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Promising Practices to Support the Development of K–12 Manufacturing Programs

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CONNSTEP is Connecticut's leading business consulting firm. Efforts focus on identifying opportunities for growth, improving productivity, and ensuring clients remain competitive in evolving market conditions. Consultants are subject matter experts who implement advanced business and technical solutions, as well as workforce strategies, using a holistic approach that generates bottom-line improvements and produces innovative, results-driven top-line growth for Connecticut organizations. CONNSTEP is an affiliate of CBIA, the Connecticut Business & Industry Association, collectively working to advance the growth and sustainability of the state's business community. The firm also works closely with CBIA's other affiliate, ReadyCT, advocating for more educational and training resources to encourage career opportunities for Connecticut's workforce.

ReadyCT

ReadyCT is a 501(c)3 nonprofit organization with a mission of advancing academic excellence and career-connected learning for all public school students in Connecticut through collaboration with business, education, and civic leadership. ReadyCT is also an affiliate of CBIA and is committed to better aligning the state's public education systems with local and regional workforce needs, especially in high-growth/high-demand industry areas such as manufacturing.

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Background and Introduction

The state of Connecticut (CT) boasts over 4,000 manufacturing companies that produce computer and electronic products, transportation equipment, chemicals, fabricated metals, pharmaceutical and medical products, and plastics. As of August 2022, manufacturing jobs were up 3,200 since August 2016, making it one of the leading sectors in the CT economy.[1] With a significant employment multiplier, durable goods manufacturing is linked to over a million CT jobs; the Economic Policy Institute estimates that for every 100 jobs in durable goods manufacturing, there are 455 jobs induced in the economy.[2]

CT is experiencing an increasing demand both for products and, to meet that demand, a more highly skilled workforce to keep pace with rapid technological advancements in manufacturing. Much of CT's 2.4 percent year-over-year job growth is driven by the aerospace and defense sectors: Raytheon Technologies Corporation, General Dynamics Electric Boat, and Sikorsky all announced major hiring, expansion, and investment initiatives over the past 5 years. These expansions will substantially increase workforce needs at small and midsized CT manufacturers throughout their supply chains.

CT manufacturers have identified significant gaps in the state's workforce development system,[3] most notably the dearth of comprehensive recruitment, education, and career pathways at the K–12 school/district level that fully aligns with their workforce needs. To meet these needs while diversifying the workforce, and to improve the manufacturing industry's competitiveness, a broad partnership led by CONNSTEP—CT's Manufacturing Extension Partnership (MEP) representative—applied for a grant from the U.S. Department of Commerce National Institute for Standards and Technology to design the Manufacturing Skills for

[1] Connecticut Department of Labor, Office of Research. (2023). Labor market information: Quarterly averages - Employment & wages by industry (QCEW) - State of Connecticut. Retrieved February 21, 2023, from https://www.cbia.com/resources/manufacturing/2022-connecticut-manufacturing-report/

[2] Bivens, J. (2019). *Updated employment multipliers for the U.S. economy*. Economic Policy Institute. https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/

[3] CBIA. (2019). *2019 Connecticut manufacturing report*. https://www.cbia.com/wp-content/uploads/2019/10/2019CTManufacturingReport.pdf

Connecticut (MSforCT) project. The overarching goal of the MSforCT project was to establish a menu of effective educational best practices that MEPs throughout the country, and manufacturers and school systems across CT and beyond, can use to establish and advance effective career pathways. Grant application partners included ReadyCT, a statewide nonprofit focused on K–12 education and career-connected learning; CBIA, CT's largest business organization; and the Connecticut Manufacturers' Collaborative, a statewide, policy-focused collective composed of the nine major manufacturing associations within CT.

In an effort to disseminate best practices and share learning beyond CT, CONNSTEP partnered with Rhode Island's (RI) MEP, Polaris, to immediately expand the project's reach. This partnership was intended to kickstart RI's emerging manufacturing early career pipeline and inform the processes that will help MEPs across the country to enhance their states' manufacturing career pathways. The Polaris MEP partnership interfaces with the RI Governor's Workforce Board's workforce development initiative, Real Jobs RI, to broaden the workforce pipeline, including making connections and working with career and technical education (CTE) programs across the state.

The specific goals of the MSforCT project included better understanding which K–12 CTE programs are most effective in preparing students for careers in manufacturing, breaking down the silos in which promising programs are operating, and sharing CT's and RI's promising practices locally and nationally. The main activities of the project were as follows:

- Conduct research about the components of a high-quality K–12 advanced manufacturing program
- Create a comprehensive inventory and analysis of manufacturing career pathway programs and initiatives across K–12 schools/districts in CT and RI
- Conduct program reviews of a sample of 13 high school programs (12 in CT and 1 in RI), including outcome data where available
- Prepare summative reports of each of the 13 programs reviewed, in consultation with ReadyCT and the schools reviewed
- Deliver a promising-practices guide to developing school-based manufacturing programs
- Build an interactive website with a repository of effective career pathway programs and key criteria for the creation of new programs to serve as an online community of practice accessible to the public that targets school districts, business associations, students and families, postsecondary institutions, and other stakeholders

This report is a summary of the 13 program reviews and includes key findings and considerations for increasing and improving the pipeline to careers in advanced manufacturing.

Summary of Key Findings

Five notable themes emerged from the program reviews as critical to the success of secondary school manufacturing programs. These themes were also most often cited when asked about the greatest strengths of each of the programs:

- A Program Champion
- Committed, Experienced Manufacturing Teachers
- Strong Business and Community Partnerships
- Effective, Supportive Leadership
- Access to Hands-On Training and Funding for Capital Equipment

A Program Champion

Without exception, each manufacturing program had at least one staff member who sat at the epicenter of the program, was knowledgeable of diverse funding opportunities, and was connected to key stakeholders. The people in these positions had the unique combination of manufacturing knowledge and expertise, teaching experience, and a passion for manufacturing.

Committed, Experienced Manufacturing Teachers

Many of the teachers interviewed in these 13 programs also possessed a unique combination of industry expertise and teaching experience. In general, the teachers interviewed had a propensity to go above and beyond to meet the needs of students; most were playing a number of critical roles in the school in addition to teaching a full course schedule.

Strong Business and Community Partnerships

Programs that have been in operation for more than 5 years have established and sustained strong partnerships with local businesses, which result in student internships and work experience opportunities that often lead to employment after graduation. Programs just getting started benefitted from staff connections with business and community partners.

Effective, Supportive Leadership

Superintendents and principals/school leadership provided both political and fiscal support whenever possible, leveraging their positions to support the growth of manufacturing pathway opportunities for students. It was clear that the leadership in these schools and districts

demonstrated distributed leadership by conveying full trust in their program coordinators and lead teachers, which enabled advancement of the work.

Access to Hands-On Training and Funding for Capital Equipment

Adequate funding is key to the success of these programs. In general, funding was not cited as a barrier in the programs that were reviewed. This may be because program coordinators and teachers developed and sustained relationships and pursued grant opportunities to ensure that their programs were supported. It takes networks to know how to best access and allocate resources.

Program Review Methodology

WestEd identified 13 programs for review through a multistep process. The approach included developing a statewide survey; identifying all existing manufacturing programs across CT for survey administration; developing and using a rubric to rank manufacturing programs on their use of high-quality, high-impact practices; and considering site demographics and industry recommendations to choose the final 13 program sites.

Statewide Survey and Program Selection

The project team reviewed sources from key organizations to develop a statewide survey intended to capture data that would inform manufacturing program selection. These organizations included the Association for Career & Technical Education,[4] the Society of Manufacturing Engineers (SME) and SME Education Foundation, the National Association of Manufacturers, and the U.S. Department of Labor, Employment, and Training Administration. The final survey instrument aligned with five broad categories:

- Curriculum standards and competencies
- Business and community partnerships
- Career development offerings
- Sequencing and articulation
- Access and equity

Identifying K–12 Manufacturing Programs for Survey Administration

ReadyCT and WestEd worked together throughout fall 2020 to develop a comprehensive statewide inventory of K–12 advanced manufacturing programs, the intended recipients of the statewide survey. To identify existing programs, WestEd consulted with ReadyCT, the Connecticut State Department of Education (CSDE), and industry partners, including RI's MEP, Polaris, to include RI as part of this review.

[4] Imperatore, C., & Hyslop, A. (2018). *2018 ACTE quality CTE program of study framework*. Association for Career & Technical Education. https://www.acteonline.org/professional-development/high-quality-cte-tools/

At the end of the effort, the team identified over 140 advanced manufacturing programs in CT and three in RI. The list of programs identified appears in Appendix A. WestEd researchers developed and administered an online survey to capture basic program data and inform the selection of programs to be reviewed.

Survey Administration

WestEd administered the online survey to K–12 manufacturing programs in CT and RI from February 3 through March 12, 2021. A total of 47 schools responded to provide information on 51 programs, representing a 33 percent response rate. A list of all CT schools completing the survey appears in Appendix B. Some of the schools previously identified in the scan responded that they did not currently offer manufacturing programs. Others partially completed the survey.

Rubric Development and Additional Sources in Program Selection

The project team used a combination of survey responses, site demographics, and industry recommendations to identify the manufacturing programs to invite to participate in the review.

The WestEd research team scored programs' survey responses using a rubric the team created during the survey development phase, attached as Appendix C. Programs were ranked based on total scores with higher survey scores representing programs aligned with high-quality, high-impact practices.

The research team consulted with ReadyCT to further analyze the program list to consider additional criteria such as the location of the program (i.e., region within CT), urban-rural classification of the school, and socioeconomic and diversity indexes of the school/district. Then the research team presented ReadyCT with the final list of programs for review. The goal was to identify a group of sites among the highest ranked programs that were also willing and able to participate in the comprehensive review. The final list of 12 CT programs selected for review can be found in Appendix D. The list of RI schools that received the survey, completed the survey, and were selected can be found in Appendix E.

Program Reviews

Program reviews included two primary sources of data: interviews/focus groups with key program stakeholders and student administrative data.

Interviews With Key Stakeholders

Once the sites were selected, WestEd researchers worked with a site coordinator, usually the program or CTE director, to introduce the study, identify the appropriate participants, and schedule interviews and focus groups with teachers, students, school counselors,

administrators, and business partners connected to each of the 13 programs. Between May and August 2021, WestEd researchers conducted a total of 27 interviews and 37 focus groups across the 13 programs, all virtually via videoconferencing due to the COVID-19 pandemic.

Student Administrative Data

WestEd requested student-level data from CT's Statewide Longitudinal Data System (SLDS): the Preschool Through 20 Workforce Information Network (P20 WIN). The research team received student enrollment data across 12 schools in the study; enrollment and persistence data in postsecondary education; and labor data for graduates of the schools, both manufacturing and nonmanufacturing students. A description of the data and its limitations can be found in Table 1 and Table 2 in the "Manufacturing Program Students' Characteristics" section. To analyze student-level data related to each program, these data were included as an appendix within each individual district report. Copies of all reports can be found on the MFG Skills–CT website.

Disseminating Results

Between August and October 2021, WestEd staff drafted site visit reports for each of the 13 programs reviewed, which informed this summary report. ReadyCT and CONNSTEP staff and the respective program representatives had an opportunity to review and provide comments on the reports.

Limitations

It is important to note the limitations of this approach to identifying programs for review and interpreting the results. The primary limitations are as follows:

- The programs were chosen among only a sample of K–12 manufacturing programs that completed the survey.
- Not all survey respondents provided complete responses.
- Surveys were completed by respondents playing diverse roles with differing levels of programmatic knowledge.
- Many of the programs were newly developed and did not have many students who had fully completed the program.
- Due to the limited sample sizes of students completing manufacturing programs, the program review did not include an impact analysis of participation on student outcomes. In other words, the research team was unable to execute a rigorous

research design that would provide evidence that participation in these programs caused positive educational or career outcomes for its participants.

- The review took place during the COVID-19 pandemic, and all interviews and focus groups were conducted virtually using a video-based platform. Therefore, researchers were unable to tour the programs and observe classes in person.
- Due to the pandemic, many students were learning virtually, and the opportunity to participate in work-based learning opportunities was limited.

Thus, the sample from which the team identified programs is limited by self-selection and the self-reported nature of the data source. It is possible that other K–12 manufacturing programs in CT and RI that did not complete the survey are indeed high quality, high impact. It is also possible that the programs chosen among the survey respondents provided incomplete and/or inaccurate information.

Key Findings

This section summarizes the key themes, based on interview and focus group data across 13 programs, that emerged as promising practices in high-quality manufacturing programs.

A Program Champion

A Unique Combination of Skills

Each manufacturing program that participated in the comprehensive review had a person who played the role of program champion. In some cases, it was a program coordinator or pathways director; in others it was the CTE director, a supervisor, or a teacher. In all cases, this person was connected to all stakeholders including school/district leadership, students, other teachers, business partners, and community colleges. The program champions possessed a combination of manufacturing knowledge and expertise, teaching experience, and a passion for helping students find the right career pathway. Due to their experiences in the manufacturing field and in various related roles in the state, these champions also had connections with funders and the know-how to secure funding and allocate adequate resources.

In one case, the program champion had well-documented policies and practices, and while staff spoke very highly of her and her work, they were also confident that she had implemented systems that could easily be executed/replicated by others. In other instances, interviewees conveyed that the program would be in jeopardy if the current champion left. In many programs, it seemed that key elements such as business partnerships and grant writing were reliant on the champion's relationships.

Involvement at All Levels

Program directors spent a significant amount of time networking and meeting with stakeholders to establish partnerships and launch programs. One CTE supervisor was involved in the program development and implementation from the classroom level to the state level. She frequently visited classrooms to ensure that the content aligned with standards, sought feedback and input from teachers with regard to curriculum development, attended state standard meetings, served on the state-level CTE Board of Trustees, and served as the education cochair for several career clusters.[5] In another program, the director of CTE and business partnerships played a significant role in the program development by attending

[5] For more, see Career Clusters on the Advance CTE website.

meetings with business community organizations, such as the chamber of commerce, and contacting businesses to discuss partnership opportunities. In most programs, the program director served as the liaison between the students and business partners and was integral in the process of securing career development opportunities for students.

> *"Anyone he sends me, I know has the skills to do the job."*
>
> *– Business partner said of a program champion*

Committed, Experienced Manufacturing Teachers

School leaders, students, and business partners in many programs described the teachers as central to the success of the program, not only for instruction and assessment, but also for securing equipment, facilitating connections to industry, and providing work-based learning placement for students. Teachers in these programs played a myriad of roles, including advocating for the students and the program, building partnerships and relationships with businesses, and seeking and securing funding and equipment.

Recruiting and Retaining Certified, Prepared Teachers

The strongest teachers held a unique combination of industry expertise and classroom experience. When asked what makes it so difficult to attract and retain teachers, program coordinators, school leaders, and teachers all said it is difficult to find candidates who have both the pedagogical/instructional experience and the manufacturing experience. In some cases, teachers had the manufacturing experience without the teaching background; those teachers were burdened by the challenges typical of a first-year teacher (e.g., classroom management challenges, difficulty understanding and aligning with learning standards, etc.). Other than a commitment to future generations, there is little incentive for manufacturing industry workers to go into teaching; most can earn a much higher salary in the private sector. Recruiting and retaining certified, prepared teachers was cited as the most pressing issue in at least 30 percent of the programs reviewed.

> *"We need more people like [him]; those people are the core of these programs, are hard to find, and they are going to retire. We need ways to sustain the program and replicate those kinds of people."*
>
> *– Fellow teacher*

Teacher Collaboration

Providing teachers with the flexibility to create schedules that meet their needs seems to increase and support collaboration with others. Because newer programs had the luxury of "starting from scratch," they experienced this flexibility more often. This allowed teachers to meet weekly as a department to discuss a range of topics including assessment, curriculum, and lab needs. Teachers developed positive, supportive relationships with one another and collaborated on their courses. In one such program, the manufacturing teachers also regularly met with the other teachers within the high school's CTE department, including those in family and consumer sciences and business, to discuss curriculum and potential opportunities for collaboration. Programs in existence for some time had a more traditional schedule and thus less flexibility, which created barriers to collaborative planning and teaching.

Professional Learning Opportunities

In all programs, teachers spoke of many opportunities for professional learning through the district as well as with industry partners and institutions of higher education (IHEs), mostly local community colleges. Programs that had partnerships with IHEs provided opportunities for teachers to take courses and keep their certifications current. Strong business partnerships also provided teachers with the opportunity to learn new technology and hands-on machine use. While there are many professional learning opportunities available, teachers were often unable to take advantage of them due to the demand of a full teaching load.

Strong Business and Community Partnerships

Work-based learning experiences are successful largely because of strong partnerships with businesses and community-based organizations. These relationships are mutually beneficial; the students gain both meaningful work experience for pay and the skills they will need to succeed in the current workforce. The businesses have the opportunity to train the next generation of workers and gain highly trained, highly skilled employees. The economy and public at large benefit from graduates who are prepared to contribute positively to their

community, which then creates the conditions for lower unemployment and higher living standards.

Local Businesses

Across all K–12 manufacturing programs reviewed, there was a strong commitment from local business partners; they invested in students with the goal of training the future workforce. In several districts, business partners communicated excitement about the direction of the program as well as their dedication to change the negative stereotype associated with manufacturing pathways. Some businesses partnered with districts to contribute to that change by engaging students at each grade level in as early as elementary school. One district had a close partnership with DaCruz Manufacturing. As a member of the district's Technical Advisory Council, DaCruz educated the district about the community's workforce needs.

Businesses that partner with schools to provide training and work-based learning for students (of those K–12 manufacturing programs that participated in the comprehensive review) include, but are not limited to, Polamer Precision, Richard's Machine, OKAY Industries, Sound Manufacturing, Electric Boat, Pratt & Whitney, and Hobson & Motzer, as well as smaller shops such as Westminster Tool.

Industry Partnerships

CT boasts many community- and industry-based partners; the manufacturing programs reviewed leverage this to create school-community partnerships, which results in better alignment of goals and curricula, more-efficient use of resources, increased work-based learning opportunities, and potential future employment placement for students. These partners include the Connecticut Center for Advanced Technology,[6] the Workforce Alliance,[7] and the Justice Education Center.[8] Regional organizations, including workforce development boards and regional education service centers, offer work-based learning experience as well as opportunities to earn degrees while working.

Other local industry groups such as the New England Spring and Metalstamping Association[9] provide training for teachers in Mobile Apps, Project Lead the Way, Learn Robotics, National Institute for Metalworking Skills (NIMS),[10] and advanced manufacturing curriculum. One district worked with the National Center for College and Career Transitions,[11] which offered training in

[6] For more, see Connecticut Center for Advanced Technology.

[7] For more, see Workforce Alliance.

[8] For more, see Justice Education Center.

[9] For more, see New England Spring and Metalstamping Association.

[10] For more, see NIMS.

[11] For more, see National Center for College and Career Transitions.

pathway development to administration. Several workforce development boards also partner with schools to place students in apprenticeships and long-term employment. Unfortunately, due to the COVID-19 pandemic, work-based learning opportunities were limited during the timing of this project.

Institutions for Higher Education

IHEs are also critical partners in the work; many IHEs noted below are specific to the K–12 manufacturing pathway programs included in the research study and serve a variety of functions from dual enrollment for students to professional learning for teachers. Some programs are housed at community colleges, such as Gateway Community College, which is the primary partner for at least two of the programs reviewed. In these examples, Gateway Community College is a central player in student recruitment and placement in industry, brokering partnerships with businesses and providing professional learning and college-teaching opportunities for teachers. In more than one program, the associate's degree pathway and dual enrollment were significant selling points for students who were considering joining the program, as it would alleviate the financial burden of attending a full 4 years of postsecondary education.

Of the programs reviewed, the University of Connecticut and the Central, Western, and Eastern Connecticut State University campuses are examples of four-year universities partnering with manufacturing programs, where students can earn college-level credit through dual-enrollment course work. Goodwin University and the state's community colleges are involved in the manufacturing pathway development at different levels of engagement. The University of New Haven provides graduate credits for Project Lead the Way professional development training for teachers.

Effective, Supportive Leadership

Commitment from superintendents, principals/school leadership, and, in some cases, legislators was key to developing and maintaining the funding and policy to support K–12 manufacturing programs. Participants in the review from all stakeholder groups recognize the economic opportunity in manufacturing as well as the skills gap among students, and they are mobilizing to address both. They also cited the climbing cost of higher education as a barrier for many, and they asserted that promoting manufacturing as a viable pathway will help change the stigma and encourage more students to pursue it.

> *"[The leadership] maintains partnerships and relationships with state officials. Having a long-term (2 to 5 years) plan and sharing that with the [representative] helps make them more effective in pitching financial asks on the state end."*
>
> *– CT state representative*

As noted previously, school leaders supported opportunities for professional learning among educators, both in district and through advanced courses and professional learning time in industry. One school noted professional learning opportunities through the Buck Institute for Education's PBLWorks,[12] which focuses on building the capacity of teachers to design and facilitate quality project-based learning, as particularly supportive.

Access to Hands-On Training and Funding for Capital Equipment

For students, the hands-on component of this type of education is the biggest attraction. Universally, students spoke of feeling a sense of accomplishment after creating a project that comes to fruition. In one school, students spoke of the pride they felt when they manufactured giant board game tables and arcade cabinets to house electronic panels. In another school, teachers spoke of creating chicken coops to house chickens at a local farm, a community storage unit to store groceries for families in need, and shelving units for a lending library project. To achieve this type of project-based learning, each program needs access to high-quality machines and technology as well as teachers who are trained to use them.

Only one or two schools pointed to a lack of funding as a problem, which indicates that there are adequate resources available to support programming, including Perkins funding,[13] state funding, partner donations, and grants. Most programs rely on the relationships and tireless work of the program coordinator to secure such funding. Programs that partner with community colleges often do not have to invest in their own capital equipment, as they have access to the college's machinery.

Manufacturing Program Students' Characteristics

The tables below present descriptive data on students across 11 CT manufacturing programs included in the program review in comparison to overall school populations.[14] It should be

[12] For more, see PBLWORKS.

[13] For more, see Perkins V: Today's Skills, Tomorrow's Careers on the CSDE website.

[14] Waterbury Career Academy was not included in the data set.

noted that manufacturing program students are defined differently in each of the schools. (See individual program reports for detailed information.[15])

Table 1. Student Demographics, Academic Year 2020/21

Student characteristics	Manufacturing program enrollment (*n* = 677)		Overall enrollment (*n* = 11,767)	
	n	%	*n*	%
American Indian or Alaska Native	*	*	28	0.24%
Asian	32	4.73%	465	3.95%
Black or African American	73	10.78%	1,771	15.05%
Hispanic/Latino of any race	176	26.00%	3,756	31.92%
Native Hawaiian or other Pacific Islander	*	*	9	0.08%
Two or more races	32	4.73%	418	3.55%
White	362	53.47%	5,320	45.21%
Female	92	13.59%	5,702	48.46%
English language learners	25	3.69%	738	6.27%
Students with disabilities	132	19.50%	1,980	16.83%
Free-/reduced-lunch eligible	279	41.21%	5,435	46.19%

Note. **Cells with five or fewer students are noted with an asterisk and are restricted from reporting. "Overall enrollment" includes manufacturing students.**

Table 1 compares the demographics of manufacturing program students to the overall population across these same schools. A smaller share of Black or African American students (a 4 percentage point difference) and a smaller share of Hispanic/Latino students (a 6 percentage point difference) enrolled in manufacturing programs compared with these subgroups' respective overall enrollment. White students enrolled in manufacturing programs at higher

[15] For more, see School Reports on the MFG Skills–CT Pathways website.

rates than their overall enrollment (53 percent versus 45 percent). Although nearly half of the overall population was female, only 14 percent of manufacturing participants were female students.

In terms of graduation, the percentage of manufacturing program students graduating from high school was similar to the graduation rates across the overall population of students.

Table 2. Secondary Graduate Rate, Academic Year 2020/21

Graduation	Manufacturing program students (*n* = 167)		Overall population (*n* = 2,677)	
	n	%	*n*	%
Graduated	158	94.61%	2,506	93.61%

Areas for Further Consideration

To meet the increased demand for highly skilled workers in manufacturing, state government, businesses, nonprofit partners, and advocates should consider the actions detailed in this section.

Recruiting and Retaining Educators in CTE

According to the National Education Association (NEA) survey in January 2022,[16] three fourths (74 percent) of NEA members said they have had to fill in for colleagues or take on other duties due to staffing shortages, and 80 percent of members reported that unfilled job openings have led to more work obligations for the educators who remain. The manufacturing programs in CT are no exception. One program lost four teachers between 2020 and 2021 because of illness, death, and retirement. A teacher in another program was relying on 12th graders to assist him in the shops due to the absence of the lead teacher. During the year span of this project, three program coordinators left their positions.

Often, teachers and coordinators serendipitously fell into teaching in these positions, and programs reaped the benefit of the expertise and experience of those individuals. Several of the schools included in this study faced challenges in recruiting and retaining teaching talent. With the current manufacturing industry growth in the state, securing these professionals cannot be left to chance. Participants suggested considering changes to teacher certification policy to provide additional pathways into the teaching profession and/or more opportunities to explore CTE fields while in teacher preparation programs.

Many of these programs relied heavily on the coordinators and their business and community relationships to secure work-based learning for students, professional learning opportunities for staff, and access to equipment. Investment in and elevation of the coordinator position has the potential to attract additional candidates from a wider pool and build a career ladder for manufacturing teachers.

[16] Jotkoff, E. (2022, February 1). *NEA survey: Massive staff shortages in schools leading to educator burnout; alarming number of educators indicating they plan to leave the profession*. NEA. https://www.nea.org/about-nea/media-center/press-releases/nea-survey-massive-staff-shortages-schools-leading-educator

Elevating the Career Path for Students by Increasing Recruitment Efforts

As one stakeholder suggested, "The greatest need for the pipeline is to change stakeholder education and awareness to change the perception" of the field of manufacturing. This requires a rebranding/public relations campaign to create more visibility in the community and in the media. Manufacturing, like other CTE pathways, is often perceived as a less-than-optimal secondary school learning experience among educators, counselors, and administrators due to its antiquated reputation as the "trade track." This is likely because key influencers are not fully informed about manufacturing as a viable, engaging, and tech-driven career pathway for students. Collectively, all educators must be given the information and tools needed to effectively communicate the opportunity to families, including helping them to understand mechanisms for dual enrollment and early college learning experiences.

Additionally, recruitment into manufacturing pathways should be early and often. High school teachers and counselors need greater access to middle school students than they are currently granted in many of these communities. A strong "early and often" model exists in Massachusetts, where Minuteman Technical High School provided the opportunity for 7th grade students from member towns to spend 4 days during April vacation at the local career technical school at no cost.[17] This allowed students to rotate through various pathways and get a sense of what CTE looks like in action. Students need to have the opportunity to learn about manufacturing as a potential pathway as early as middle school, and program staff need access to middle school students and their families.

> *"A significant labor shortage exists in high-demand sectors due to insufficient training capacity, an underdeveloped talent pipeline, and a lack of marketing focus to attract students to these rewarding careers."*
>
> *– Governor's Workforce Council strategic plan (2020, p.19)*

[17] Thomas, E. (2021, March 15). *Register: April vacation programs for middle school students*. Minuteman High School. https://www.minuteman.org/announcements-and-letters/news-updates/news-post-do-not-post-here/~board/news/post/register-april-vacation-program-for-middle-school-students

Offering Early, Robust Career Planning and Preparation

Career planning and preparation is important to begin early on in a student's academic career. The most effective career development efforts are delivered using a multiyear, whole-school approach led by advisors and other mentors, combined with the use of readily available online tools and resources, as well as access to work experience.[18] Students begin developing self-awareness and reflection, including self as a learner and as a worker, in the primary and elementary school years.[19] There is opportunity to leverage CT's Student Success Plan (SSP)[20] by requiring the SSP to be more integral to the student experience earlier in the K–12 experience. Providing opportunities for students to engage in pathway exploration, inclusive of manufacturing, could be part of that integration. This recommendation aligns with Strategy 2.5 of the Governor's Workforce Council strategic plan.[21]

The Academy of Manufacturing, Engineering, & Technology (MET) at New Britain High School is one such program providing early pathway exploration. Elementary school principals and the Assistant Coordinator of Science, Technology, Engineering, Art, and Mathematics (STEAM) and Summer Programs are implementing a systematic approach to providing STEAM experiences to students in grades K–12 by planning STEAM and CTE courses as early as elementary school. Middle school technology education courses and labs will be modeled after New Britain's MET Academy, thus creating a pipeline for high school and postgraduate manufacturing. A new curriculum information teacher works to ensure the middle school curriculum aligns both vertically and horizontally and that the high school curriculum aligns with the new manufacturing equipment. This district-wide approach will increase the number of students exposed to career planning and prepared for any pathway, including manufacturing.

Investing In and Prioritizing Quality Data

As described in the methodology, the mixed-methods research design included identifying 13 manufacturing programs primarily based on self-reported survey data; conducting interviews and focus groups with program stakeholders to delve deeper into the programs' policies and practices; and analyzing student-level, longitudinal data from P20 WIN. Local programs and school districts did not consistently collect the data needed for the quantitative analyses, which

[18] Solberg, V. S. H. (2019). *Making schools relevant with individualized learning plans: Helping students create their own career and life goals*. Harvard Education Press.

[19] Howard, K. A. S., & Ferrari, L. (2021). Social-emotional learning and career development in elementary settings. *British Journal of Guidance & Counseling, 50*(3), 371–385. https://doi.org/10.1080/03069885.2021.1959898

[20] For more, see Student Success Plan on CT's state website.

[21] Governor's Workforce Council. (2020). *Workforce Strategic Plan*, Section 2.2. https://portal.ct.gov/-/media/Office-of-the-Governor/News/20201028-Governors-Workforce-Council-Strategic-Plan.pdf

prompted the need to request SLDS data.[22] This data request was more complex than the research team's typical SLDS requests, requiring 12 distinct data request descriptions since each of the 12 programs had different start dates and definitions of manufacturing program students.

The data request process was lengthy. At the start of the research study in November 2020, the WestEd team began discussions with CSDE about the study's research questions and the needed student-level data on the sample of CT-based manufacturing programs. WestEd and the state SLDS representatives participated in additional meetings and maintained communications between November 2020 and December 2021. The research team developed a data request and responded to requested revisions during the subsequent 4 months. In addition, WestEd secured student-level data from the RI-based program, which had limited data. In the northeast, students often move across state lines for postsecondary education and work. More compatible and consistent SLDS would benefit states, students, IHEs, and employers.

In addition to developing the data request itself, there were additional delays related to the legal aspects of requesting state educational data. CSDE was revamping its process for sharing data with external entities, which included revising its formal data-sharing agreement (DSA). WestEd received a DSA in March 2022, a full 16 months after starting initial discussions. The WestEd legal, contractual, and data security review and CSDE/CT Department of Labor countersigning the DSA took an additional 2 months. Each program then uploaded its manufacturing program student-assigned state identifiers for defined years directly to the CSDE contact, thus adding an additional layer of data security but requiring an additional step for data verification questions between CSDE and the program contacts. Specifically, several programs required additional correspondence to clarify the data needs. In addition, several program contacts left their positions during the project, which made it difficult to gain access to the programs' data.

WestEd's DSA included the provision of data intended to answer research questions 13–15 (see Appendix F). The CT Department of Labor was able to successfully identify and match 8,460 of the 17,237 students enrolled in the 12 schools to track and share their wage data from 2017–2022. This gives us a match rate of 49 percent. This figure can be explained by the fact that the target group of the study is represented by adolescents and young adults between ages 14 and 24 at the time of data collection. This means that most of these individuals are either still in the educational system (secondary or postsecondary) or have only recently entered the labor market. Out of the total student population in our data set, 1,299 students (7.5 percent) of those were manufacturing students. The wage records of 372 students (28.6 percent) from the manufacturing cohort were successfully matched with the student data. Those 372 students represent 4 percent of the total wage data set.

[22] Though CT has an SLDS, many states, including RI, do not have such systems. The specific RI program in this study also did not collect systematic student-level data needed for the study.

In addition to the disproportionate share of manufacturing students in the wage data, another limitation was the missing key indicators of occupation and industry of the individuals to address the research questions related to student employment and the characteristics of their employers. We lacked the data to describe the experiences of manufacturing students in the manufacturing or related industries.

Although the data request process took nearly 20 months from start to finish, such data are necessary to examine manufacturing students' employment outcomes. A robust, longitudinal data system—whether at the state level or local program or district level—is needed for future research to truly examine program impacts on students' employment outcomes.

Supporting Structured Partnerships and Networks

Many study participants expressed a desire to connect with colleagues in similar roles across the state. Investing in networking opportunities and supporting an intermediary to convene and facilitate networks specific to manufacturing pathway programs would be an efficient way to economize and leverage resources, potentially achieving many of the above policy recommendations. Collaboration across sectors to facilitate coordination, communication, and implementation is the most effective strategy to better align training programs with industry needs and integrate career pathways education with work-based learning opportunities.

The state could consider encouraging the consolidated/pooled use of Perkins and local grant funding to support networks and communities of practice around the state and region. The MFG Skills–CT website has the potential to serve as an online community of practice to support and facilitate learning. A more structured partnership could support the design, development, and implementation of academic- and career-planning curriculum aligned with CT's SSP.

> *"We need partnerships across the state to unite everyone in a network to move forward."*
>
> *– Assistant Superintendent of Pathways and Partnerships*

Conclusion

Overall, the review of 13 manufacturing programs revealed several key elements across the identified programs. This includes, but is not limited to, needing a program champion, having leadership support, and nurturing strong partnerships with both the community and local businesses. These elements, along with others, have played a key role in the success of the programs reviewed during this study.

Considerations for future work, such as long-term academic and career planning and creating and sustaining strong partnerships, are aligned with the Governor's Workforce Council strategic plan developed in 2020. To address the projected worker deficit—specifically in the field of manufacturing—and upskill and close the talent gap, the state needs a multifaceted training approach to recruit its future workforce.[23] This begins with improving awareness and attractiveness of manufacturing careers among middle and high school students.

[23] Governor's Workforce Council. (2020). *Workforce Strategic Plan*, Section 2.2.

Appendix A: Inventory of CT K–12 Advanced Manufacturing Programs, by District

Ansonia School District

Ansonia High School, Ansonia, CT

Berlin School District

Berlin High School, Berlin, CT

Bolton School District

Bolton High School, Bolton, CT

Bridgeport School District

Bassick High School, Bridgeport, CT

Bridgeport Regional Vocational Aquaculture School, Bridgeport, CT

Central High School, Bridgeport, CT

Fairchild Wheeler Interdistrict Multi-Magnet High School, Bridgeport, CT

Kolbe Cathedral High School, Bridgeport, CT

Warren Harding High School, Bridgeport, CT

Bristol School District

Bristol Central High School, Bristol, CT

Bristol Eastern High School, Bristol, CT

Brookfield School District

Brookfield High School, Brookfield, CT

Capitol Region Education Council

Academy of Aerospace and Engineering, Windsor, CT

Cheshire School District

Cheshire High School, Cheshire, CT

Clinton School District

The Morgan School, Clinton, CT

Colchester School District

Bacon Academy, Colchester, CT

Connecticut Technical Education and Career System

A. I. Prince Technical High School, Hartford, CT

Bristol Technical Education Center, Bristol, CT

Bullard-Havens Technical High School, Bridgeport, CT

E. C. Goodwin Technical High School, New Britain, CT

Eli Whitney Technical High School, Hamden, CT

Ella T. Grasso/Southeastern Technical High, Groton, CT

Emmett O'Brien Technical High School, Ansonia, CT

H. C. Wilcox Technical High School, Meriden, CT

Harvard H. Ellis Technical High School, Danielson, CT

Henry Abbott Technical High School, Danbury, CT

Howell Cheney Technical High School, Manchester, CT

J. M. Wright Technical High School, Stamford, CT

Norwich Technical High School, Norwich, CT

Oliver Wolcott Technical High School, Torrington, CT

Platt Technical High School, Milford, CT

Vinal Technical High School, Middletown, CT

W. F. Kaynor Technical High School, Waterbury, CT

Windham Technical High School, Windham, CT

Coventry School District

Coventry High School, Coventry, CT

Cromwell School District

Cromwell High School, Cromwell, CT

Danbury School District

Danbury High School, Danbury, CT

Darien School District

Darien High School, Darien, CT

Derby School District

Derby High School, Derby, CT

East Granby School District

East Granby High School, East Granby, CT

East Haddam School District

Nathan Hale-Ray High School, Moodus, CT

East Hartford School District

East Hartford High School, East Hartford, CT

Synergy Alternative High School, East Hartford, CT

Woodland School, East Hartford, CT

East Haven School District

East Haven High School, East Haven, CT

East Lyme School District

East Lyme High School, East Lyme, CT

Eastern Connecticut Regional Educational Service Center

Quinebaug Middle College, Danielson, CT

Ellington School District

Ellington High School, Ellington, CT

Enfield School District

Enfield High School, Enfield, CT

Fairfield School District

Fairfield Ludlowe High School, Fairfield, CT

Fairfield Warde High School, Fairfield, CT

Farmington School District

Farmington High School, Farmington, CT

Glastonbury School District

Glastonbury High School, Glastonbury, CT

Granby School District

Granby Memorial High School, Granby, CT

Greenwich School District

Greenwich High School, Greenwich, CT

Griswold School District

Griswold High School, Griswold, CT

Groton School District

Robert E. Fitch High School, Groton, CT

Guilford School District

Guilford High School, Guilford, CT

Hamden School District

Hamden High School, Hamden, CT

Hartford School District

Hartford Public High School, Academy of Engineering and Green Technology, Hartford, CT

Pathways Academy of Technology & Design, East Hartford, CT

Killingly School District

Killingly High School, Killingly, CT

LEARN Regional Educational Service Center

Connecticut River Academy, East Hartford, CT

Lebanon School District

Lyman Memorial High School, Lebanon, CT

Ledyard School District

Ledyard High School, Ledyard, CT

Madison School District

Daniel Hand High School, Madison, CT

Manchester School District

Manchester High School, Manchester, CT

Meriden School District

Francis T. Maloney High School, Meriden, CT

Orville H. Platt High School, Meriden, CT

Middletown School District

Middletown High School, Middletown, CT

Milford School District

Joseph A. Foran High School, Milford, CT

Jonathan Law High School, Milford, CT

The Academy, Milford, CT

Monroe School District

Masuk High School, Monroe, CT

Montville School District

Montville High School, Oakdale, CT

New Britain School District

New Britain High School, New Britain, CT

New Canaan School District

New Canaan High School, New Canaan, CT

New Haven School District

Engineering and Science University Magnet School, West Haven, CT

Metropolitan Business Academy, New Haven, CT

Riverside Education Academy, New Haven, CT

Wilbur Cross High School, New Haven, CT

New London School District

New London High School, New London, CT

Newtown School District

Newtown High School, Sandy Hook, CT

North Stonington School District

Wheeler High School, North Stonington, CT

Norwich Free Academy

Norwich Free Academy, Norwich, CT

Old Saybrook School District

Old Saybrook High School, Old Saybrook, CT

Plainfield School District

Plainfield High School, Plainfield, CT

Plainville School District

Plainville High School, Plainville, CT

Plymouth School District

Terryville High School, Terryville, CT

Portland School District

Portland High School, Portland, CT

Regional School District 1

Housatonic Valley Regional High School, Falls Village, CT

Regional School District 4

Valley Regional High School, Deep River, CT

Regional School District 5
Amity Regional High School, Woodbridge, CT

Regional School District 7
Northwestern Regional High School, Winsted, CT

Regional School District 8
RHAM High School, Hebron, CT

Regional School District 10
Lewis S. Mills High School, Burlington, CT

Regional School District 12
Shepaug Valley School, Washington, CT

Regional School District 15
Pomperaug High School, Southbury, CT

Regional School District 16
Woodland Regional High School, Beacon Falls, CT

Regional School District 17
Haddam-Killingworth High School, Higganum, CT

Regional School District 18
Lyme-Old Lyme High School, Old Lyme, CT

Regional School District 19
E. O. Smith High School, Storrs, CT

Rocky Hill School District
Rocky Hill High School, Rocky Hill, CT

Seymour School District
Seymour High School, Seymour, CT

Shelton School District
Shelton High School, Shelton, CT

Simsbury School District
Simsbury High School, Simsbury, CT

Somers School District
Somers High School, Somers, CT

South Windsor School District
South Windsor High School, South Windsor, CT

Southington School District
Southington High School, Southington, CT

Stafford School District
Stafford High School, Stafford Springs, CT

Stamford School District
The Academy of Information Technology, Stamford, CT

Stonington School District
Stonington High School, Stonington, CT

Stratford School District

Frank Scott Bunnel High School, Stratford, CT

Stratford High School, Stratford, CT

Suffield School District

Suffield High School, Suffield, CT

Thomaston School District

Thomaston High School, Thomaston, CT

Thompson School District

Tourtellotte Memorial High School, North Grosvenordale, CT

Torrington School District

Torrington High School, Torrington, CT

Trumbull School District

Trumbull High School, Trumbull, CT

Unified School District 1

State of Connecticut Department of Correction, Wethersfield, CT

Vernon School District

Rockville High School, Vernon, CT

Wallingford School District

Lyman Hall High School, Wallingford, CT

Mark T. Sheehan High School, Wallingford, CT

Waterbury School District

Crosby High School, Waterbury, CT

John F. Kennedy High School, Waterbury, CT

Waterbury Career Academy, Waterbury, CT

Wilby High School, Waterbury, CT

Waterford School District

Waterford High School, Waterford, CT

Watertown School District

Watertown High School, Watertown, CT

West Hartford Public Schools

Conard High School, West Hartford, CT

William H. Hall High School, West Hartford, CT

West Haven School District

West Haven High School, West Haven, CT

Westbrook School District

Westbrook High School, Westbrook, CT

Wethersfield School District

Wethersfield High School, Wethersfield, CT

Windham School District

Windham High School, Windham, CT

Windsor School District

Windsor High School, Windsor, CT

Windsor Locks School District

Windsor Locks High School, Windsor Locks, CT

Wolcott School District

Wolcott High School, Wolcott, CT

Woodstock Academy

The Woodstock Academy, Woodstock, CT

Appendix B: CT Advanced Manufacturing Program Survey Respondents, by District

Ansonia School District

Ansonia High School, Ansonia, CT

Bridgeport School District

Bassick High School, Bridgeport, CT

Bristol School District

Bristol Central High School, Bristol, CT

Bristol Eastern High School, Bristol, CT

Cheshire School District

Cheshire High School, Cheshire, CT

Colchester School District

Bacon Academy, Colchester, CT

Connecticut Technical Education and Career System

Bristol Technical Education Center, Bristol, CT

Bullard-Havens Technical High School, Bridgeport, CT

Eli Whitney Technical High School, Hamden, CT

H. C. Wilcox Technical High School, Meriden, CT

Harvard H. Ellis Technical High School, Danielson, CT

Platt Technical High School, Milford, CT

Vinal Technical High School, Middletown, CT

W. F. Kaynor Technical High School, Waterbury, CT

Coventry School District

Coventry High School, Coventry, CT

East Granby School District

East Granby High School, East Granby, CT

East Haddam School District

Nathan Hale-Ray High School, Moodus, CT

East Hartford School District

East Hartford High School, East Hartford, CT

East Haven School District

East Haven High School, East Haven, CT

Eastern Connecticut Regional Educational Service Center
Quinebaug Middle College, Danielson, CT

Glastonbury School District
Glastonbury High School, Glastonbury, CT

Griswold School District
Griswold High School, Griswold, CT

Hamden School District
Hamden High School, Hamden, CT

Hartford School District
Hartford Public High School, Academy of Engineering and Green Technology, Hartford, CT

LEARN Regional Educational Service Center
Connecticut River Academy, East Hartford, CT

Lebanon School District
Lyman Memorial High School, Lebanon, CT

Madison School District
Daniel Hand High School, Madison, CT

Manchester School District
Manchester High School, Manchester, CT

New Britain School District
New Britain High School, New Britain, CT

Plainfield School District
Plainfield High School, Plainfield, CT

Plainville School District
Plainville High School, Plainville, CT

Regional School District 16
Woodland Regional High School, Beacon Falls, CT

Regional School District 8
RHAM High School, Hebron, CT

Rocky Hill School District
Rocky Hill High School, Rocky Hill, CT

South Windsor School District
South Windsor High School, South Windsor, CT

Stonington School District
Stonington High School, Stonington, CT

Suffield School District
Suffield High School, Suffield, CT

Thomaston School District
Thomaston High School, Thomaston, CT

Thompson School District
Tourtellotte Memorial High School, North Grosvenordale, CT

Torrington School District

Torrington High School, Torrington, CT

Unified School District 1

State of Connecticut Department of Correction, Wethersfield, CT

Wallingford School District

Lyman Hall High School, Wallingford, CT

Waterbury School District

Waterbury Career Academy, Waterbury, CT

West Hartford Public Schools

Conard High School, West Hartford, CT

William H. Hall High School, West Hartford, CT

Windham School District

Windham High School, Windham, CT

Windsor School District

Windsor High School, Windsor, CT

Appendix C: Scoring Rubric

Category name	Full question	Response required to receive point	Related high-quality CTE program element	Element-weighted score
Identified Student Populations	Has your program identified student populations in your vicinity that are typically underserved educationally or underemployed due to educational, economic, or other barriers?	Yes	Access and Equity	0.3333333333
Identified Root Causes	Has your program identified the root causes of identified gaps in participation and performance of these student groups?	Yes	Access and Equity	0.3333333333
Organizations to Support Access and Equity	Has your program utilized any organizations and/or resources to support your efforts related to access and equity?	Yes	Access and Equity	0.3333333333
Business Partnerships	Is your program involved in any business partnerships?	Yes	Business and Community Partnerships	0.5
Community Partnerships	Is your program involved in any community partnerships (e.g., partnerships with nonprofit organizations, public agencies, and/or government offices)?	Yes	Business and Community Partnerships	0.5
Career and Technical Student Organizations	Has your school established one or more career and technical student organizations?	Yes	Career and Technical Student Organizations	1
Age > 5 Years	What year did the program start? (Researchers calculated the program's age using the starting year provided.)	> 5 Years	Data and Program Improvement	0.5

Category name	Full question	Response required to receive point	Related high-quality CTE program element	Element-weighted score
Program Data	Please describe the types of data the program collects and how data are used.	Response Provided	Data and Program Improvement	0.5
Specialized Facilities	Please describe any specialized facilities, equipment, technology, and/or materials available to program participants. Please provide any relevant website links or documentation.	Response Provided	Facilities, Equipment, Technology, and Materials	1
Staff Professional Development	Do program staff have opportunities to participate in professional learning activities specific to advanced manufacturing?	Yes	Prepared and Effective Program Staff	1
Sequenced Courses	Does the program structure require students to take courses in a sequence (e.g., Advanced Manufacturing Technology I, Advanced Manufacturing Technology II, Advanced Manufacturing Technology III, etc.)?	Yes	Sequencing and Articulation	0.3333333333
Credentials	Which of the following industry-recognized credentials does your program offer?	At least 1 selected	Sequencing and Articulation	0.3333333333
Credit That Articulates to the Next Level	Which of the following opportunities to earn credit that articulates to the next level of education does your program offer?	At least 1 selected	Sequencing and Articulation	0.3333333333
Industry-Recognized Standards and Competencies	Does your program's curriculum incorporate industry-recognized technical standards and competencies (e.g., NIMS)?	Yes	Standards-Aligned and -Integrated Curriculum	0.25

Category name	Full question	Response required to receive point	Related high-quality CTE program element	Element-weighted score
Employability Skill Standards	Does your program's curriculum incorporate employability skill standards, such as problem-solving, critical thinking, teamwork, communications, interview skills, and workplace etiquette, that help students succeed in the workplace?	Yes	Standards-Aligned and -Integrated Curriculum	0.25
Publicly Available Standards	Are program standards publicly available and accessible?	Yes	Standards-Aligned and -Integrated Curriculum	0.25
Curriculum Reviewed Regularly	Is the program's curriculum reviewed regularly?	Yes	Standards-Aligned and -Integrated Curriculum	0.25
Career Development	Which of the following career development opportunities does your program offer?	At least 1 selected	Student Career Development	1
Work-Based Learning	Which of the following work-based learning opportunities does your program offer?	At least 1 selected	Work-Based Learning	1
Total possible score				**10**

Appendix D: Final List of CT Programs Selected for Review

Bacon Academy Manufacturing at Bacon Academy
Colchester School District, Colchester, CT

Bristol Manufacturing Production Pathway at Bristol Central and Bristol Eastern High Schools
Bristol School District, Bristol, CT

Early College Advanced Manufacturing Program at Connecticut River Academy
LEARN Regional Educational Service Center, East Hartford, CT

Precision Machining Technology at Eli Whitney Technical High School
Connecticut Technical Education and Career System, Hamden, CT

Hamden Engineering Careers Academy at Hamden High School
Hamden School District, Hamden, CT

Intro. to Manufacturing at Lyman Hall High School
Wallingford School District, Wallingford, CT

Manchester Public Schools Manufacturing Program at Manchester High School
Manchester School District, Manchester, CT

Academy of Manufacturing, Engineering & Technology at New Britain High School
New Britain School District, New Britain, CT

Manufacturing for Industry at RHAM High School
Regional School District 8, Hebron, CT

Manufacturing Pathway at Tourtellotte Memorial High School
Thompson School District, North Grosvenordale, CT

Precision Machining Technology at Vinal Technical High School
Connecticut Technical Education and Career System, Middletown, CT

Manufacturing Academy at Waterbury Career Academy
Waterbury School District, Waterbury, CT

Career and Technical Education at Windsor High School[24]
Windsor School District, Windsor, CT

[24] Windsor High School declined to participate in the program review.

Appendix E: RI Program Inventory, Survey Respondents, and Selected Program

Inventory of RI K–12 Advanced Manufacturing Programs, by District

North Kingstown School District

North Kingstown High School, North Kingstown, RI

Warwick Public Schools

Warwick Area Career and Technical Center, Warwick, RI

William M. Davies, Jr. Career and Technical High School

William M. Davies, Jr. Career and Technical High School, Lincoln, RI

RI Advanced Manufacturing Program Survey Respondents, by District

North Kingstown School District

North Kingstown High School, North Kingstown, RI

William M. Davies, Jr. Career and Technical High School

William M. Davies, Jr. Career and Technical High School, Lincoln, RI

Final List of RI Programs Selected for Review

William M. Davies, Jr. Career and Technical High School's Machine Technology Program

Lincoln, RI

Appendix F: Study Research Questions

- What are the characteristics of students participating in a sample of manufacturing programs during the 2020/21 academic year?
- To what extent do the characteristics of the manufacturing students mirror the characteristics of the school's overall population?
- What are the demographic characteristics of students participating in a sample of manufacturing programs?
- To what extent do the demographic characteristics of the manufacturing students mirror the characteristics of the school's overall population?
- What are the academic characteristics of students participating in a sample of manufacturing programs?
- To what extent do the academic characteristics of the manufacturing students mirror the academic characteristics of the school's overall population?
- To what extent do students participating in a sample of manufacturing programs complete secondary degrees or certificates?
- To what extent do the completion rates of the manufacturing students mirror the completion rates of the school's overall population?
- To what extent do students participating in a sample of manufacturing programs enroll and persist in postsecondary programs?
- To what extent does the postsecondary enrollment and persistence of the manufacturing students mirror the school's overall population?
- To what extent do students participating in a sample of manufacturing programs complete postsecondary degrees or certificates?
- To what extent do the completion rates of the manufacturing students mirror the completion rates of the school's overall population?
- To what extent do students participating in a sample of manufacturing programs obtain employment in manufacturing or related industries?
- To what extent do the rates of employment in manufacturing or related industries for the manufacturing students mirror the rates of employment in manufacturing or related industries for the school's overall population?
- What are the characteristics of the employers that employ students participating in a sample of manufacturing programs?