EDUCATION AND EMPLOYMENT RESEARCH CENTER

Executive Summary:

The Hidden Innovation Infrastructure Project: Understanding the Economic Development Role of Technician Education in the Changing Future of Work

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Executive Summary

Overview

How community colleges promote the development of their regional economies through technician education is important yet understudied. To advance understanding, the Rutgers University's Education and Employment Research Center (EERC) examined this question in collaboration with eight community colleges via the Hidden Innovation Infrastructure (HII) Project funded by the National Science Foundation's Advanced Technological Education (ATE) program.

Technician education will be critical to revitalizing American manufacturing and upskilling workers in the years to come. This report examined college training program dynamics across disparate geographies and manufacturing sectors to identify common institutional and strategic approaches aligned with regional economic development opportunities and needs.

We found that community colleges contribute to economic development through strategic, regional roles defined by the college president, local industrial history, and partners' vision for the region's development trajectory. However, we also found that potential contributions may be unrealized if regional partners fail to articulate a role for the colleges in navigating technological change and advancing innovation. College administrators, faculty and instructors, area employers, and community partners all have roles to play in making these connections more explicit and strategic.

Our detailed findings are organized by three major focus areas.

- College activities and strategies: The internal and external dynamics shaping colleges' activity footprint
- Employer contributions: Observations on innovation and collaboration
- Ecosystem analysis: Integration with regional economic development partners

Research Approach

Each community college included in the study features exceptional technician education programs. The research captures the full range of activities, actors, and strategies involved in their implementation. At every site, the study examines employer partners' perspectives on the programs and their graduates, along with the regional economic development partnerships that position these community colleges as key operators of technician education programs serving their regional manufacturing bases.

Site Selection

Colleges contributing to the case studies were Lorain County Community College, Clark State College, and Columbus State Community College in Ohio; Pima Community College, Mesa Community College, and Estrella Mountain Community College in Arizona; Daytona State College in Florida; and Gateway Technical College in Wisconsin. Across these sites, manufacturing sectors ranged from newly expanding to deeply established. Each college had a different approach to sector-based strategies and the alignment of programs with regional economic priorities. Participating colleges sought to understand how their approaches to education, training, business support, and regional engagement contributed to advancing regional innovation and competitiveness.

Focal Programs of Study

In all three Arizona schools, we studied the statewide automated industrial technology (AIT) program. Our focal program areas in Ohio were manufacturing engineering technology and industrial technology at Clark State, electro-mechanical engineering technology and electronic engineering technology at Columbus State, and microelectronic manufacturing (MEMS) and automation engineering at Lorain. We focused on engineering technology and computer engineering technology at Daytona State and advanced manufacturing technology and welding at Gateway Technical College.

Data Collection and Analysis

The study draws on multiple rounds of interviews, site visits, and surveys to understand how community colleges contribute to regional economic development. Researchers conducted two rounds of semi-structured interviews with college leaders, faculty, and staff at eight institutions, first online (April–November 2022) and later through site visits (May–October 2023). Follow-ups were conducted through May 2024. In total, 73 college representatives participated, including presidents, deans, faculty, and advisors. To incorporate industry and regional perspectives, the team interviewed 20 employer partners across advanced manufacturing sectors and 32 regional economic development partners representing chambers of commerce, workforce boards, manufacturers' associations, and economic development agencies. The resulting data provided a multidimensional view of how technician education programs align with workforce and innovation goals in their local economies.

College Activities and Strategies

Technician education programs served as the foundation for broader engagement with economic development partners. In the eight case study colleges, education and training activities provided an important anchor for robust business support and engagement, enabling more effective customized training and local economic planning that supported successful firm attraction and retention. These linkages were critical, as talent availability and training infrastructure were persistently important factors in business location and expansion decisions.

The most prevalent education and training activities included offering hands-on and work-based learning, securing grants for lab equipment, and establishing and sustaining dual enrollment programs. Colleges were successful in these education and training activities when they had strong partnerships with businesses and industry leaders as well as with community-based nonprofit organizations.

Wide variation existed in how personnel were situated within colleges to meet the evolving needs of manufacturers. This variation corresponds in part to differences in industrial settings, manufacturing ecosystems, college leadership, and college funding. In several cases, college presidents anchored their institution's vision and led engagement with their local manufacturing sector, and they sometimes appointed senior leaders to oversee workforce and manufacturing programs. In regions with mature manufacturing ecosystems, administrators and staff gained critical knowledge and insights by engaging with industry. Where connections were weaker, departments sometimes dedicated staff to align industry and community interests or created new institutions.

A variety of strategies and tactics helped link degree-granting and shorter-term training programs to the technological innovation capacity of regional employers as well as to community development priorities. Employers played a key role in the activities and strategies that ensured a responsive technical education system, strategic equipment investments, and curricular upgrades. Other key partners included regional economic development organizations, industry and business associations, high schools, vocational schools, universities, government agencies, community-based organizations, and other community colleges.

Employer Contributions

Employers viewed community colleges as essential providers of foundational skills.. Through sustained partnerships, many employers came to see colleges as valuable partners in advancing industry-specific skill development and regional training initiatives. These partnerships, often supported by state coordination efforts, positioned colleges as facilitators of regional skill-building and as brokers of employer-to-employer connections. All employer partners emphasized the importance of hands-on experience with local manufacturers for high-quality, relevant technician skills.

Some employers held a broader view of the regional industry and saw the importance of coordination in skill building. Larger employers tended to have greater capacity to take an industry-wide view of talent development and to support regional workforce initiatives. For example, a partnership between Mesa Community College and a major semiconductor manufacturer in Arizona was intentionally designed to meet the needs of employers across the regional semiconductor sector. This approach demonstrates how strong anchor partnerships can evolve into broader, industry-driven technician education programs. In several cases, smaller employers also anchored these partnerships and programs.

College technician programs played an important intermediary role. Businesses may be reluctant to invest in shared training programs that could also strengthen competitors, yet community colleges can help alleviate this hesitation by demonstrating how stronger, better-aligned technician pipelines improve outcomes for all firms. For example, Gateway Technical College collaborated with regional manufacturers to confront talent shortages, reduce poaching pressures, and shift the focus of training efforts toward collective solutions. Colleges supported coordination efforts across employers through employer involvement in curriculum and program development.

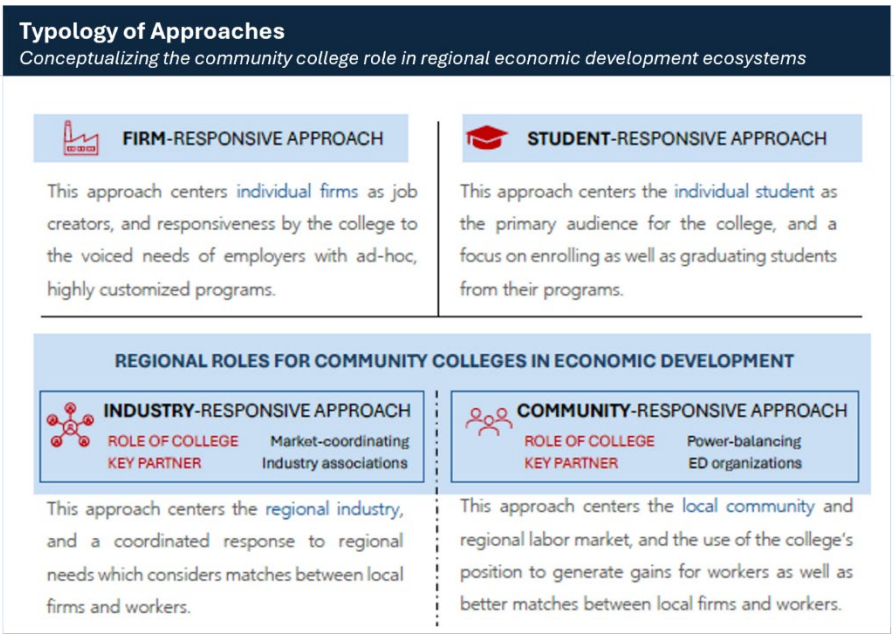
Multiple forms of collaboration among community colleges, employers, and economic development partners improved industry coordination and enhanced regional competitiveness. We found concrete examples of how community college-trained technicians contributed to process innovation on the job. However, community colleges and their employer partners were still working to establish a collective language to articulate how technician education programs were linked to innovation processes. By better articulating how technician education drives innovation, community colleges and partnering employers can help strengthen the nation's manufacturing and technological edge. They are uniquely positioned to pinpoint the talent and skills needed to optimize technology applications to manufacturing in the context of fast-paced technological change.

Ecosystem Analysis

Regional partners reported several contributions from their partnering colleges. They noted the colleges provided high-quality training and education to enhance technical skills for manufacturing in the region by attracting talent into the manufacturing field and by supporting innovative and productive manufacturing firms. In this way, they made a unique contribution to and added value to regional economic development efforts, supporting manufacturers who invested in technician education and providing high-quality services to manufacturing businesses seeking to sustain and grow operations in the region. They broadened the technician talent pool by recruiting women and people of color and by assisting low-wage earners, veterans, and formerly incarcerated people in accessing well-paying jobs in manufacturing.

College technician programs can engage in the development of their regions in different ways. The analysis of colleges' activities along with employer and economic development partner feedback yields an ecosystem-wide perspective of each institution's manufacturing sector. This analysis points to four approaches that describe how community colleges engage in regional economic development: student-responsive, community-responsive, firm-responsive, and industry-responsive. Each approach represents a different way colleges balance serving students, employers, and regional industries, reflecting both supply- and demand-side strategies for economic growth.

Figure 1. Typology of Approaches



The typology outlined in the figure provides a framework for understanding the diverse roles community colleges play in economic development. Most colleges combine aspects of multiple approaches, adapting their role according to local conditions and partnerships. Their multiple roles help regions pursue both competitiveness and inclusive growth.

Recommendations

The research shows the ways that community colleges can contribute to economic development through strategic, regional roles, yet their contributions often go unrecognized and their capacities underutilized. More work is needed to raise awareness among employers and regional economic development organizations of how community colleges can contribute to technological change and the hidden innovation infrastructure of technician education. The following recommendations can help make these connections more explicit and strategic.

- Community college leadership can prioritize engagement with businesses and economic development actors, including local industry leaders, and institutionalize partnerships with them.
- Employers can coordinate with other firms in their region to champion technician education and articulate its impact on their business and industry.
- Regional economic development organizations can emphasize the inputs of both labor-supply (college) and labor-demand (industry) actors and support coordination between them.
- State-level economic development organizations can facilitate coordination by convening, offering financial subsidies, and establishing statewide networks and programs.

- NSF ATE program administrators can use their convening power to promote the contributions of technician education to regional economic development organizations in terms that all parties understand and value.
- NSF ATE evaluators can establish a shared set of measurable outcomes that clearly evaluate and communicate the results of technician education.
- NSF ATE principal investigators at community colleges can strengthen their regional impact by including business supports and regional engagement activities, engaging across all college workstreams.

About

The Education and Employment Research Center

Rutgers' Education and Employment Research Center (EERC) is housed within the School of Management and Labor Relations. EERC conducts research and evaluation on programs and policies at the intersection of education and employment. Our work strives to improve policy and practice so that institutions may provide educational programs and pathways that ensure individuals obtain the education needed for success in the workplace, and employers have a skilled workforce to meet their human resource needs. For more information on our mission and current research, visit smlr.rutgers.edu/eerc.

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National Science Foundation

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. National Science Foundation's Advanced Technological Education program: atecentral.net/about.

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