution with more than 1,700 students enrolled in its 26 baccalaureate degree programs and 2 master's degree programs. With nearly equal numbers of men and women attending, Benedict College welcomes students from all 46 counties in South Carolina, 30 states across the US, and 26 countries around the world.¹ At Benedict College, the full-time undergraduate population consists of 50.6 percent Black women and 40.2 percent Black men.²

Benedict College has been a critical member of the South Carolina HBCU consortium-driven degree-based apprenticeship program. Dr. Leon T. Geter, Criminal Justice Administration and Social Sciences (CJASS) Department chair and director of the Center for Cybersecurity, has served as Benedict's representative in consortium activities. When asked about the goals of the apprenticeship program, Dr. Geter stated, "to recruit, train, and mentor a skilled workforce toward successful career pathways; to enhance and improve the productivity and outcomes of an organization; to provide additional and comprehensive training options for students to develop marketable skills, abilities, and knowledge; to provide cost-effective training for workers in various industries; and to increase recruitment and retention of workers during and after an apprenticeship." For Dr. Geter, program success should be measured by an apprentice's successful completion of on-the-job and classroom training activities, as well as high satisfaction among participating apprentices and employers. To ensure continued success, Dr. Geter believes engagement with other stakeholders like the Benedict College Career Services Department and its Adult Education Program, the South Carolina Department of

Probation, Pardon, and Parole, Richland County's Department of Labor, and Apprenticeship Carolina are key.

To sustain the program, Dr. Geter believes that "Consistent stakeholder collaboration will be critical to ensure the success and sustainability of the apprenticeship program in both the short and long terms. Marketing and promoting the apprenticeship program will be central for communicating the benefits of the program on both the individual and organization levels. Also, ongoing funding will be a critical component for the sustainability of the program and to increase the number of organizations offering opportunities for apprenticeships."

VOORHEES COLLEGE

Designated as an historic district, Voorhees College is located in Bamberg County in the city of Denmark, South Carolina. It is an accredited four-year, coeducational, career-oriented liberal arts college associated with the Episcopal Church and the United Negro College Fund. Voorhees College has a full-time undergraduate student body that is 57 percent Black women and 40.6 percent Black men.

Voorhees College offers degrees in numerous fields, including accounting, biology, criminal justice, computer science, sociology, English, and mathematics. Voorhees offers a training program in cybersecurity education and has a special partnership with the National Nuclear Security Administration that enables students to participate in summer internships in cybersecurity at various locations across the United States.

Dr. Xiqiang Zheng, associate professor in mathematics and computer science, represents Voorhees College in the consortium meetings. He appreciates that the apprenticeship program serves as a bridge between professors and employers. Professors have a dense schedule between teaching and research, and often do not have strong employer connections in their professional networks. Thus, the apprenticeship program offers these ties to students. For Dr. Zheng, program success looks like aligning the knowledge that the students are learning with the skills local employers need.

The Employer Perspective

INTEGER TECHNOLOGIES

Integer Technologies is a software company located in Columbia, South Carolina, that is building a team of dedicated scientists and engineers to tackle national security problems. Its mission is to "create a safer world by translating scientific discoveries into reliable products that address urgent national security needs...at the speed of relevance." It is a research and development company with three core lines of business: power and energy systems; unmanned systems; and digital engineering.

Integer Technologies was the first employer to join the HBCU consortium-driven degree-based secure software developer program. The company attracts talent by partnering with local universities, and joining the HBCU consortium RAP was a natural extension of its existing internship program. Duke Hartman, CEO of Integer Technologies, explained why he joined the program: "We were already working with SCSU to try to hire some of their students," and added that it "seemed like a reasonable

program and Urban seemed to provide an additional value of prescreening students.” Moreover, in thinking about the benefits and advantages of using apprenticeship to train in tech occupations, Mr. Hartman shared that an apprenticeship is “[a] relatively low-cost way to get to know students while they are studying, providing students with some money while in school, and provides an opportunity to evaluate students and be well informed and ready to offer a full-time position to students upon graduation.”

Integer Technologies works on issues related to the internet of things and connected devices,⁶ as well as digital twins of engineered systems.⁷ One example of this is the company’s efforts in designing an electrical micro-grid with power electronics, electrical generation, sensors, and computing devices all networked together. The Integer apprentice will be supporting the team focused on software development and implementing development security operations practices.

Mr. Hartman explained that this apprenticeship program will significantly improve the degree of diversity in their company, saying “We will go from one underrepresented minority in our office before the program to two or three (depending on how many apprentices we take on). This out of a staff of about 10.” He further noted, “If [the program] works well, we would like to continue expanding our participation.” In the future, Integer hopes to interview and select students earlier in the recruitment cycle, from January through March, to better reach top candidates before they commit to other employment opportunities.

STAFFING FIRM

The global human resources firm offers workforce strategy, solutions, and consultancy services across a wide array of industries. The services offered are expansive, impacting the way companies, job seekers, and the workforce development system think when it comes to partnering with an outsourced human resources vendor. One way the staffing firm is changing the perception of its role is through Apprenticeship and Workforce Innovation (AWI) solutions. This has led to the staffing firm developing, managing, and sponsoring RAPs and apprentices.

In May 2022, the staffing firm officially joined SCSU’s program as a participating employer of record, giving its network of employer partner connections in South Carolina a chance to hire tech talent from a diverse local candidate pool. A senior vice president (SVP) spoke with Urban staff about why the staffing firm is participating in this apprenticeship program, how apprentices will contribute, and what the staffing firm’s plans for the future are. The SVP shared, “There are numerous advantages to tech apprenticeships including accessing untapped talent pools, improving retention, and uplifting underrepresented communities. Apprenticeships hire based on potential and skills as opposed to degrees and certifications, providing career pathways through earn and learn opportunities. People also develop current knowledge, skills, and certifications that are directly applied on the job bringing immediate value to employers.” Thinking about why employers may be reticent to use the apprenticeship model, he noted, “the investment in time companies must make to mentor, guide, and develop an apprentice into a skilled professional. Also, apprenticeships are a new form of talent development, so companies will need to take the leap and be early adopters. Finally, registered

apprenticeships also require compliance, reporting, and can be subject to audits, although firms like [ours] can alleviate these burdens.”

The staffing firm has client companies that span all industries across the nation, and the companies anticipate their apprentices will be working on cybersecurity in a broad array of areas including Security Operations, Governance Risk and Compliance, Auditing, and Forensics. In thinking through how this program will help their clients cultivate a more diverse workforce, the SVP said, “We are partnering with our clients to expand the talent pool from underrepresented communities. We can help companies with their environmental and social governance goals and initiatives by accelerating organizational diversity and expanding social impact.” Moving forward, the staffing firm would like to expand this apprenticeship program nationally by adding more IT occupations. To achieve a sufficient level of scale, the staffing firm hopes to attract grant awards and other investments to fuel greater growth in client adoption of the apprenticeship model.

Lessons from the HBCU Consortium Pilot Program

Throughout the process of forming the consortium, registering the apprenticeship program, and recruiting employers and students, the Urban Institute, SCSU, and other partners learned valuable lessons about more effectively achieving each of those key milestones. A few key takeaways for setting up and organizing a successful program are (1) make sure to create clear roles and responsibilities within the consortium; (2) have a project manager so tasks can be delegated and tracked in a timely manner; and (3) engage employer partners early and often so they develop an understanding of apprenticeship and its benefits. It often requires multiple interactions with employers to help them feel comfortable with the approach and model before they commit to participating, and some employers may only be convinced once they see evidence of program success.

Box 1, below, summarizes the steps that were taken to launch this consortium-driven degree-based RAP. For more detail on how to start your own consortium-driven degree-based RAP, check out Urban’s playbook titled, *Apprenticeship Comes to Campus* (Hawkins et al. 2022). For more detail on the benefits of apprenticeship to various audiences, see our fact sheets for students,⁸ schools,⁹ and employers.¹⁰

BOX 1

Summarizing the Steps to Launch a New Consortium-Driven Degree-Based RAP

- Connect with local employers, industry associations, or workforce intermediaries to determine which occupations are most needed.
- Search for National Guideline Standards, CBOFs, and other high-quality sources to determine what KSAs are necessary for a specific occupation.
- Find and engage training providers and educational institutions that can deliver the classroom instruction for the selected occupation.
- Execute MOUs with those training entities to establish the consortium.

- Develop the full program standards and WPS.
 - Reach out to relevant local employers and have them review the program standards before submission to the DOL or SAA.
 - Get interested employers to formally sign employer acceptance agreements committing to participating in the program.
 - Submit the program standards to the DOL or appropriate SAA.
 - Obtain program approval from the DOL or SAA.
 - Recruit additional employers (if needed) to join the program by signing employer acceptance agreements.
 - Advertise the program to students through email, posters on campus, and class announcements to get students to apply.
 - Screen applicants using criteria necessary to succeed in the program.
 - Select students to interview with participating employers.
 - Register students who are hired as apprentices with the program by signing the standard DOL apprenticeship agreement.
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Recurring Themes

While the aforementioned playbook attempts to generalize the process for forming a consortium, designing and registering an apprenticeship program, and recruiting employers and students, this brief aims to elevate the voices of those involved in the South Carolina HBCU consortium to amplify their experiences and reflections about the launch and future of the program. Urban researchers interviewed representatives from six varying organizations—three colleges, two employers, and an intermediary. Throughout these conversations, several themes began to emerge. There was general agreement among interviewees that this **apprenticeship program offers a lot of benefits to students and employers**. With a credential and meaningful work experience, apprentices are stronger applicants and are more likely to have career success beyond their apprenticeship in the tech industry. National studies have found a potential return on investment of up to 1:1.47,¹¹ and South Carolina apprenticeship employers receive a 1:1.26 average return on investment in five years' time (and more than double that in seven years),¹² improved company diversity (Kuehn 2017), and a skilled employee who is more likely to remain with the company.¹³

Partnerships between schools and employers are critical to improving education and increasing diversity. Both the schools and employers were excited about working together to make sure the students are being taught the skills they need to be productive employees. Professors were eager to observe the impact that OJT will have for students' collegiate learning experience. Employers were eager to add more diversity in their technology workforce.

HBCUs are a source of untapped talent in the IT field. This program is creating a diverse pipeline of skilled workers from HBCUs. The professors noted that sustaining the program will involve marketing and outreach to recruit more employers and students and finding funding to support program operations. Currently, three apprentices are in the program, and stakeholders are hopeful that their success will encourage more employers to sign onto the program. SCSU is taking a step to expand the program by adding a new occupation and registering National Guideline Standards, which will enable the program to work with at least one additional employer outside of the state.

Conclusion

The Urban Institute technical assistance team recognized this promising opportunity in South Carolina to improve diversity in the tech industry. Tech industry workforce demographics reveal a need for increased diversity, and there is a desire among employers to make their teams more inclusive. To address the connected issues of inadequate diversity and an overall talent shortage, employers must explore underutilized approaches to recruitment and training. HBCUs are a proven source for diverse STEM talent. This degree-based apprenticeship program helps address challenges faced by businesses and create more opportunities for students by connecting a pipeline of skilled, diverse talent to employers that are willing to hire, train, and mentor students with demonstrated interest and potential. The consortium model allows the HBCUs to pool resources and collaborate to train the next generation of IT talent.

Notes

- ¹ “Labor Force Statistics from the Current Population Survey,” US Bureau of Label Statistics (BLS), last updated January 20, 2022, <https://www.bls.gov/cps/cpsaat11.htm>.
- ² “Local Area Unemployment Statistics,” BLS, last updated June 17, 2022, <https://www.bls.gov/web/laus/lausthl.htm>.
- ³ Michael Liedtke, “Cognizant CEO Discusses Fierce Battle for Technology Talent,” *AP News*, November 29, 2021, <https://apnews.com/article/coronavirus-pandemic-technology-business-lifestyle-health-89cfe9ea3f20d1f4d4d0ec0f0318d285>.
- ⁴ Julie Elberfeld, “The Tech Talent Gap Is a Self-Inflicted Wound,” *Fortune*, January 20, 2022, <https://fortune.com/2022/01/20/the-tech-talent-gap-is-a-self-inflicted-wound-labor-shortage-hr-recruitment-great-resignation-julie-elberfeld/>.
- ⁵ “The Numbers Don’t Lie: HBCUs Are Changing the College Landscape,” United Negro College Fund, accessed June 23, 2022, <https://uncf.org/the-latest/the-numbers-dont-lie-hbcus-are-changing-the-college-landscape>.
- ⁶ The internet of things is the concept of connecting any device to the internet and to other connected devices. The IoT is a network of connected things that collect and share data about the way they are used and about the environment around them. For more information, see Jen Clark, “What Is the Internet of Things?,” IBM Business Operations Blog, November 17, 2016, <https://www.ibm.com/blogs/internet-of-things/what-is-the-iot/>.
- ⁷ A digital twin is a virtual representation of an object or system that spans its life cycle, is updated from real-time data, and uses simulation, machine learning, and reasoning to help with decisionmaking. For more information, see Maggie Mae Armstrong, “Cheat Sheet: What Is Digital Twin?,” IBM Business Operations Blog, December 4, 2020, <https://www.ibm.com/blogs/internet-of-things/iot-cheat-sheet-digital-twin/>.

- ⁸ Rayanne Hawkins, Diana Elliott, and John Marotta, “Launch Your Career with a Degree-Based Cybersecurity Apprenticeship,” Urban Institute, June 21, 2022, <https://www.urban.org/research/publication/launch-your-career-degree-based-cybersecurity-apprenticeship>.
- ⁹ John Marotta, Rayanne Hawkins, Myca San Miguel, and Jacqueline Rayfield, “The Case for Degree Apprenticeships in Tech,” Urban Institute, April 22, 2022, <https://www.urban.org/research/publication/case-degree-apprenticeships-tech>.
- ¹⁰ Michael Pruitt, Rayanne Hawkins, Myca San Miguel, and Jacqueline Rayfield, “Diversify Your Talent,” April 22, 2022, <https://www.urban.org/research/publication/diversify-your-talent>.
- ¹¹ “Return on Investment (ROI),” National Investment, accessed June 23, 2022, <https://nationalapprenticeship.org/roi>.
- ¹² “Improving Youth Apprenticeship Data Quality: Challenges and Opportunities,” Advance CTE, June 23, 2022, <https://careertech.org/resource/improving-youth-apprenticeship-data-quality>.
- ¹³ “ApprenticeshipUSA Toolkit: Research and Statistics,” US Department of Labor, <https://www2.palomar.edu/pages/wcce/files/2018/08/Apprenticeship-ROI-Research-and-Statistics-1.pdf>.

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Acknowledgments

This brief was funded by the United States Department of Labor. We are grateful to them and to all our funders, who make it possible for Urban to advance its mission.

The views expressed are those of the authors and should not be attributed to the Urban Institute, its trustees, or its funders. Funders do not determine research findings or the insights and recommendations of Urban experts. Further information on the Urban Institute’s funding principles is available at urban.org/fundingprinciples.

The authors would like to thank Dr. Nikunja Swain of South Carolina State University for his leadership of the HBCU Consortium and this apprenticeship program and Girish Seshagiri of Apprenticeship Implementation Solutions, Inc., for sharing his experience with and enthusiasm for registered apprenticeship programs.



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