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Lessons in Community Colleges Eonomic Development from NSF ATE

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JUNE 2023

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Acknowledgments

The authors would like to thank the many people who contributed to this report. We are grateful to our research project advisory board members whose thoughtful suggestions guided this work. We also appreciate the input and advice from former NSF ATE project officers, Gerhardt Salinger and Liz Teles. We are particularly grateful to the ATE grantees who participated in interviews and provided feedback on this report. We appreciate the feedback of Elizabeth Barnett an earlier draft. At EERC, Tracy Cangiano skillfully provided research support through various phases of the project, Angel Butts of The Word Angel LLC provided editorial assistance, and Jade Zack provided excellent design support. The authors are solely responsible for any errors. The authors are grateful to the National Science Foundation for their financial support of this work.

This material is based upon work supported by the National Science Foundation under Grant No. 2026262.

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Background

A skilled technical workforce is important for the health of regional economies. The NSF ATE program invests in community college technician education programs around the country that support regional economic development by educating skilled technicians to be productive in the workforce. Some colleges and their programs extend their focus on economic development beyond general technical education using a variety of approaches that align their education and training with specific regional needs and provide targeted business support and regional engagement. (See Van Noy et.al, 2023 for a more detailed discussion of this conceptualization of economic development.) In this research project, we examined programs and practices employed by ATE grantee centers and projects and their potential link to economic development. Interviews with a purposeful sample of these ATE grantees are reported in the full report, "Crossing Over to Economic Development in Community Colleges: Lessons from NSF ATE Grants" (Van Noy et al., 2023). This report includes a compilation of four case studies exemplifying how ATE grantees intentionally engage community college technician education in economic development. These cases are:

- Florida Advanced Technological Educational Center (FLATE)
- The Center for Advanced Automotive Technology (CAAT)
- Consortium for Alabama Regional Center for Automotive Manufacturing (CARCAM)
- InnovATEBIO

Florida Advanced Technological Education Center (FLATE)

The mission of the Florida Advanced Technological Education Center (FLATE), an NSF-ATE Center of Excellence from 2004 to 2020, is to support the creation of a world class technician workforce for Florida manufacturing. Along with funding and resources provided by NSF, FLATE has received funds from the state and national Departments of Labor as well as the Florida Department of Education (FDOE) to design, create, and insert a Florida-wide two-year associate degree (AS) in Engineering Technology degree program in over 85 percent of Florida's 28 state colleges. FLATE is currently housed with FloridaMakes, the National Institute of Standards and Technology Manufacturing Extension Partnership (MEP) member center, which serves as FLATE's fiscal agent. The resources supporting FLATE ensure Florida's manufacturing education programs from K-12 to postbaccalaureate continue to thrive. FloridaMakes works with Florida manufacturers through a network of fourteen regional manufacturing associations (RMAs) that cover the state's large footprint. These RMAs provide both direct services to manufacturers, including advocacy, workforce, business improvement, and technology adoption, as well as FLATE services related to educational programs and partnerships that flow from and are supported by FloridaMakes. Therefore, FLATE now does its work not only through the perspective of educational institutions but also through the lens of Florida's manufacturers.

This case study focuses on three key elements of FLATE's work: First, its role in providing regional coordination in support of the manufacturing industry by leading workforce development efforts to standardize curriculum and programs in the state. Second, its leading role in supporting the state's workforce and economic development goals. Third, the transition of FLATE to its current status as a center that is recognized and funded by both the Department of Commerce and NSF and therefore sufficiently resourced to continue its ongoing role supporting Florida's manufacturing ecosystem.

FLATE Goals: Consistent Pathways Development to Support Industry

FLATE focused on two primary goals to create stronger and more consistent educational pathways that support the manufacturing industry in the state: 1) coordinating the various certifications and two-year programs in the state's two-year colleges to create a consistent and updated statewide manufacturing education delivery system through statewide and local articulation agreements and 2) creating a smooth pathway from high school to higher education via credit-bearing industry certification programs that articulate into associates of science (AS) programs in Engineering for up to 15 credit hours.

Prior to the formation of FLATE, manufacturing education programs varied widely across the state, and much of Florida's technician training was limited to noncredit industry certification programs conducted primarily by two-year institutions. FLATE determined that one way to address the evolving needs of industry and to advance technician training was to facilitate a statewide articulation agreement among colleges offering manufacturing programs. An expeditious way to do this was to begin structuring manufacturing programs within the context

of the state's existing framework of student outcomes and approved courses define by Florida's Curriculum Frameworks. This way, programs developed in partnership with employers would be eligible to articulate into AS programs at any college offering manufacturing education in the state. This move enhanced workforce development by granting workers and students portable credentials recognized anywhere in the state along with the ability to leverage those credentials toward credits in any of Florida's manufacturing certificate or AS programs. Together with the FDOE and Daytona State College, FLATE forged statewide, individualized, and accessible pathways to bachelor's degrees (BS) in Engineering Technologies.

ATE funding enabled FLATE'S work to evolve statewide starting in 2002 with a planning grant and three participating colleges to the launch of a regional center in 2004 that involved colleges, employers, the Florida Department of Economic Opportunity, and the State Department of Education's Career and Adult Education Division. Over time, the center's programs grew to include 22 out of 28 of Florida's State and Community Colleges.

Keen to support the state of Florida's priority to meet the needs of the manufacturing base, FLATE was motivated by a desire for significant scaling up of workforce capacity. The majority—about three-fourths—of Florida's manufacturing sector was, and continues to be, composed of small and medium firms employing fewer than 50 workers. They manufacture products and equipment for a wide range of sectors including computer and electronics, aerospace, food and beverages, communications, medical, and pharmaceuticals, as well as components supporting the Department of Defense. Wages earned by those working in the state's manufacturing sector have been consistently among the highest compared to other industries in their regions.[1]

The articulation pathway FLATE created and continues to maintain was important for both workforce and economic development and for supporting both employers and workers. FLATE further contributed to economic development by seeking to increase workforce capacity to meet the needs of state employers, to attract new workers and grow Florida's manufacturing base, and to enable higher skill development and education attainment among incumbent workers and students. As FLATE scaled up, its programs, particularly its entry-level certification for new and incumbent workers across the state, generated considerable momentum in the manufacturing sector.

Convening Colleges and Employer for Curriculum Development

One of the key roles of the FLATE Center in developing the program and articulated pathways was to serve as convenor and aggregator, bringing together colleges, employers, high schools, CareerSource Florida (the state workforce development agency), the FDOE and the entities overseeing manufacturing programs to develop appropriate skill standards and curricula. FLATE also led the efforts to get state approval for the new programs. The network of colleges created by FLATE offered manufacturing programs that worked with local employer partners and advisory boards. Industry partners identified the skill needs and curricular requirements. This

1 https://lmsresources.labormarketinfo.com/library/pubs/industryprofile/manufacturing.pdf

information was shared with other colleges through FLATE. The colleges, employers, the FDOE, and FLATE then collaborated in an iterative process to prioritize and sort the aggregated skill needs to best meet manufacturer needs efficiently within the college programs.

FLATE adopted the national skills standards from the Manufacturing Skills Standards Council (www.msscusa.org) after ensuring that they were consistent with the new state standards and benchmarks, that had been aligned with regional industry needs, they were also designed so that students could be successful in certification assessments. In the review process, colleges presented FLATE's skill standards to their individual departments and industry advisory committees for approval. Once this process was complete, the approved courses and programs were sent to the FDOE's Division of Career and Adult Education.

FLATE made sure that affiliated colleges engaged their respective employer advisory boards to help them understand the articulated certification and degree programs as they were being developed. Part of its ongoing employer engagement strategy was to work with employers to help them understand and regularly contribute to curriculum development and to better understand the applicable educational policies, rules, and regulations. By statute, Florida requires program standards and benchmarks to be formally reviewed by both industry and educators every three years. Having employers signed approval is an important requirement of the process. In between the formal tri-annual reviews, FLATE convenes its college partners for ongoing conversations for continuous improvement of its programs, the skill standards, curricula, equipment, and resources and college promising practices in teaching and learning.

Program standards review and approval is a multi-step process in Florida and, for manufacturing programs, the FLATE Center has a leadership role. The first review step typically involves cleaning up and clarifying program standards, benchmarks, and course components. Colleges and industry can also suggest deletions and additions at both the standard and benchmark levels. The second step returns the updated version of those documents with aggregated comments and edits to all stakeholders for final comments and/or approvals. Finalized versions are formatted and sent to the FDOE for endorsement and encoding into the state's master list of programs. FLATE thus acted as a convenor and intermediary between colleges, employers, and the state and, in the process, situated all its programs under a "Made in Florida" branding. A website of the same name provided information about FLATE's programs, industry, pathways, and careers for students and the community. The Made in Florida brand is an effort to provide statewide visibility of the manufacturing education programs across the state.

In addition to working with colleges and employers through advisory councils, FLATE convened another group called the Florida Forum for Engineering Technology (ET) twice per year. Hosted by a rotating roster of colleges located throughout the state, these meetings were, and continue to be, joined by local industry, equipment vendors and other local partners, including secondary Career and Technical Education administrators and teachers, and workforce professionals. FLATE's rationale for creating the ET Forum was to strike a balance between its role as convenor and aggregator for the statewide program and its obligation to ensure that colleges had a voice at the table. By developing the ET Forum as a way for colleges to talk about special projects or

new curriculum needs and to express views from industry, FLATE increased the reach of the colleges to other institutions and to employers to build connections that also benefited faculty and individual programs. With a biannual attendance of over 70, the ET Forum remains a strong vehicle for collaboration amongst manufacturing programs, the FDOE, industry partners, and other stakeholders.

Another important activity undertaken by FLATE was to aggregate the workforce needs of manufacturing employers statewide to determine which courses and programs were feasible or would have traction in different regions. This task is typically challenging or just not possible for smaller colleges and those in remote or rural areas. Identifying and helping to develop programs that support manufacturers workforce needs in these areas is vital for their success.

Supportive Legislation: The CAPE Act

At the same time as FLATE was working on its statewide articulation, a piece of legislation was enacted that provided significant boost to its efforts. In 2007, the Florida Legislature passed the Career and Professional Education (CAPE) Act, the aim of which was "to provide a statewide planning partnership between the business and education communities in order to attract, expand, and retain targeted, high-value industry and to sustain a strong, knowledge-based economy." The Act called for the FDOE and CareerSource Florida (the state workforce development agency) to work together toward this goal, creating a strategic link between workforce and economic development. One of the key elements of the CAPE Act was the creation of a list of state-approved industry certifications critical to Florida's employers. Each approved certification program had its own articulation into a degree program through a statewide agreement in which the number of credits awarded were determined by the length and content of the certification. The Act also aimed at incentivizing the use of aligned industry certifications, such as by giving high schools, technical colleges and state colleges the opportunity to receive additional funding when their students successfully completed any of the state-approved industry certification assessments.

The overlaps between the Act's approach to creating workforce capacity and bringing programs under a common umbrella through an articulation agreement and FLATE's intent and strategy in building a statewide articulation agreement in manufacturing were not merely a happy coincidence. They were mutually reinforcing. The CAPE Act came into place while FLATE was in discussion with MSSC and employers to create an articulation agreement for its Certified Production Technician (CPT) credential as well as working to expand beyond the three initial colleges it had been working with in Tampa Bay, Pensacola, and Palm Bay. Because similar objectives were in in play, the Act proved to be a timely tool to help support FLATE's mission and advance its pathways project. FLATE seized the opportunity by playing a key role in implementing the Act, developing the first statewide articulation document for the MSSC CPT to the A.S. ET. articulation agreement for one of the main certifications the Act approved for manufacturing programs. The MSSC CPT covers the fundamental skills for advanced manufacturing. Later, other industry certifications aligned to FLATE's Engineering Technology programs also became part of the CAPE Act's master list. Initially intended to serve workers with industry certifications and enable them to transfer to a two-year degree program, FLATE's programs were opened to high

school students as well. This high school pathway supported the CAPE Act's goal of incentivizing schools to offer students in career and technical education programs that are aligned to industry certification.

The new degree program together with the statewide agreement has had other important benefits. It not only facilitated removal of outdated programs and streamlined program development but also allowed graduates of the programs to be employed and manufacturers to hire from any of the ET-degree-granting colleges in Florida, not just in their region, thereby supporting economic development statewide. FLATE was able to assist many manufacturing programs across the state transition to the new system in various ways, such as by helping their college and industry partners understand the system's value.

Outreach to High Schools

FLATE worked at aligning its programs with high school advanced manufacturing programs. Its certification programs served as an important access point for high school students to both employment and higher education by giving them exposure to employers as well as the opportunity to pursue degree programs without repeating the fundamentals taught in the certification program. Students could earn up to 15 college credits toward an associate of science degree and earn multiple certifications simultaneously. To generate participation in its programs, FLATE consistently conducted outreach efforts aimed at lowering the barrier for employers to engage with school students—primarily by organizing industry tours for high school and middle school students. Over a period of six years, FLATE enabled close to 25,000 students to visit manufacturing facilities. Many new partnerships were forged because of these tours, including work-based learning opportunities for students and new employer partners.

Sustainability

In 2015, FLATE was looking for fresh funding sources to begin to prepare for the end of ATE grant funding in 2020. Between 2015 and 2020, it engaged in projects with FloridaMakes. FloridaMakes is the official representative of the Manufacturing Extension Partnership (MEP) in Florida, a program of the National Institute of Standards and Technology, an agency of the Department of Commerce that provides business and technical services to small and medium manufacturing businesses. Initially, FLATE worked on a project basis with FloridaMakes through memorandums of understanding conducting joint outreach events to educators and manufacturers. Together the groups organized industry tours and school visits and convened regional stakeholders using the state's RMAs as core partners to explore and define regional and statewide industry skill needs.

Given that the MEP program is designed to serve small- and medium-sized employers, the program had few connections to colleges. FLATE viewed this as an opportunity to offer its services by helping MEP employers build those connections. This strategic alignment turned out to be fruitful for both parties—so much so that in 2020, when the FLATE Center ended its NSF ATE funding, its activities and personnel were absorbed by FloridaMakes, with the MEP serving as its fiscal agent. With additional grant funding from NSF and the FDOE, FLATE now connects manufacturing partners with schools and colleges as part of FloridaMakes while

also engaging a larger manufacturing education audience in its own outreach, curriculum development, and professional development missions. FLATE now conducts its activities through an industry lens, however; whereas earlier, its role was to convene employers for educators, it now also represents industry to colleges. Further, FloridaMakes organizes specialty groups within it for technical services, innovation, and business services, and FLATE is helping these groups with workforce education efforts by getting them engaged in high school and college curriculum and faculty development, and increasingly, by facilitating efforts to bring new technology to schools and colleges. (FLATE has identified the need for updated technology in educational settings as a new and important area of employer need.)

From the perspective of FLATE's former PI, the change to FLATE's role in the FloridaMakes context represents a shift in its understanding of employers' needs and concerns. One key outcome of this shift is that it has raised awareness of the importance and complexities of technical education and the industrial workforce among manufacturers. Also, earlier, despite its role as a convenor, FLATE was perceived as an arm of the education sector. Now that it is situated within the MEP, FLATE has come to be viewed as an important part of the manufacturing ecosystem in Florida—one that contributes to the manufacturing sector's sustainability and growth. In addition to its continued role as convenor of and creator of partnerships between employers, educators, and students, FLATE has begun to contribute to a broader set of issues that concern small manufacturers. In its new role, FLATE's contributions include activities such as advocacy; disseminating rules and regulations for import/export, taxation, transportation, and logistics; and business development—issues that, while outside the scope of workforce development, are nonetheless vital for economic development.

The Center for Advanced Automotive Technology (CAAT)

The Center for Advanced Automotive Technology (CAAT) began formally in September 2010 with a regional center grant from NSF ATE, followed by an NSF ATE resource center grant operating from 2018 through June 30, 2023. CAAT has applied for continuing funding from NSF ATE and has secured funding from state workforce entities and Macomb Community College (MCC) where the Center is housed. Together, these grants have helped advance community college technician education in automotive technology education and created an extensive set of resources that are accessible on the CAAT website (http://autocaat.org/Home/). Envisioned to help develop community college technician education around critical advancements in vehicle electrification, hybridization, and related areas, CAAT has evolved into an important resource for community colleges nationwide that offer programs in the advanced automotive technology (AAT) sector.

Established through a partnership between MCC in Warren, Michigan, and Wayne State University (WSU) in Detroit, CAAT focuses on the dual mission of supporting local economic development while developing and sharing AAT program curricula. Central to CAAT's mission is helping community colleges and other educational systems and institutions—from K-12 to the university level—to implement AAT education. Both of CAAT's leading partners offer curriculum and credentials in electronic vehicle (EV) technology, with MCC offering both an AS with embedded credit and noncredit credentials. A key component of MCC's program involves working with employers of all sizes to prepare new and incumbent workers in the automotive industry, and this training function contributes to CAAT's capacity to meet regional workforce needs.

Operating in a partner role since the beginning of CAAT, WSU draws on NSF ATE funding to build a robust learning environment for both undergraduate students—including transfers from MCC and other community colleges—and graduate students. WSU also provides resources to support faculty and student research in such specializations as electrification, hybridization, energy storage, lightweighting, automated/autonomous technologies, and auto cybersecurity. Overall, WSU's collaboration with MCC strengthens CAAT's role in leading curriculum reform, course development and adoption, and numerous industrial-academic-government collaborations focusing on the evolving needs of the automotive industry, which we describe in more detail below.

Academic Progamming in Advanced Automotive Technology

CAAT's academic programming includes the development and implementation of a blended program of study at MCC offering embedded credentials and leading to an AS and transfer to WSU. This unique program combines what are often disparate engineering technology fields into one unified curriculum that includes electrical, maintenance, information technology (IT), testing, and product development. The curriculum supports education and training associated with the traditional automotive sector while addressing the emerging needs associated with connected and automated vehicles (CAV). Educational resources have been created by the

partner institutions, MCC and WSU, as well as other community colleges and universities through CAAT's seed funding program, which we will discuss later in this section.

An important aspect of CAAT's workforce development mission involves strategic partnerships with K-12 education districts. Over the years, CAAT has facilitated relationships with vocational and technical schools to help grow the talent pipeline into community college technician education and technology education programs at MCC and WSU where a large proportion of enrollees are low-income, first-generation and students of color. MCC reports approximately 60 percent of incoming students to its program in vehicle engineering technology are recent high school graduates. A goal of these relationships is to create seamless 2+2+2 educational pathways that extend from high school to the community college and on to the university. The integration of a strong science, technology, engineering, and mathematics (STEM) curriculum in high schools is essential to provide the foundational knowledge and skills students will need to navigate this pathway.

Seed Funding to Pilot and Implement New Cirriculum

CAAT offered seed funding to K-12 educators, community colleges, and universities to develop, pilot test, and implement AAT curriculum. This seed funding also supported professional development to enable faculty to create educational pathways leading to good jobs in the automotive sector. This innovative seed-funding strategy enabled schools, community colleges, and universities to create and implement curriculum in areas that did not exist previously. Through these CAAT resources, educators worked with employers to develop curricula on connected automated vehicles (CAV), alternative fuels and fuel cells, material light-weighting, and vehicle electrification and hybridization. The third-party evaluation that summarized the Center's seed funding between 2014 to 2017 reported that CAAT had granted slightly over $350,000 across seventeen awards to K-12 school districts, community colleges, and universities over the three-year period. All seed funding to the K-12 education level was awarded to Michigan school districts, whereas seed funding to postsecondary entities went to colleges and universities in Michigan as well as in other states.

CAAT has also played a role in networking and supporting other NSF ATE centers and grants. Through its seed funding program, for example, CAAT made two awards to Jackson State University in Alabama, which also engaged in the CARCAM consortium, and it was a partner in the now sunsetted Northwest Engineering and Vehicle Technology Exchange (NEVTEX) at Central Oregon Community College. In addition, the CAAT director has a continuing role as senior personnel for the Center for Autonomous Technologies (NCAT) led by Northland Community and Technical College in Minnesota and engages as a partner in the National Electric Vehicle Consortium at Indian River State College in Florida.

The CAAT Industry Council

Undergirding CAAT's curricular activities, the Center operates an industry council of twelve professionals advising on new and emerging technologies, faculty training, laboratory staffing, and other programmatic elements. Employers associated with this council also contribute equipment, training, and financial support. Three types of funding from employers are dedicated to corporate training programs for GM and other Original

Equipment Manufacturers (OEMS) CAAT focused on training and pre-training, providing funding to MCC to pay tuition and fees for current and new employees to participate in workforce training; some of these programs are corporate specific. For example, CAAT has worked closely with Chrysler to prepare first-line supervisors in manufacturing, including an apprenticeship-like experience that involves three days of instruction at MCC and two days in a manufacturing environment.

CAAT's director reported that out of approximately 780 apprenticeships with 45 companies, about 500 are associated with ET, including automotive technology. These include both DOL-registered and unregistered apprenticeships in automotive industry manufacturing, first-line supervision, auto manufacturing plant support, vehicle engineering technical skill trades, and customized training specific to the automotive industry. The Automotive Service Educational Program for company-sponsored dealership service technicians is also included in this group of apprenticeships.

Donations and loans from companies in the region are important to offering education that supports the latest in AAT curriculum. These donations include laboratory equipment that prepares students for automation within manufacturing and automotive-type parameters. Labs include automation lines that with many different types of robots that provide students with the knowledge and skills they will need to be successful in the workplace.

Economic Development Functions

Over the years, CAAT has engaged in strategic employer engagement to create a base of programs and services that go beyond the preparation of educational pathways to prepare maintenance technicians to meet the changing technical requirements of EV automotive industries. CAAT sees local economic development as its key goal through partnerships with industry, education, government, and professional organizations. To achieve this objective, CAAT engages in intentional activities to support local economic development by also engaging state entities through partnerships with industry, government, and professional organizations. CAAT's role also extends to other regions of the country where the automotive industry has a strong presence in regional economies.

CAAT works directly with employers of all sizes in the region. Small businesses include suppliers, parts makers, and repair shops. Medium-size businesses affiliated with CAAT include automotive dealerships offering service technician programs and apprenticeships. Large businesses include auto makers like Ford and General Motors (GM) that offer apprenticeship programs and other training through publicly funded reimbursement and private funding programs. CAAT has worked with these entities through a regional collaborative that includes the Michigan State Economic Development Corporation and MI Works, the state's workforce development office. Moreover, CAAT works with the Michigan Alliance for Greater Mobility Advancement, a consortium that includes OEMs, tier suppliers, workforce organizations, state government entities, and educational institutions to address the automotive industry's skills and training needs. According to the CAAT director, there are quite a lot of funds for these programs now.

CAAT Partners, Convenings, and Networks

A long-standing focus of CAAT's efforts includes convening a wide range of stakeholders involved in economic development, such as by leading an annual conference on AAT directed at a wide range of audiences that includes employers, community college educators, university faculty, and public workforce and economic development agencies and organizations. Paused during the pandemic, these annual conferences operated from the start of the NSF ATE grant for CAAT through 2019, then resumed in September 2022 after COVID-19 subsided enough for in-person meetings to resume. Meeting agendas focus on topics related to industry updates and offer workshops for faculty. CAAT's role in professional development also involves partnerships with a host of other groups engaged with the automotive industry both within and outside Michigan, including the Michigan Automotive Teachers Association and the North American Council of Automotive Teachers.

A relatively recent and important outgrowth of CAAT's evolving role in economic development is creating the Electric Vehicle Mobility Collaborative, which is led by the CAAT director. Spurred on by the heightened need to understand how regional economies are changing in the light of the COVID-19 pandemic, the Collaborative seeks to "stay on top of employer needs" by identifying and disseminating information on growing occupations and their commensurate knowledge and skill needs. The Collaborative works very closely with employers to discern what occupations are growing and what skills are needed in these occupations, which happens through the involvement of 19 employers. In addition to CAAT, the Collaborative involves nine Michigan community colleges and four universities coming mainly from the southeast region of the state as well as other entities such as the Center for Automotive Research at the University of Michigan and the Detroit Economic Development Corporation. A key goal of the Collaborative is to ensure curriculum is developed and offered to meet employer needs, including in mobility, EV, recreational, and military arenas.

Asked if the Electric Vehicle Mobility Collaborative is having an impact on economic development, the CAAT director responded, "Absolutely," reinforcing the importance of collaborations involving public and private organizations. CAAT's extremely broad reach with employers is exemplified by the involvement of over 6000 industry leaders in its consortium over the years. Thus, while CAAT plays a critical role in workforce development, its reach goes well beyond education and training, including helping stakeholders envision what the automotive industry will look like in the future and how community college technician education can play an immediate and long-term role in shaping that vision.

Consortium for Alabama Regional Center for Automotive Manufacturing (CARCAM)

In the early 2000s, Alabama, seeking to replace its flagging textile industry, drew automotive companies such as Honda, Mercedes, and Toyota as well as about 20 automotive suppliers into the state. The Consortium for Alabama Regional Center for Automotive Manufacturing (CARCAM) was a regional NSF-ATE center established in 2005 to support this growing automotive industry by developing a skilled workforce. An important feature of CARCAM's approach to developing the workforce involved regional coordination to support the state's economic development efforts. It operated as a center until 2018.

Regional Coordination

CARCAM started with a partnership involving five community colleges, with Gadsden State Community College serving as the fiscal agent. Under CARCAM's facilitation, these colleges worked closely with employers to develop curriculum for a certificate and an AS in automotive technology to train the technicians needed by the industry. In addition to creating outreach programs targeted toward high school students, CARCAM sought to become a resource for worker upskilling and faculty professional development. It developed work-based learning co-ops for students in partnership with employers and facilitated scholarships to enable students to access automotive manufacturing careers. From 2011, it served as an intermediary between the Alabama Automotive Manufacturers Association (AAMA), the Alabama Community College System (ACCS), and later the Alabama Industrial Development Training Association to advance workforce development in the state. At the same time, CARCAM facilitated a significant amount of regional coordination between the CTE providers in the ACCS as well as individual colleges and automotive employers like Honda, Toyota, and Mercedes Benz. CARCAM's work also involved suppliers, industry associations, state agencies for workforce and economic development, high schools, and universities.

From its inception, CARCAM sought to bring together educators and industry through its Industry Advisory Committee (IAC). The IAC meetings sought to align technical programs created by CARCAM with industry workforce needs. CARCAM acted as an intermediary between AAMA and 15 of the 24 community colleges in Alabama. They also administered a scholarship on behalf of AAMA for students in automotive technology-related programs at CARCAM colleges. CARCAM's programs expanded to other industries with a certificate applicable to automated manufacturing that involved AAMA and other industry associations including the National Center for Supply Chain Automation. CARCAM also worked with three university partners to engage key faculty resources in addressing statewide economic and employment trends, curriculum, and program articulation.

Convening Work-Based Learning

A key element in CARCAM's work was the convening and engaging of stakeholders to create a regional effort linked to economic development focused on work-based learning opportunities. This emphasis is apparent in their work both to create a co-op or school-to-work program as well as to establish the FAME apprenticeship program in Alabama. Each of these activities was continued and expanded after the formal end of CARCAM.

School-to-work co-op program. Through their work with CARCAM, Gadsden State Community College developed and expanded a new co-op model for their programs. Their advisory committee meetings revealed the need for students to get industrial experience while in school to promote work readiness. At the time, there was a work-and-learn co-op program that involved students studying one semester and working on site with the employer in the next, but this approach lengthened students' time to graduation the time working off campus often caused them to miss courses that were offered only once a year. Working through CARCAM, Gadsden State Community College and Honda introduced a new school-to-work co-op model by which students would rotate between the plant and their college program every week on a predetermined schedule, spending two or three fixed days of the week at the plant and the remainder at school. The co-op was designed to be completed in five semesters, ending in an AS. Students had to meet a set of qualifying criteria to participate in the co-op called Fast Track by Honda, which allowed a maximum of 30 hours per week of work in two shifts. To qualify, students had to: 1) be enrolled full-time in a qualified two-year automotive program; 2) have completed one semester of study; 3) maintain a GPA of 2.5 better; and 4) make a commitment to work three consecutive semesters. Students were guided on the job by plant employees.

Several of Gadsden's neighboring colleges, including Central Alabama Community College, Jefferson State Community College, and Lawson State Community College, started implementing Fast Track, and CARCAM worked with its suppliers to facilitate convenings for the colleges and employer partners. CARCAM coordinated with other industry partners and colleges to expand the similar co-op programs to 15 of the 24 colleges in the Alabama Community College System.

According to a CARCAM case study of its work, 10 percent of the Honda Plant's Equipment Service Group in 2017-18 was hired through the CARCAM program, with graduates' skills and work-readiness receiving 100 percent positive feedback[2]

Federation for Advanced Manufacturing Education (FAME) Program. Another approach to cultivating work-based learning was through the Federation for Advanced Manufacturing Education's advanced manufacturing technician (FAME) program. Working closely with Toyota, Calhoun Community College, another CARCAM institution, adopted the nationally recognized FAME program in Kentucky to prepare students for careers as industrial maintenance workers. Designated to be an industry recognized although not formally registered apprenticeship program, FAME had some distinguishing aspects. It worked with regional employers' collectives who helped develop targeted local curriculum and also paid for the training. The program used cohorts of

2 Case Study: CARCAM, (n.d.), NSF Award 1304036.

students to take part in the work-study program to create "multiskilled" technicians through a strong emphasis on employability skills and mentorship. FAME gained traction among CARCAM colleges and employer partners through CARCAM's coordination and scaling efforts.

Both the school-to-work co-op and the FAME program formed the work-based learning approach to workforce development in the state. CARCAM's role as a regional intermediary and convenor in working with colleges, industry, and state entities sought to scale up these programs, expanding them beyond the initial five colleges to eventually cover 15 of the community colleges in the system. Between 2013 and 2016, 976 CARCAM program students participated in co-ops, apprenticeships, and other work-based learning with employers in the state. By 2017, the state had 127 companies offering co-ops or apprenticeships. Industry-supported scholarships funded by AAMA and, later, the state enabled students to participate in these programs.

Sustainability. Co-ops and industry-recognized apprenticeships eventually became an institutionalized part of the state's workforce development and economic development efforts. The Alabama Office of Apprenticeship was formed in 2019 to manage and fund work-based learning programs including internships and apprenticeships to support the state's automotive and automated manufacturing industries. The state also passed the Alabama Industry Recognized and Registered Apprenticeship Program Act of 2019 to incentivize employers to use apprenticeships for their workforce needs. These events helped pave the way for ACCS, in 2020, to launch the US DOL-funded Alabama Advanced Manufacturing Apprenticeship Program (ALAMAP), which included both the 'Industry-recognized' FAME apprenticeships supported by employers, and ALAMAP's scholarships for students. The leadership at ALAMAP, which works closely with the Office of Apprenticeship, has strong historical connections with CARCAM and credits it for creating the mechanisms by which ALAMAP's programs were first implemented regionally in colleges and later adopted by the state to meet its economic development goals.

InnovATEBIO Center

Housed at Austin Community College (ACC), InnovATEBIO has been a national ATE center since 2019, and in that role has sought to lead and convene efforts in the biotechnology field for community colleges nationally. InnovATEBIO is built on the foundation laid by Bio-Link, a preceding ATE national center housed at the City College of San Francisco. Bio-Link was established in 2004 with the three-pronged mission of (1) increasing the number and diversity of biotechnicians in the workforce; (2) meeting the growing needs of industry for appropriately trained technicians; and (3) institutionalizing community college programs and practices for high-quality education and training. InnovATEBIO continues the work of Bio-Link in building a biotech workforce by developing and standardizing curriculum, providing professional development, tracking industry trends, and disseminating information among educators, students, alumni, and industry partners.

InnovATEBIO's approach to workforce development has included curriculum development and standardization for two certificates and an AS program in biotechnology. This curriculum work uses the industry-validated Washington Skills Standards to help ensure community colleges across Texas offer biotech programs that teach the same core courses and achieve equivalent performance outcomes.[3] InnovATEBIO's partners work to recruit students into the biotech workforce through dual enrollment programs for high schools and offer a one-year postbaccalaureate certificate for four-year degree holders in the biosciences.

In addition, InnovATEBIO tracks and publishes annual reports on emerging trends in biotechnology with partners such as the National Coalition of Biosciences Institutes. Through ACC, InnovATEBIO works with various stakeholders, including regional employers, state universities, high schools, industry associations, employer organizations, and state economic development entities to support the development of the biotech industry in the Central Texas region as well as statewide. InnovATEBIO's engagement with the regional industry was solidified through ATE grant activities with curriculum and program development and through the ACC Bioscience Incubator. This incubator, a notable approach to community college engagement in regional economic development, is discussed in the next section.

Development of the Incubator

The ACC Bioscience Incubator was established in 2016 to support the state's efforts to address the needs of the bioscience industry, which was identified as a priority sector for Texas's economic development goals. Many entities contributed to the Incubator's development and growth, with the InnovATEBIO National Center being the most recent. In fact, it can be said that although InnovATEBIO is relatively new, it inherited 'DNA' from prior ATE entities like Bio-Link and its regional spin off, the AC2 Bio-Link Regional Center. Other entities in the area that were directly or indirectly instrumental in the development of the Incubator also contributed.

The origins of the ACC Bioscience Incubator go back more than a decade. In 2011, a study conducted by the

3 https://www.sbctc.edu/colleges-staff/programs-services/workforce-education/skill-standards

Austin Technology Incubator at the University of Texas (UT) Austin identified the need for access to labs and incubator facilities for start-ups. Already part of Bio-Link, ACC began collecting information from companies in the Texas Life-Sciences Collaboration Center in nearby Georgetown, TX in 2012 to understand the potential impact of an incubator. In 2014, the ACC Biotechnology Department established the ACC Bio-Link Institute with the purpose of improving industry connections, helping companies conduct R&D, and connecting students with employers through internships, thus setting the groundwork for an incubator. In 2015, ACC received $2.9 million in ATE funding for the AC2 Bio-Link Regional Center, Bio-Link's first regional spin off to advance its work in Texas and build industry connections. A clear evolution from the foundation laid by the AC2 Bio-Link Institute to the work of InnovATEBIO is reflected in the latter's goals to "characterize the process of starting new incubators and college-led operations for student internships" and to build regional networks of schools, colleges, and employers.

Around the same time, ACC partnered with UT Austin and the Texas Life Science Collaboration to apply for funding from the Texas Emerging Technology Fund (ETF) in the state's Division of Economic Development and Tourism to start an incubator. The application was supported with data from the 2011 UT Austin study and ACC's own economic scan; ACC also leveraged its purchase of an abandoned shopping mall with the intent of converting a portion of the mall into the incubator. They received a $4.9 million grant from the ETF to start the ACC Bioscience Incubator (ABI), with ACC serving as the fiscal agent. Work started in 2016, and the Incubator opened in 2017, building on the work of Bio-Link, the AC2 Regional Center, and the ACC Bio-Link Institute.

The ACC Bioscience Incubator primarily supports regional early-stage companies that typically work on small federal business grants and have yet to demonstrate they have a scalable, 'commercializable' idea. The Incubator provides space for these early-stage companies at a low cost, with equipment provided at no cost to develop and test products. It also offers internships for students enrolled in ACC's biotechnology programs, who act as a technical workforce to help the start-ups.

Incubator Design

Only the second community college-based incubator in the country when it started, the ACC Bioscience Incubator has three main components: 1) Lab space from ACC in a converted portion of a mall reconstruction; 2) Lab equipment valued at nearly $2 million that ranges from cold storage, balances, and water baths to high-end analytical instrumentation funded by an ETF grant as well as other workforce development grants from the state; 3) Education and training commitments that are written into agreements between ACC and participating companies.

The ACC Bioscience Incubator does not fund start-ups, nor does it take an equity stake or Intellectual Property (IP) ownership in the hosted companies. Instead, it provides start-ups with equipment that would be cost prohibitive to purchase on their own, along with the services of ACC staff and student interns to maintain and operate the equipment. The Incubator's operating expenses are met through the revenue generated from the monthly bench fee paid by companies to use the facilities. These operating expenses includes personnel costs, intern salaries, and equipment maintenance agreements. Companies are encouraged to hire ACC students as paid interns or provide free instruction by teaching classes or workshops at ACC or other colleges affiliated with InnovATEBIO.

Industry Involvement

To become part of the Incubator, companies demonstrate to the steering committee the value of the Incubator to their organization using a set of criteria. The criteria include their establishment as a fully formed company and a reasonable plan toward commercialization, as well as the need for not only the laboratory space but also the specific instrumentation and equipment housed at the Incubator. Contracts with companies are typically 6–18 months in length and give the company 24/7 access to the facility and its equipment. The number of companies in the Incubator at any one time varies depending on how much lab and equipment they each use. The total number of companies reached a peak of 15 prior to COVID. In addition to the lab technician support, the expertise afforded through the academic programs at ACC provided support in areas of typical weakness, such as graphic design, web development, CAD design, and marketing. Business assistance services are also available through an extended network of expertise that includes the Austin Technology Incubator (ATI).

Employers in the Incubator are required to participate in education in some way. This typically takes the form of hiring students or participating in teaching or curriculum development. They have the option to hire students from any of ACC's programs, but there is an obvious focus on biotechnology. To recruit interns, employers share a job description with staff at the Incubator who, in turn, pass the information along to ACC students. An interview process ensures a fit between students' and employers' needs. Internships usually last one semester and include the option for students to earn credits toward their AS. The Incubator uses the same process to match ACC students with opportunities at regional businesses that are not Incubator companies. Incubator companies may also be involved in education by working with ACC faculty to design curriculum or by teaching classes as guest lecturers. They can also conduct workshops at the Incubator itself, at ACC, or at one of InnovATEBIO's affiliate colleges.

Student Engagement

There is no single definitive point in a student's program when they apply to work at the Incubator. Students of ACC's biotechnology programs leading to a certificate or an AS can apply to work as interns for the Incubator itself or for any of its participating companies at any time. This is especially valuable to students in ACC's AS program in biotechnology, which has an internship requirement. To earn four credit hours, students must spend 196 contact hours with the employer. Students who receive credit for their work at the Incubator are not required to be paid by the Incubator or by their employers, but they often receive payment regardless.

A goal for student internships is to provide a safe space for work-based learning that gives them a chance to understand and interact with industry while exploring their own interests and abilities. Contact with industry helps students learn more about potential employment options as well as how they can strive to meet employers' needs. For the many students in ACC's biotech program who have degrees from other countries or are four-year-degree holders coming returning to school for ACC's one-year postbaccalaureate certificate program, internships offer work-based learning and industry exposure.

Regional Engagement

Leadership of the InnovATEBIO Center and ACC Incubator are active participants in regional efforts to promote the biotech sector. They are called upon to provide technical assistance and to participate in various industry events organized by the region's active biotech stakeholders, including BioAUSTINCTX, a regional industry association convening stakeholders in the industry; the Austin Chamber of Commerce, which hosts events to entice more investors in life sciences; UT Austin; and other bioscience incubators, biotech employers, and hospitals. There are also smaller and informal affinity groups of lab space and incubator stakeholders that meet and refer companies to each other and work together to attract more investments to help grow the biotech industry in Austin. Both the InnovATEBIO Center and the ACC Bioscience Incubator leadership report working consistently with employers to raise the profile of community college programs and students for the regional biotechnology labor market.

Dissemination

The ACC Bioscience Incubator seeks to promote regional development by lending its expertise to set up new incubators. In 2017, Bio-Link and the Incubator convened a national summit, Community Colleges as Drivers for Regional Economic Development. More recently, the InnovATEBIO Center and the ACC Incubator have been approached by other entities to share lessons learned. One of these is another regional employer organization, the Round Rock Chamber of Commerce, which is looking into whether an incubator is feasible for a biosciences innovation cluster for the new medical school at UT Austin.

Conclusions

In this paper we described roles and actions that community colleges funded by the ATE have undertaken to support regional economic development. We highlighted relationships that ATE center grantees have established with partnering community colleges, other educational institutions, employers, and economic development organizations in four case examples: Florida Advanced Technological Education Center (FLATE), the Center for Advanced Automotive Technology (CAAT), Consortium for Alabama Regional Center for Automotive Manufacturing (CARCAM), and InnovATEBIO. We described programs and practices employed by these ATE centers to illustrate how community colleges funded by ATE engaged in economic development in different industry sectors and regions of the country. Whereas this study was not intended to formally evaluate the impact of these ATE grantee centers, we are comfortable describing how community colleges have worked together in particular regions to link education and training to strategic regional economic development goals and initiatives.

A companion paper synthesizes the findings on exploratory research our team conducted through 28 virtual interviews with 23 ATE grantee centers and projects. An important outcome of this research was the identification of three major categories of economic development activities: education and training, business support, and regional engagement. This schema is important not only because it recognizes the key role education and training plays in community college economic development but also because it goes farther in recognizing business support and regional engagement as important economic development activities. In the four cases presented in this paper, we gain insights into how these activities are nested in the context in which community colleges are operating by examining how community colleges carry out these activities, who they involve and who they are intended to serve and impact, and how they are perceived to work for these audiences. Table 1 summarizes the economic development activities discussed in each of the four cases and provides an overall picture of activities implemented in all four cases. We recognize that this table may not reflect everything these grantees did or are doing to advance economic development; rather, we summarize key elements of economic development that stood out in our research process as particularly valuable lessons for readers to take with them into their own future practice.

TABLE 1: SUMMARY OF COMMUNITY COLLEGE ECONOMIC DEVELOPMENT ACTIVITIES

Economic Development Activities	FLATE	CAAT	CARCAM	InnovATEBIO
Education and Training				
Courses & programs aligned with local workforce needs	X	X	X	X
Customized training		X		
Business Support				
Entrepreneurship training; small-business incubation and assistance				X
Opening up facilities for use by local companies	X			X
Technology transfer and applied research		X		
Regional Engagement				
Conducting economic scans	X			
Participation in local economic planning/ policymaking	X	X	X	X
Assistance in attracting employers to the region	X	X		X
Convening regional stakeholders	X	X	X	X

Source: HII Literature Review paper

All four ATE grantees engaged in education and training to prepare technicians for employment in industry sectors important to their regions. In all four cases, pathways began in K-12 education and extended to and through community college certificate and AS programs, with intentional connections to the baccalaureate degree and beyond. In the case of FLATE and Florida's colleges, these baccalaureates were awarded by the community colleges, whereas in the case of InnovATEBIO, the community college offered a postbaccalaureate certificate for four-year degree holders. In all cases, credentials were embedded within articulated curricula intended to prepare technicians with knowledge and skills needed to be productive in their respective engineering technology specialization (e.g., manufacturing, automotive, biosciences).

The ATE grantees offered support for businesses operating statewide or in regions of their states. For example, InnovATEBIO supported an expansive incubator and related programs and provided services meant to encourage and support entrepreneurs in the biosciences. Working in partnership with manufacturers, FLATE drew on its long experience with preparing technicians for employment to forge an ongoing relationship with FloridaMakes that served a large network of manufacturers across the state. In another example of business services, CAAT partnered with nine Michigan community colleges, four universities, the Center for Automotive Research (CAR) at the University of Michigan, the Detroit Economic Development Corporation, and others to research and disseminate employer needs across this collaborative network to ensure programs remained current in this rapidly changing technology area.

Regional engagement involving education, employers, government, and other stakeholders was ubiquitous to all of the ATE grantees. Convening groups to communicate and learn from one another about how to create and operate a highly functioning education and economic ecosystem was common to all the ATE centers, though the ways these activities functioned varied widely to meet particular regional needs. This variation likely stemmed

from the fact that a different combination of education, workforce, and economic organizations operated in the different regions where the ATE Centers resided, and each of these entities had different history and experience with regional economic and workforce development. In some cases, efforts to advance new education and training models were emphasized while in other cases there was more emphasis on developing relationships to move forward collectively.

Looking to the future, we encourage more research on ATE grantee engagement in economic development, including understanding education and training activities that have a long history in community college education. Recognizing that the mission of community colleges is centered in providing access and opportunity for student populations historically underserved by higher education, knowing what role they play in advancing more inclusive economic growth is important. Additionally, it is important to understand the larger role community colleges may play in providing business supports and engaging with employers and other educational providers to advance regional economies. Sharing what ATE grantees are doing in these areas may inform more community colleges and their partners of ways they might engage in economic activities that grow regional economies.

About

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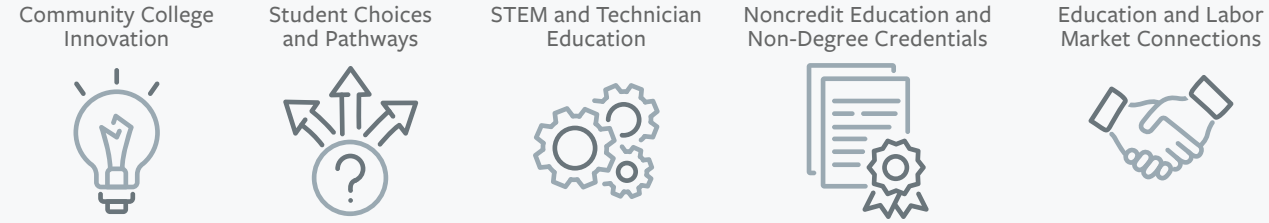
EERC Areas of Focus



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The U.S. National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. In Fiscal Year 2022, its budget is $8.8 billion. NSF funds research in all 50 states through grants to nearly 2,000 colleges, universities and other institutions. Each year, NSF receives more than 50,000 competitive proposals for funding and makes about 12,000 new funding awards.

With a focus on two-year Institutions of Higher Education (IHEs), the Advanced Technological Education (ATE) program supports the education of technicians for the high-technology fields that drive our nation's economy. The program involves partnerships between academic institutions (grades 7-12, IHEs), industry, and economic development agencies to promote improvement in the education of science and engineering technicians at the undergraduate and secondary institution school levels. The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways; and other activities.

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