ADVANCED TECHNOLOGY EDUCATION CENTER (ATEC)

AT TUNXIS

- A New Workforce Recruitment and Training System for the 4th Industrial Revolution

The Report of the Advanced Manufacturing Education Center Working Group

Established Under Connecticut Special Act 23-4

February 15,, 2024

"If you want something you've never had, you must be willing to do something you've never done." *- Thomas Jefferson*

After a decade of workforce initiatives and hundreds of millions of dollars in public investment, lack of skilled workers remains by far the most significant barrier to manufacturing growth in Connecticut.[1]

Now is the time to do something we've never done . . .

Advanced Technology Education Center
at
CT State Community College - Tunxis Campus[2]

. . . the first comprehensive K thru College pathway in Connecticut for recruiting, educating and employing the digital industrial workforce of today and tomorrow.

[1] CBIA 2023 Manufacturing Report
[2] The working group acknowledges that full implementation of this proposal is contingent upon the CT State College and University system receiving adequate, dedicated funding to complete and operate the facility.

Forward

The global manufacturing marketplace is in a time of major transition.The first three industrial revolutions - initiated first with the advent of the steam engine, later the assembly line, and later still computerized automation, introduced foundational changes to both how manufacturing was conducted as well as the workforce skills required to support it.

Today, as machine learning through digital communication has ushered in a fourth Industrial revolution, the marketplace is once again distinguishing between those companies willing and able to evolve from those who are not.. Similarly, geographic localities with educational pipelines providing the skilled workforce to support such companies are growing economically while other areas are beginning to stall. McKinsey is forecasting that “manufacturers’ demand for traditional skills . . . will decline by 30% over the next decade while their demand for technical skills will increase by 50%.”[3]

Now Connecticut must decide if it will boldly innovate its manufacturing workforce training model in order to retain its manufacturing and educational leadership status. We should not allow budgetary challenges, outdated public perceptions of manufacturing, and complacency associated with our past leadership status distract us from the urgency of the moment. Will Connecticut seize the opportunity presented or fall behind in the global manufacturing marketplace?

Our companies are committed to being leaders in innovation fueled by the Fourth Industrial Revolution (I4.0). We are committed to doing so right here in Connecticut, where the workforce talent we have needed to compete in the Third Industrial Revolution economy is second to none.

We also recognize our responsibility to actively participate in partnership with the state in this effort. That is why we have enthusiastically embraced the opportunity to serve on this working

[3] Top 5 Industrial Manufacturing Trends in 2024

group and are proud to join with our colleagues in presenting this report proposing the ATEC system which we believe constitutes the technology education ecosystem of the future.

Connecticut now has a once-in-a-generation opportunity. The combination of the National Science Foundation's designating Connecticut as the location for the first-in-the-nation National Center for Next Generation Manufacturing, state ownership of a partially refurbished 44,500 square foot building immediately adjacent to the CT State-Tunxis campus where the National Center will be located, an established consortium of industry partners ready to work with CT State Community College, together with a cache of motivated and talented students, all but demands that the comprehensive, holistic system proposed in this report be brought to fruition at Tunxis as expeditiously as possible.. Doing so will launch our community college system and our state into prominence with respect to building the I4.0 workforce of the future. Failing to do so would risk nothing short of Connecticut's future economic potential as well as the potential career aspirations of thousands of students from a broad spectrum of socio-economic backgrounds.

As you review this report, we hope you will gain new insight and enthusiasm for supporting the incredible opportunity before us.

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Executive Summary

Connecticut's economic prosperity in the 20th century is directly related to the size and quality of its manufacturing workforce. Its economic prospects for the 21st century will be similarly determined. But the workforce needs of the 21st century are evolving quickly and thus far, Connecticut is not meeting those needs with nearly half of all Connecticut manufacturers in a recent survey citing lack of skilled workers as their largest impediment to growth.

Recognizing the urgency of this reality, the Connecticut General Assembly established a working group to design a new training model for 21st century manufacturing careers and to develop a plan to implement the model at one of the state's community college campuses.

The working group first identified several challenges that distinguish earlier manufacturing workforce needs from those of the Fourth Industrial Revolution "I4.0". The working group determined that the new training model must be comprehensive to include partnerships with organizations able to ensure both the curriculum and the training devices utilized by the community college stay current with the latest technology needs of employers in the area. And that these employers, located within a reasonably accessible distance from the community college, operate as a formal consortium guaranteeing apprenticeship and career opportunities for students in exchange for the college ensuring the training needs of the consortium companies is enacted within the curriculum.

The working group also addressed the need to identify populations of prospective students and fashion new approaches for stimulating their interest in enrolling,

including high school dual credit programs as well as providing “hands-on” opportunities to experience potential I4.0 careers. The working group further recognized the need to significantly increase accessibility to traditionally underserved communities in part, by locating the training facility near currently identified distressed municipalities and within a reasonably short commuting distance from where mass transit infrastructure is already in place.

Finally, the working group selected the preferred community college campus to locate the first such training center as the Tunxis Campus of the Connecticut State Community College and identified several implementation elements, along with a budget, timeline and key performance indicators associated with doing so.

<u>It is important to emphasize the currently, the CSCU does not have funds necessary to fully implement the plan proposed in this report.</u>

The working group has facilitated initial discussions among CSCU, the Governor’s Office and the General Assembly with the goal of funding and implementing the new training program within an “Advanced Technology Education Center” (ATEC) at Tunxis as expeditiously as possible.

I. Legislative Directive to the Working Group

The working group was assembled in accordance with Connecticut Special Act 23-4. Its purpose is to establish an Industry 4.0 career training model that may be duplicated throughout the state and to facilitate its implementation at an existing advanced manufacturing technology center at a regional community-technical college.[4]

Key elements to be addressed in the working group's report under the legislation include:

- Selecting the college where the center is to be located and establishing a budget and timeline for completing the necessary infrastructure.
- Establishing sustainable public-private partnerships to provide the latest equipment, training and apprenticeship opportunities for students and instructors
- Establishing a community robotics center at the advanced manufacturing technology center to support program awareness, enrollment and community involvement
- Establishing, in underserved communities, robotics programs, events and competitions to engage students in grades kindergarten to twelve
- Incorporating mechanisms to maximize opportunities for traditionally underserved communities.

[4] Working Group members are listed in Appendix 1

II. Establishing an Industry 4.0 career training model

In order to establish an effective career training model to support an I4.0 economy, several 21st century technology, academic, social, business, and workforce challenges must be taken into consideration,
They include:

- The Pace of Change
- Student Supply
- Employer demand and involvement in career development
- Alignment of academic pathways
- Access to traditionally underserved communities
- Exposure & Marketing

The remainder of this section discusses how each of these challenges is addressed in our proposed model. A model the working group has designated as the Advanced Technology Education Center (ATEC) - a comprehensive, innovative and holistic system for addressing the workforce needs of the I4.0 economy.

a. **The Pace of Change**

The first two industrial revolutions, generally associated with the advent of the steam engine and the assembly line respectively, and to a lesser extent the third with computer integration, enjoyed long periods of technology stability such that training materials and curricula could remain effective for years or even decades.

The pace of technology change in the I4.0 economy is exponentially faster. The speed, breadth and depth of this revolution is driving states to rethink how educational institutions create value for students, industry, parents and themselves. In an I4.0 economy, workforce training strategies are challenged with respect to the speed at which equipment and instructional materials become obsolete. For example, the vast majority of instruction in the state's current "advanced" manufacturing centers aligns with the workforce needs of the Third Industrial Revolution (I3.0) technologies. What was "advanced" when these centers were established is now, while still important and widely used within manufacturing, insufficient to train an I4.0 workforce.[5] Governments and large public educational institutions are not designed for rapid changes or quick course corrections. Additionally, a recent report from MIT posits a growing gap between technology investment and workforce investment expressing that, "[A]advanced manufacturing requires workers with a technician's practical know-how *and* an engineer's comprehension of processes and systems."[6]

The ATEC Model Solution:

Staying current with technology developments and employer workforce needs is essential to ensuring that career training programs are relevant and marketable. Fortunately, other states have found success in these areas by partnering with organizations whose mission is to assist them in becoming more nimble and responsive to their customers' needs, specifically with respect to technical education. Two such organizations are The Federation for Advanced

[5] This, along with nomenclature associated with the NSF national initiative regarding "Advance Technology Education (ATE) is why the working group proposes to designate this system as an "Advanced Technology Education Center" rather than an "Advanced Manufacturing Center".
[6] The Technologist

Manufacturing Education ("FAME"), and a German company known as Festo Didactics .

FAME - Led by manufacturers, and supported by education partners, FAME creates a best-in-class curriculum encompassing hands-on and virtual programming that provide real, tangible solutions to the latest challenges in skills training and workforce development across a variety of industries within manufacturing. The core of FAME's methodology is forming strong collaborative coalitions among industry, education and government. With respect to industry, FAME builds strong consortiums of businesses with similar workforce needs and works with them to develop workforce outcome commitments (such as apprenticeships and job opportunities upon graduation) that their education and government partners can rely on. In turn, those partners entrust FAME to deliver the course of study and curricula, which educators commit to delivering in the classroom. FAME's role in producing guaranteed apprenticeship and career outcomes is discussed further below. For our purposes ~~here~~, they fill an essential piece of the ATEC model by facilitating and maximizing the ability of educational institutions to stay current, relevant and valuable to industry with respect to their evolving workforce talent needs.[7]

[7] A sample FAME "success story" can be seen at Guilford Technical Community College in North Carolina. There, students receive a paid position three days a week with a sponsor employer and attend classes at GTCC the other two days. After receiving 1,800 hours of on-the-ground experience, most graduates proceed to direct employment with a sponsoring company and earn wages that are, on average, 25 percent more than non-FAME graduates. FAME graduates are also able to transfer their credits to a four-year university to pursue a variety of STEM programs.

Festo Didactic

Festo Didactic is a world leader in technical training and development. Acting as a partner to educational institutions, governments and businesses, Festo designs and implements training systems and hand-on labs that keep instruction at the cutting edge of technology changes. Their offerings include equipment and curriculum and can range from simple simulation software, customer training packages and the modular training factory to fully equipped, state-of-the-art training centers.

Importantly, Festo's ongoing partnership ensures that as technology evolves, the training tools and equipment available to their educational partners will evolve as well. Thus, students and educators can be confident they are providing the highest educational value to their students.

b. **Student Supply**

In earlier industrial revolution economies, a career in manufacturing was often considered the most accessible pathway to achieve the American dream of a middle-class lifestyle. High school programs in hands-on, "shop" related classes were commonplace opportunities even in high schools located within wealthier communities. In recent decades, for a wide range of reasons, CTE program offerings in comprehensive high schools has declined sharply. Federal, state and school district initiatives, starting with No Child Left Behind (NCLB) led to funding priorities shifting education dollars away from the trades (and arts) toward meeting high stakes testing goals. This coupled with a cultural shift in what can

now be described as an over valuation of a four year college degree drove students away from CTE shop classes into more traditional core academic courses. Additionally, educator salaries across much of Connecticut were 'frozen' following the 2008 recession, leading industry capable CTE educators to leave the classroom for better opportunities in the private sector, decreasing further the availability of 'shop' class offerings to Connecticut HS students.

To meet the growing demand for a technically skilled manufacturing workforce, enrollment in I4.0 technical education programs must be significantly increased.

The ATEC Solution:

Connecticut, like many states, is facing major shortages in manufacturing workers. Enrollment at CT State's manufacturing programs is declining. Reversing this trend is critical to the sustainability of both CT State and area manufacturers. States that attempt to address this problem by focusing on increasing student enrollment in existing college programs are likely to fail or, at a minimum, see results far short of those states that reimagine those programs as comprehensive, holistic systems that create value for all stakeholders and that prepare their students for the I4.0 economy.

The working group tackled this challenge by first recognizing that there is low hanging fruit with respect to attracting prospective candidates to an ATEC workforce development ecosystem.

Thousands of Connecticut K-12 students enthusiastically participate in competitive youth robotics programs throughout the state. By designing and building robots students learn the principles of mechanical, electrical, and software engineering - a

combined I4.0 field of study known as “mechatronics”. Connecticut also is fortunate to have a robust technical high school system where some of the schools offer certificates in areas related to I4.0 technologies, including mechatronics.

Accordingly, the ATEC model incorporates opportunities for these student populations, whether the focus of their interest is mechatronics or some other I4.0 technology, to come together at a partnering community college where they can not only be motivated by interactions with other students with similar interests, but can be exposed to a tangible, experiential learning environment that will fire many of their imaginations and help them envision a pathway to a I4.0-related career. The ATEC model calls for each partnering community college to incorporate space within its facility for such purposes. The working group designated these areas as, “Inspiration Arenas.”

The community college itself will also greatly benefit from this vibrant and recurring recruitment opportunity where college representatives can meet highly qualified and motivated candidates, opening their eyes to the potential before them. A potential they may not have had the opportunity to see, feel, touch and learn about ~~ever~~ before.

c. <u>Employer demand and involvement in career development</u>

During much of the 20th century, employers had little or no role in the development of academic or hands-on work opportunities for high school students. Employers simply had their workforce needs met by listing job ads in the papers and selecting from a ready supply of interested applicants. In

Connecticut, we were fortunate to have several large employers in the defense industry located in different parts of the state. Everyone had a neighbor, relative or friend that worked for Pratt & Whitney, Electric Boat or Sikorsky. With the Fourth Industrial Revolution, employers, including those just mentioned, are scrambling to find qualified employees and have committed huge resources to in-house training programs to compensate for the lack of skilled workers seeking jobs in their facilities. More recently, employers have sought out opportunities to work with academic institutions at all levels with the goal of growing the amount of talent available to them. Some of these programs have been successful but generally not in the area of training skilled I4.0 professionals.

The ATEC Solution:

Demand for I4.0 technicians is rapidly growing. I4.O technology investment is expected to grow at nearly 20% annually between 2023 and 2032[8] with manufacturing expected to dominate market share.[9] Accordingly, demand for workers with the skills to design, build, and service these technologies can expect similar growth.

Recent data published by ZipRecruiter indicates nearly 200 current job openings in or within 25 miles of Connecticut for mechatronic engineers, with an average annual salary of $80,000 (compared to a national average of $90,000).[10]

Many states, including Connecticut, have developed apprenticeship programs to help accelerate workforce readiness. There is no doubt about the positive results

[8] Global Market Insights
[9] Fortune Business Insites

[10]" Salary: Mechatronic Engineer in Connecticut (Oct, 2023)

of apprenticeship programs for employers and employees. Apprenticeships provide an opportunity for employees to have access to education, on the job training and help them prepare for high paying jobs.

Accordingly, ATEC expands on existing apprenticeship opportunities to provide what it considers an “Apprenticeship 4.0” experience where students gain crucial real-world experience in an I4.0 manufacturing environment.

Apprenticeship 1.0

Connecticut has long enjoyed well-developed apprenticeship programs that offer a direct pathway to employment through a combination of on the job training and related classroom instruction. Apprenticeships currently offered within the state’s Advanced Manufacturing Technology programs, including those at 11 of the 12 CT Community College campuses, are primarily focused on traditional trades in metalworking (precision machining, welding, tool making)

Apprenticeship 4.0.

Apprenticeship must evolve to meet the changing needs of manufacturing for the future. As the I4.0 economy advances, hands-on training is needed in the areas of technology and troubleshooting around automation, IoT, robotics, and mechatronics. With the rapid pace of technology advancement many companies requiring these skills do not have the seasoned journeymen needed for apprenticeship success. They need help launching and maintaining a technology-based apprenticeship program. That is why the working group is proposing a new approach to apprenticeship within the ATEC system.

Unlike our existing employer by employer apprenticeship model, designed as a relationship between individual students and employers, we propose formation of an Apprenticeship Consortium made up of companies requiring similar skill sets who are geographically located near the host community college.

According to Tony Davis, National Director of the Manufacturing Institute's FAME program, "proximity of the employer sponsors to the host educational institution is critical to success", primarily due to minimized transportation logistics.

The model will be student cohort based, forming a sense of community between apprentices, which has proven to increase apprenticeship completion rates. Each apprenticeship cohort will be recruited by the sponsoring companies through targeted recruitment events held at the Inspiration Arena.

A key element of the ATEC system, is to identify and organize a consortium of local industries that have a current and future need for workers with I4.0 technology skills and that are willing to commit to providing apprenticeship and career opportunities to students and graduates, in exchange for direct involvement in the development of the curriculum utilized by the community college partner.

Developing these relationships can be greatly facilitated by partnering with nationally recognized apprenticeship coordinators such as

FAME (introduced above) and the Space Coast Consortium Apprenticeship Program (SCCAP). SCCAP is hosted by, and operates under the auspices of, SpaceTEC Partners, Inc. as an autonomous subcommittee. SpaceTEC is an internationally-accredited certifying body providing industry-recognized credentials for technicians serving in the Military and those working in Aerospace, Aviation and Advanced Manufacturing industries.

SCCAP is an industry-driven apprenticeship program led by a consortium of advanced manufacturers in the Space, Aerospace, Aviation, and Defense industries, with a focus on implementing world-class apprenticeship programs in occupations that require higher levels of education to perform in today's competitive advanced manufacturing environment. Automated manufacturing processes including CNC, mechatronics, robotics, additive manufacturing, IT, Cybersecurity, and other cyber physical environments related to globally competitive Industry 4.0 technologies.[11]

Organizations such as FAME, SCCAP and Festo[12] have proven records of impressive success in building systems that work in harmony to recruit, build knowledge and provide the skills necessary to develop I4.0 technicians.

The ATEC system includes apprentice consortiums working with these organizations in order to maximize participation and value for students, employers and the host academic institution

[11] Welcome to SCCAP! (spacecoastconsortium.org)

[12] More specific to the study of mechatronics, the previously discussed Festo Didactics has also developed its own Mechatronics Apprenticeship Program. An example of where this program has been implemented can be found at Sinclair Community College in Dayton, Ohio.

d. <u>Alignment of academic pathways</u>

Until recently, little consideration was given to creating multi-level, coordinated career pathways where the various levels of education, K thru college, were structured to be complimentary with respect to specific careers. A degree at whatever level was an indication that the student had completed a well-rounded curriculum appropriate for their age which gave them the opportunity to gain further education and a more prestigious degree from the next academic level. Today's I4.0 economy demands that students' educational experiences in K-college are coordinated and aligned in such a way that their education is career-additive and strategically structured to make them marketable regardless of what level their formal education may end. In other words, certificates and degrees must build upon each other in a highly coordinated way.

<u>The ATEC System Solution</u>:
Creating a K-college comprehensive I4.0 workforce training system must include a seamless pathway for continuous learning through primary, secondary and post-secondary education levels, including study at a 4 year college or university - preferably in relative proximity to each other. The ATEC system incorporates this pathway.

States across the country are recognizing the value of creating dual-credit programs whereby students can earn college credit while still in high school. More details, success stories, and recommendations are presented below in Appendix 4. For our purposes, it is important to know that the ATEC system emphasizes and facilitates these highly beneficial dual-credit outcomes.

As a system that has direct coordination and responsibilities for K thru college students, ATEC depends upon school administrators, faculty, industry champions, and local school systems committing to providing academic and workforce preparation experiences that are highly coordinated and streamlined for maximum efficiency and student success.

e. **Access to Traditionally Underserved and underrepresented Communities**

Making I4.0 technology training accessible to these communities is both a moral imperative and an enormous opportunity for growing Connecticut's future I4.0 economy. "Women currently account for less than one-third of the total manufacturing workforce, and the proportion of Black, Asian, and Latinx employees is only slightly higher at 36%, according to 2022 data from the US Bureau of Labor Statistics."[13]

Accessibility has several components. Factors such as geographic proximity and location of mass transit resources are primary considerations. These factors are presented in more detail below with respect to the specific community college partner recommended in this report. Additionally, local school systems together with local, regional, and state government agencies must work collaboratively to implement academic and transportation schedules that facilitate student participation in ATEC activities.

[13] Top 5 Industrial Manufacturing Trends in 2024

All members of the working group are committed to working with all relevant constituencies to provide maximum opportunities for underserved communities to take full advantage of the education and career opportunities the ATEC will provide.

Significantly, a non-profit organization, the Central Connecticut Robotics Alliance (CCRA), has been established for the purpose of "creating and administering a Community Robotics Center in Central CT" and to "provide outreach and assistance to expand youth robotics programming in surrounding underserved communities."

Many underserved areas in CT presently lack youth robotics programs, presenting a significant opportunity for expansion within these communities.

f. **Exposure & Marketing**

Perhaps the most difficult hurdle in creating an I4.0 ready workforce is exposing students, parents, counselors and administrators to new paradigm with respect to careers in an I4.0 manufacturing economy. Overcoming long-standing public misperceptions about manufacturing is challenging and requires more than slick posters and appealing words. Students and other stakeholders need to see, touch and feel what it means to participate, grow, and prosper in an I4.0 world - prosper financially, intellectually and socially.

The ATEC System Solution:

The venue at the center of ATEC's exposure and marketing power is the "Inspiration Arena" described above. The Arena is ideally located within the

partnering community college and will host high-profile, STEM/I4.0 related events primarily for primary and secondary school students who have demonstrated a strong interest in some aspect of I4.0 technology. For example, a junior high school elective class or club studying additive technology, a high school robotics team, or a community organization focused on the benefits and perils of artificial intelligence. The Arena need not be used exclusively for youth however. A local business organization focused on learning about cybersecurity, or a group of teachers looking to further their knowledge of I4.0 technologies may attend an I4.0 teacher externship conference hosted by the community college or a different organization but conducted in the Arena.

Whatever the event or whomever the audience, the ATEC approach is that once they are in the Arena, they will experience activities that will open their eyes to the I4.0 future and learn of all the opportunities to pursue their education and careers as part of that future. We envision that the host community college would have a permanent area within the arena for marketing its I4.0 academic programs and offer tours of its I4.0 laboratory, ideally located adjacent to, and visible from, the Arena space.

The working group-recognized that opportunities to attract students are enhanced where the training pathway is efficient and includes curriculum alignment through all levels of education (as discussed above). Such a “seamless pathway” will provide incentives with practical and positive financial and career implications.

In short, the proposed ATEC infrastructure provides the highest value opportunity for face-to-face marketing to thousands of high-value candidates every year. The working group suggested this might be referred to as “experiential marketing”.

Consistency with the legislation as well as the goals of the NSFCNGM

The ATEC model system for I4.0 career development meets the deliverable requirements of the legislation and also aligns well with many of the goals of the National Science Foundation's Next Generation Manufacturing Center (NSFCNGM).
Specifically, the ATEC:

- Provides for instruction in the latest I4.0 technologies thanks to partnership with global technology education provider (Festo Didactic)

- Includes student inspiration and recruitment elements to maximize student interest and enrollment

- Is specifically designed, in part, for the purposes of inspiring traditionally underserved communities, upskilling teachers in I4.0 technologies, and providing a positive education resource for the communities and regions where they are located

- Is easily transferable to other community college campuses which may wish to focus on different I4.0 technology(ies) and career outcomes

III. WHY TUNXIS?

A. Spring Lane Building

CT State - Tunxis, located in Farmington, is one of the 12 campuses of the newly merged CT State Community College. It is also part of a larger community of institutions known as the College of Technology.[14]

To support the rapidly expanding need for skilled workers in the state's manufacturing industry, CT State-Tunxis acquired a 44,500 square foot vacated building adjacent to campus in 2018 with plans to renovate to house offices, classrooms, and instructional labs. The building, located at 21 Spring Lane, is diagonally adjacent to the CT State-Tunxis main campus and includes over 200 parking spaces.

[14] See Appendix 2 for further information on the College of Technology

Since acquiring the building, CT State Tunxis has employed a phased approach towards renovating the property. Recently completed Phase 1 and 2 renovations will house administrative offices and classrooms, along with a sizable instructional lab for training in Precision Machining Technology (on equipment typically found in manufacturing facilities over the past 20 years.) This is the same Industry 3.0 technology found in “Advanced Manufacturing Centers” located throughout the state on other CT State and CTECS campuses. A portion of the building will also house the nations’ first “National Center for Next Generation Manufacturing” as designated by the National Science Foundation in 2021.[15]

Of further significance, a proposed 6,000 square feet of additional space within the Advance Technology Education Center[16] at Tunxis will house a lab for hands-on training in robotics and mechatronics engineering technologies (RMET). These technologies are being rapidly deployed in manufacturing, logistics, medicine, and elsewhere with the advent of Industry 4.0.

B. Private Sector Consortium

Economic impacts of manufacturing, especially small and mid-sized manufacturing, are closely associated with regional economies. Accordingly, the workforce needs of regional employers must have a firm nexus with the curricula

[15] See Appendix 3 for background and further information concerning the NSF designation and grant award.
[16] The National Science Foundations Advanced Technological Education (ATE) program supports the development of innovative approaches for educating highly skilled technicians for the industries that drive the nation's economy. Accordingly, to highlight the connection between the facility and the NSF, as well as to distinguish it from the many “Advanced Manufacturing Centers” currently located in Connecticut that almost exclusively train students up through I3.0 technologies, the Working Group is recommending the facility be referred to as the Advanced Technology Education Center at Tunxis.

offered at local and regional institutions, necessitating strong partnership between the two.

The recent MIT study noted above, concluded the following: “We’ve found that industry partnerships work best with groups of employers. Community colleges partnering with a single company or industry often struggle due to the fact that a company’s level of engagement may rise or fall depending on the business climate and need for workers. But to survive, community college programs need a steady flow of students. Working with groups of employers tends to mitigate the ebb and flow of individual company needs.”[17]

Employers in the greater Bristol/Farmington/New Britain and Waterbury region have come together and are prepared to create a formal consortium to provide cooperative apprenticeship positions and potential full-time opportunities to students upon graduation. The proposed consortium requires a local partnering educational institution for formation by design. Tunxis provides an ideal location to establish such a partnership.

C. Home of the NSF Next Gen. Mfg. Center & Robotics Center

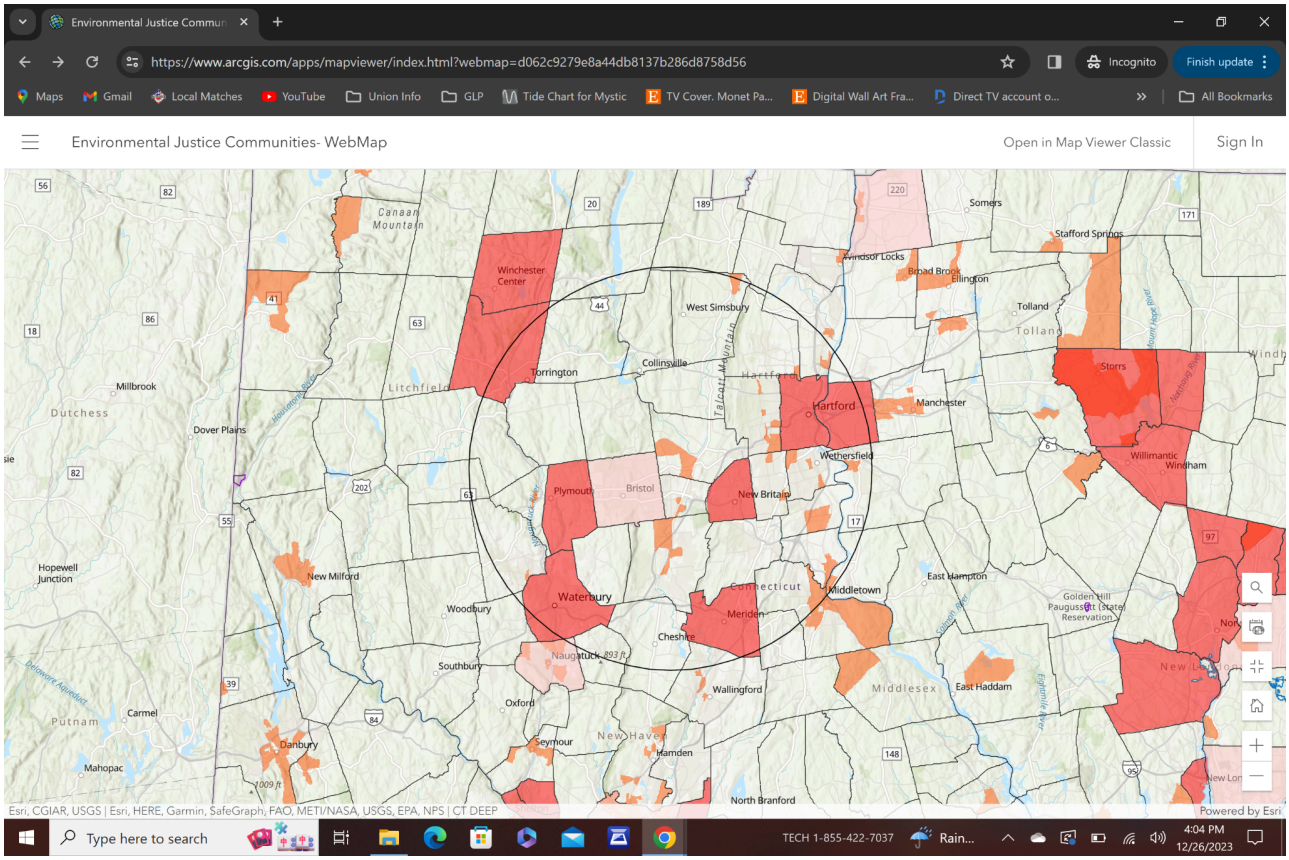
The Tunxis Campus is already nationally distinguished for being the home of the National Science Foundation’s Next Generation Manufacturing Center. As a national focal point, it makes perfect sense to locate a state-of-the-art, Industry 4.0 Advanced Technology Training Center in the very same building. Together, these assets could make the Tunxis Campus a national destination for officials and organizations seeking to learn how to bring cutting edge

[17] The Technologist

technical education to their communities. Additionally, roughly 15,000 sq. ft of footprint of the Spring Lane facility is proposed to be designated as a Community Robotics Center - largely, but not exclusively dedicated to hosting robotics events and competitions involving teams from throughout the northeast. These and other events will result in thousands of secondary students seeing for themselves the new world of manufacturing and manufacturing training and will provide an unprecedented recruitment opportunity for CT State-Tunxis. A partnership with the non-profit Central Connecticut Robotics Alliance (CCRA) will minimize staffing requirements and administration costs of the center.

D. Proximity to traditionally underserved communities

Of critical significance is the location of the Tunxis campus relative to traditionally underserved communities. The following map illustrates that a significant number of distressed municipalities are located within just 15 miles of the Tunxis campus (the radius of the superimposed circle). This represents a significant opportunity for thousands of students who may have never seen a robot or experienced a modern manufacturing training center, to have their imaginations ignited and inspire their future aspirations.

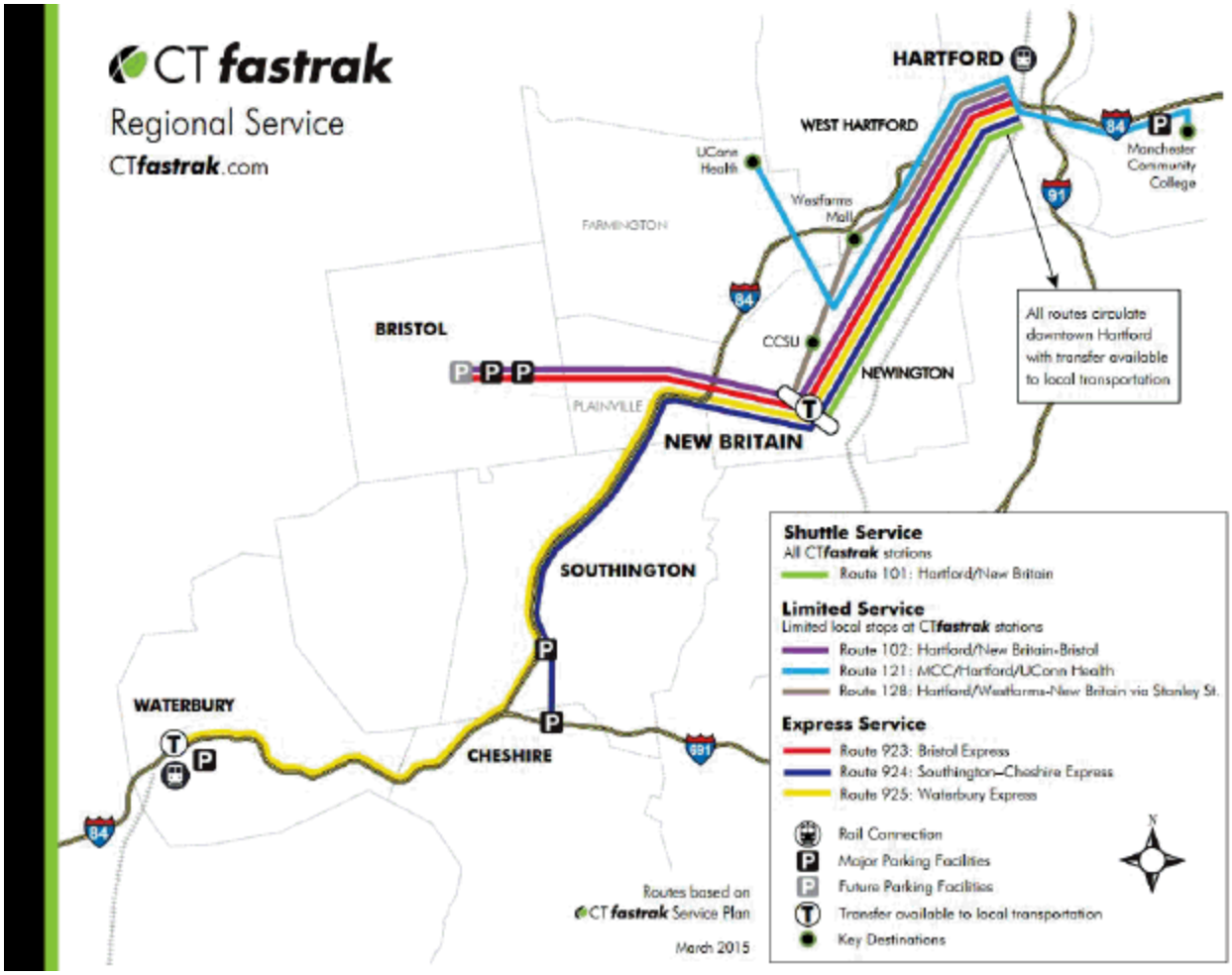


Distressed municipalities (dark red) within 15 miles of the Tunxis campus[18]

E. Accessibility via mass transit

Regarding transportation opportunities, the following diagram illustrates a robust regional rapid bus transit service provided through CTfastrak.

[18] https://www.arcgis.com/apps/webappviewer/index.html?id=d04ec429d0a4477b9526689dc7809ffe



More comprehensive lists and maps of transportation resources in the more immediate area of the college are available at http://waytogoct.org/resource-guide/.

In short, the working group recommends Connecticut's first ATEC be located at 21 Spring Lane, immediately adjacent to the CT State Tunxis Campus. Once completed and operational, the Tunxis ATEC will be a facility unlike any other, designed specifically for the recruitment, training and employment of the next generation of manufacturing technicians.

The working group acknowledges that implementation of this recommendation is contingent upon the CT State College and University System (CSCU) receiving adequate, dedicated funding to complete and operate the facility. While 21 Spring Lane is a highly desirable space for this initiative, should the dedicated funding not be forthcoming, an alternative operational space suitable for the ATEC in central Connecticut will regrettably need to be explored and identified.

IV. The ATEC System as Proposed for Tunxis

The ATEC system utilizes collaborative partnerships among local public school systems, community organizations, non-profits, manufacturing companies, a 2-year community college and a 4 year college or university. Below is a schematic diagram of the ATEC system generally, followed by Table 1 which describes each of the ATEC elements generally as well as how those elements are proposed to be incorporated with the ATEC at Tunxis. Following Table 1 is a more detailed discussion of the ATEC implementation elements for Tunxis.

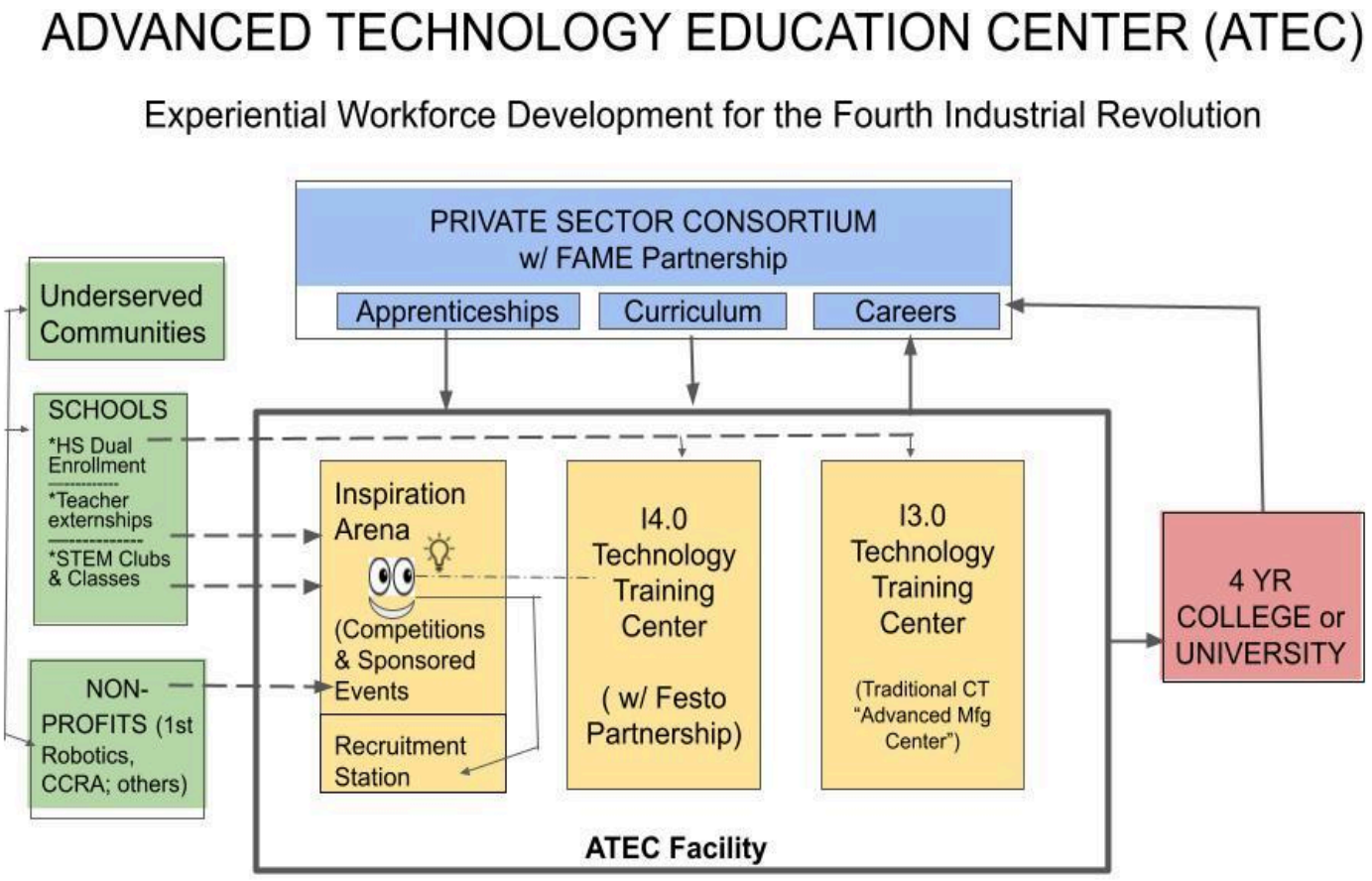


Table 1

ATEC System Element	Generic Element Component	Description	Component as implemented at Tunxis
Spring La. Facility @ Tunxis	I3.0 Technology Training Center	Training lab where beginning students gain understanding of machining and problem solving with traditional manufacturing technologies.	Training lab with a variety of traditional manufacturing technologies up thru and including CNC machining.
Spring La. Facility @ Tunxis	I4.0 Technology Training Center	The I4.0 Training Center provides state of the art training in whichever I4.0 technology(ies) for which the community college is providing training.	State of the Art Robotics & Mechatronics training lab established and maintained in partnership with Festo Didactic (or similar partner)
Spring La. Facility @ Tunxis	Inspiration Arena	The purpose of the Inspiration Arena is to provide communities with hands-on exposure to one or more I4.0 technologies for which the community college supplies training	Community Robotics Center in partnership with CCRA

ATEC System Element	Generic Element Component	Description	Component as implemented at Tunxis
Spring La. Facility @ Tunxis	Recruitment Station	A small office or booth area within the inspiration arena where guests can learn more about the Community Colleges career training offerings in the I4.0 technology(ies) of focus	Robotics & Mechatronics (RMET) focused resource center for recruiting students into CT State-Tunxis.
Private Sector Consortium	A formal collaboration of area employers with a stake in the success of the total system	The consortium provides guidance ~~is~~ for curriculum development, provides apprenticeships to students and careers to students upon graduation	The Tunxis Consortium includes AG Russell Co., Okay Industries, Stanley Black and Decker, Trumpf, Bauer,(add others as they come on board)
4- year College or University	Area college or university having a four year program in the I4.0 technology which is the focus of the community college.	Area college or university where graduates of the community college can continue their course of study towards a baccalaureate degree.In effect, the community college acts as a feeder system to the 4-year program.	Central Connecticut State University is located within 10 miles of the Tunxis campus and has a well-developed B.S. degree program in Robotics & Mechatronics Engineering Technology (RMET)
Community at Large	Underserved Communities	ATECs to be located where they are reasonably accessible to traditionally academically underserved communities	Within a 15 mile radius of Tunxis, there are significantly sized urban centers including Waterbury and New Britain.
Community at Large	K-12 Schools	Dual enrollment students access ATEC training; K-12 students and STEM-related clubs participate in events within the Inspiration Arena; teachers receive training through summer programs and externships within the Private Sector Consortium companies.	Public k-12 school systems within a 15 mile radius of Tunxis instruct over XXX thousand students.
Community at Large	Non-Profits	Area non-profits serving student-age population may rent out, attend or participate in events within the Inspiration Arena	Robotics teams throughout the state, scouting organizations and other groups that encourage students to develop career goals

V. Tunxis ATEC Implementation Elements

A. Completing the necessary infrastructure at the center

See next section on budgeting and timelines for completing the center

B. Increasing Enrollment By Engaging Existing STEM-Motivated Students and Traditionally Underserved Communities.

Targeting youth with demonstrated interest in STEM activities is a recruitment proven strategy. A long-term study by Brandeis University concludes that participants in FIRST Robotics programs are significantly more likely to enter engineering and computer science fields.[19]

Connecticut's Office of Manufacturing recognizes the potential impact of growing the sport of Youth Robotics, "the sport where every kid can go pro".[20] Connecticut's Manufacturing Innovation Fund recently approved $2.2 million to support and expand K-12 robotics sports programs throughout CT. Financial support for program expansion is targeted at "Alliance Districts" which include Bristol, New Britain and Waterbury. Although the MIF funding will be impactful in CT, maximizing its impact will require support of a strong and supportive ecosystem.

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[19] [1]first-longitudinal-study-impact-summary-findings-at-108-months.pdf (firstinspires.org)

[20] Robotics: The Only High School Sport Where Every Kid Can Go Pro | FIRST (firstinspires.org)

Providing a central and accessible Community Robotics Center for area youth robotics teams to engage and grow is a proven ecosystem catalyst. Locating this center on a college campus can be “transformative” for the host institution. A prime example of this is located on the campus of Kettering University (formerly General Motors Institute) in Flint Michigan. Kettering is a cooperative education institution with outstanding engineering programs.

The Kettering University FIRST Robotics Community Center, opened in 2014, is the first of its kind on any university campus in the country.[21] The facility provides build spaces for area FIRST and VEX Robotics teams, a regulation size practice field, along with multiple labs for machining, design, 3D printing, and strategizing. More importantly, the students on these teams have unprecedented access to Kettering University's faculty, staff and facilities. Kettering students and staff also serve as mentors to local K-12 teams using the facility.

In the words of Kettering president Dr. Robert McMahan, “the FIRST Community Center has been transformative for the University, both in recruiting and engagement with the surrounding Flint community”. Currently one in three undergraduate students at Kettering is a FIRST Robotics alumni. The center has 3 paid staff and is financially self-supporting by running summer camps and workshops throughout the year.[22]

In Connecticut a non-profit organization, the Central Connecticut Robotics Alliance (CCRA), has been established for the purpose of “creating and administering a Community Robotics Center in Central CT" and to “provide outreach and assistance to expand youth robotics programming in surrounding underserved communities.” The CCRA is composed of dedicated and

[21] www.opportunityamericaonline.org/kyfame
[22] FIRST Community Center | Kettering University

experienced leaders from area FIRST Robotics teams. (Note: There are 10 FRC Teams based within 10 miles of the Tunxis Campus).

Fig. 1 shows CT Youth Robotics participation in 2023. Although CT teams have historically performed very well, statewide participation rates are considerably lower than states with strong public support like Michigan and New Hampshire. Also, many underserved areas in CT currently offer no youth robotics programming so the potential for growth is large. The CCRA plans to utilize the Community Robotics Center (CRC) and its member teams to proviide support and mentoring to newly formed and developing programs. Co-locating a Community Robotics Center with the RMET program at CT State-Tunxis will expose hundreds (thousands?) of STEM oriented students throughout the state to the RMET program and this career pathway.

FIGURE 1
CT Youth Robotics Participation 2023

	FIRST® Robotics			VEX® Robotics			Total			
Age Group	Program	Teams	Students	Program	Teams	Students	Teams	Students	CT STUDENTS	% Participation
K-1	FLL Dicover		168					168	68012	0.2%
2-4	FLL Explore	22	568	IQ	13	100	35	668	108656	0.6%
5-8	FLL Challenge	118	1256	IQ	120	700	238	1956	155543	1.3%
7-12	FTC	39	390	VRC	35	210	74	600	246074	0.2%
9-12	FRC	51	1020	VRC	125	750	176	1770	166049	1.1%
Totals		**230**	**3402**		**293**	**1760**	**523**	**5162**	498260	1.0%

The CCRA understands that locating the Community Robotics Center within the Advanced Technology Education Center at CT State-Tunxis would maximize its

workforce pipeline impact, but will seek an alternative site if necessary. Their hope is to establish a model which could be replicated by other non-profit “alliances” at other CT State campuses.

C. Providing Dual Credit Entry Point

A second strategy for early student engagement at Tunxis-ATEC will be expanding targeted dual enrollment class offerings to area comprehensive High Schools. Dual Enrollment programs provide high school students the opportunity to take college credit-bearing courses and serve as an entry point into career pathways. Through Connecticut’s Community College System, now merged into a single CT State Community College with multiple campuses, thousands of high school students throughout Connecticut have taken advantage of dual enrollment opportunities.

For example, students from area high schools, including Bristol High School and New Britain High School, have been able to earn college credit towards a manufacturing related certificate or degree awarded at Tunxis. Unfortunately, recent budget challenges have resulted in suspension of the manufacturing training curriculum at Tunxis which is having serious negative consequences for training and employment opportunities for area high school students.

It is estimated that a fully operational Advanced Technology Education Center at the Spring Lane facility adjacent to Tunxis would open opportunities for hundreds

of area high school students to earn professional certifications and college credits while still matriculating at their local high school.[23]

Completing the Tunxis-ATEC will immediately, significantly, and beneficially impact the educational, economic and career prospects for students throughout the region and the state.[24]

D. Coordinating the HS, AS, and BS Curriculum for seamless career advancement

It is to the State's credit that in 2021, the College of Technology reviewed and aligned all of its certificates and A.S. degree curriculum among the 12 community colleges for approval from the Aligned Program Review Committee (APRC) and the Board of Regents (BOR) to ensure that it is included in the college catalog upon the merger to CT State Community College.

The alignment included the review of 2 A.S. Degree Programs – Engineering Science and Technology Studies, 15 Technology Studies A.S. Degree Options, and 88 individual courses.

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[23] For example, The Hamden Engineering Careers Academy (HECA) is providing dual enrollment opportunities including associate degrees in manufacturing engineering and certificates in CAD to Hamden High School students through a partnership with CT State Gateway. See "Exemplar Models" in Appendix 4

[24] Dual enrollment programs should continue to grow as a key component of the state's strategy to address workforce development challenges throughout Connecticut. Policy changes are needed to encourage this growth by establishing statewide standards and procedures. See, Recommendations" in Appendix 4.

The Working Group Curriculum Subcommittee has reviewed the COT's aligned curriculum and mapped courses from COT credit certificates and A.S. degree programs to courses in the Robotics & Mechatronics Engineering Technology (RMET) B.S. degree at Central Connecticut State University.[25]

This course mapping can be used to determine pathways for students in various COT engineering and technology programs, including multiple manufacturing programs, to continue their education in the high-demand field of robotics and mechatronics.

The I4.0 career pathway targeted by the proposed Tunxis-ATEC model is Robotics and Mechatronics Engineering Technology (RMET). This in-demand skill set offers high paying career opportunities in automated manufacturing (and logistics) and at Original Equipment Manufacturers (OEMs).

Dual Credit: An RMET Entry Point

Creating a career pathway entry point for High Schoolers can give students a head start and the opportunity to explore the career before graduation. Offering 4 targeted entry level RMET courses to area High Schools (one per semester Jr. and Sr. year) would provide students the opportunity to earn up to 12 college credits along with associated industry recognized credentials. Upon graduation these students will be well prepared for entry level positions in automated manufacturing or to continue on the RMET pathway at CT-State. These students will be the ideal candidates for RMET apprenticeships offered by the proposed Apprenticeship Consortium companies.

[25] See Appendix 5

CT State- A.S. RMET Program

Demand for Advanced Manufacturing Technicians (AMTs) with RMET skills is as high, or higher, than for degreed RMET engineers. AMT's, often acting as Field Service Technicians, can earn salaries equivalent to, or exceeding those of, degreed engineers. Offering an Associates level RMET program at the Tunxis-ATEC, aligned with the program at CCSU, will provide students with both an Engineering Technician career pathway and the ability to continue their education toward a BS degree. Students transferring to CCSU with proven success in the A.S.RMET program will certainly strengthen and potentially grow the CCSU program.

Tunxis-ATEC RMET Laboratory

The Tunxis RMET program will need to provide meaningful experiential hands-on learning components. The proposed Tunxis-ATEC plan includes a 6,000 sq. ft. laboratory equipped with the latest industrial technology training equipment and materials. Selecting an industry partner and an industry developed learning system will ensure equipment and curriculum are continuously updated as technology evolves. This approach also facilitates granting of industry recognized stackable credentials. The one time investment in furnishing and equipping the RMET laboratory for two cohorts of 24 students is estimated at $1 million.

CCSU BS RMET Program

First launched in 2012, the Robotics and Mechatronics Engineering Technology (RMET) program at Central Connecticut State University (CCSU) was the first

RMET program in New England to gain ABET-ETAC accreditation. Responding to evolving industry trends and stakeholder feedback, the RMET program underwent a significant update in Fall 2019. This revision incorporated the latest technological advancements in Robotics and Mechatronics, ensuring the curriculum remains at the forefront of engineering education. The program is hosted exclusively at CCSU's main campus in New Britain, Connecticut.

The RMET program's distinctiveness lies in its experiential learning philosophy, combining hands-on, project-based learning with real-world applications utilizing industry standard hardware and software. This approach, encompassing high-impact educational practices like collaborative assignments, capstone projects, and internships, has led to a consistent demand for graduates among local employers and an impressive 100% job placement rate. Currently there are approximately fifty students in the program and most students receive job offers by the conclusion of their junior year. Notably, the program currently has capacity for significant growth, but would benefit from more qualified applicants,

E. Establishing an Industry-lead Apprenticeship Consortium

Major Connecticut companies including Stanley Black & Decker, Trumpf, Okay Industries, The Arthur G. Russell Company, Bauer and others represent significant local demand for workers with these skills. They are committed to providing apprenticeship and career opportunities to graduates in exchange for direct involvement with curriculum development within the academic program. The consortium is already prepared to activate new and accelerate their existing

apprenticeship programs in order to provide on the job training for periods ranging from 1 to 4 years.

The enthusiasm from these companies is significant because their workforce needs are urgent. This urgency demands that policy-makers and the state's community college system work collaboratively and expeditiously to make this new, comprehensive training system a reality at the Tunxis campus. Their workforce needs are immediate such that other opportunities to develop talent may draw their attention away from Tunxis or Connecticut entirely.

Additionally, dual-credit programs can be inhibited due to a patchwork of procedures and policies across Connecticut. For example, teacher credentialing, teacher observation and course review processes lack coherence. Student enrollment criteria, costs, and success criteria also lack consistency. A variance in rigor and expectations from institution to institution also presents a challenge. While Connecticut colleges generally have a stated aim to leverage dual enrollment to ensure greater access to post secondary opportunities for at-risk populations, the methodologies for achieving this goal are as diverse as the institutions represented. In addition to the varied procedures and policies impacting student opportunities, experience and outcomes in using dual enrollment, their prospects are further hampered by a lack of Connecticut state legislative guidance, best practice or statute, such as those that would encourage the use of dual enrollment for critical workforce needs in Connecticut. Creating a dual enrollment strategy at the state level to encourage high school students to take advantage of the rich industry specific training programs at the certificate and / or Associate Degree level that is offered by CT State and the CSCU system

would meaningfully impact the qualified workforce capable base of candidates in Connecticut.

The working group therefore recommends that CT State commence discussions with the consortium of private sector companies along with FAME to formalize agreements regarding apprenticeships, curriculum development and career opportunities for students and graduates of the Tunxis ATEC. Further, the working group recommends establishment of a legislative committee to develop statewide standards for dual-enrollment programs

VI. Budget, Timeline, Funding Sources & Metrics/KPIs

The working group learned early on in our discussions with CT State that full implementation of an ATEC at the Tunxis Campus could not move forward without a commitment for adequate funding from the State of Connecticut. We have strongly encouraged and participated in discussions to determine the amount of funding required and a timeline once that funding has been allocated. The legislature has also indicated an interest in having discussions regarding funding once a budget and timeline have been established and CSCU commits to both once funds are allocated. The following reflects the working group's current understanding of both funding and timeline issues at the time of this writing.[26]

[26] The working group acknowledges that full implementation of this recommendation is contingent upon the CT State College and University System (CSCU) receiving adequate, dedicated funding to complete and operate the facility. While the Tunxis campus is a highly desirable location for the ATEC, should the dedicated funding not be forthcoming, an alternative operational space suitable in central Connecticut will regrettably need to be explored and identified.

A. Budget & Funding Sources

The Working Group has not yet received a firm budget estimate from CT State CC for implementation. However, based on discussions at our Working Group meetings, we estimate approximately $4 million is needed to complete the Spring Lane facility renovations and approximately $1million for additional furniture, fixtures, and lab equipment. ***This figure represents about one percent of the roughly $400 million provided by the state to technical education in 2023.***

However, to better and more fully understand the costs and timeline associated with the full implementation of an ATEC at CT State Tunxis (and the proposed site of 21 Spring Lane, a state-owned property), updated and refined capital and funding estimates will need to be completed. Further, a needs assessment of the desired space – that more fully examines the true square footage costs associated with the property – should be completed, including a $35k master plan and $125k pre-construction services analysis. These additional efforts and cost analyses will allow for determining a more realistic budget and funding model for this project.

Annual operating costs for both the Machine Technology and Robotics & Mechatronics programs are roughly estimated at $1 million. Once fully established, revenue generated by the ATEC in the form of student enrollment, summer teacher externships and hosting community events will partially offset operating expenses.[27]

[27] Should discussions move forward on funding, the CT State Community College may wish to explore opportunities to allocate space at other community colleges as Inspiration Arenas and seek additional funding for such allocations where feasible.

Administration and staffing of the Community Robotics Center will be provided by the non-profit CCRA. They will fundraise, solicit grant funding, and host paid participation events to sustain operation of the CRC. Volunteer staffing, along with potential CT-State student work-study support, will keep operational cost to a minimum.

BONDING: For the remaining portion of the building, it is roughly estimated that an additional $4 million dollars is needed to renovate the space. An additional $1 million is required for furniture, fixtures and equipment (FFE) for the RMET Laboratory. As noted above, more refined analyses need to be conducted to better define these costs.

BLOCK GRANTS: In addition, operating funds for a minimum of three years in the amount of $1 million / year is needed to operate the entire 44,500 sq. ft building and offer programming.

FEDERAL GRANTS: The federal government regularly provides grant opportunities for the expansion of manufacturing training. Connecticut should aggressively pursue these opportunities to expedite completion of the Tunxis ATEC.

CONGRESSIONAL SUPPORT: Connecticut's Congressional delegation has successfully provided assistance to the institutions in the state for expanding manufacturing training. Efforts to pursue such support for the Tunxis ATEC should be aggressively initiated.

B. Timeline

The Working Group has not yet received an estimated timeline for implementation from CT State CC. The working group is pleased that CT State has announced its plans to initiate academic programs utilizing the I3.0 area of the building beginning Fall, 2024. For purposes of establishing an estimated implementation timeline for completion of the building and initiating full ATEC programs, we identify the time at which the State of Connecticut, Congress and/or other body providing the financial commitment necessary to move the project forward as T_0. These time frames are aspirational and we look forward to a more precise timeline developed by CT State Community College in the near future.

T_0= Time at which plans and budgets are finalized, funding is secured and allocated for completion of Spring Lane facility in accordance with the budgets

T_0 + 6 months= architectural and engineering services completed

T_0 + 12 months = building structurally completed and outfitted

T_0 + 18 months = staff hired, curriculum finalized, student enrollment goals met

T_0 + 24 months = final preparations completed, academic programs commence

C. Metrics & Key Performance Indicators

Key metrics of the success of Tunxis ATEC project will be:

- Engaging Youth Robotics Community
  - Number of K-12 student engagements at the Community Robotics Center annually
  - Number of Alliance District Teams supported

- Dual Credit Entry
  - Number of RMET credits awarded through Dual Credit Programming
  - Number of High Schools offering RMET Dual Credits

- Coordinated Curriculum RMET Pathway
  - Number of students enrolled at CT-State with previous HS RMET credits
  - Number of AS RMET degrees awarded
  - Number of students enrolled in CCSU RMET program with AS RMET
  - Number of BS RMET graduates

- Apprenticeship Consortium
  - # of apprentices registered
  - # of sponsoring companies
  - % completion rate
  - % job placement upon graduation

VII. Working Group Recommendations

1. The Governor, Legislature, CSCU, CT State Community College and industry representatives urgently collaborate to identify and secure funding for establishing the first ATEC in Connecticut at the Tunxis Campus Spring Lane facility

2. CT State Community College commence discussions with the consortium of private sector companies to establish a partnership formalizing agreements regarding apprenticeships, curriculum development and career opportunities for students and graduates of the Tunxis ATEC.

3. The Central CT Robotics Alliance, in conjunction with CT State Community College Tunxis Campus, commence planning and hosting STEM related events at the ATEC robotics center.

4. Adopt statewide standards for dual / concurrent enrollment programs

5. Local, regional and state transportation officials establish plans for expanding transportation opportunities for students in traditionally underserved communities to access the Tunxis ATEC

VIII. Appendices

APPENDIX 1: WORKING GROUP MEMBERS

Tracy Ariel	Program Director, CT Office of Workforce Strategy
Mark Auletta	COO, Bauer Inc.
Mary Bidwell	Assoc. Dean of Advanced Manufacturing, CT State Community College- Asnuntuck and Tunxis Campuses
Eric Brown	Government Affairs Representative
Mark Burzynski	Technical Talent Development Advisor The Arthur G. Russell Company
Dan Coccchiola	Director of Career Pathways and Workforce Development, EdAdvance
Jessica Chavez-Gutierrez	Training Manager, TRUMPF
Richard DuPont	Dir. Campus and Community Relations, CT State-Housatonic AMTC
Marty Guay	Vice President, Business Development
Jason Howey	President and CEO, AVNA, Inc.
Darryl Reome	Campus CEO CT State CC Tunxis
Ravindra Thamma	Professor, Robotics & Mechatronics CCSU
Karen Wosczyna-Birch	Executive Director and Principal Investigator; NSF National Center for Next Generation Manufacturing

APPENDIX 2: COLLEGE OF TECHNOLOGY

The Connecticut College of Technology (COT) was established in 1992 under Connecticut Public Act 92-126 and includes all twelve Connecticut community colleges (now merged to CT State Community College), ten public and private partner universities, the Connecticut Technical & Career Education System and nonprofit organizations. This unique infrastructure and governance provides seamless articulation between the community colleges and partner universities providing multiple points of entry for degree completion. The two core programs of the COT are Engineering Science and Technology Studies. The Engineering Science program provides a theoretical, calculus-based curriculum while the Technology Studies program provides hands-on, problem-based curriculum that includes credit certificates, microcredentials, and fifteen industry-driven options that respond to workforce needs. All community college campuses offer the Engineering Science and Technology Studies A.S. Degree parent programs while Technology Studies Options are offered at respective community college campuses based on local industry needs.

Community college students who complete their A.S. degree in the COT Engineering Science program have the ability to continue their program of studies as juniors in engineering programs at the Central Connecticut State University, Southern Connecticut State University, Charter Oak State College, University of Connecticut, Fairfield University, the University of Hartford, Sacred Heart University, University of New Haven, or the University of Bridgeport. Students who complete their A.S. degree in one of the COT Technology Studies Options can continue seamlessly as juniors in programs at Central Connecticut State

University, Eastern Connecticut State University, Southern Connecticut State University, and University of Hartford. Additional articulation agreements are in place with Southern Connecticut State University and Eastern Connecticut State University as well as with additional private universities and colleges.

College of Technology Site Coordinators Council

Under the leadership of the COT State Executive Director, the COT Site Coordinator's Council provides the leadership and governance for the COT. The Council meets monthly and averages between 35-40 representatives from all 12 Connecticut community college campuses, 4-year public and private university partners, the Connecticut Technical High School System, nonprofits, and business and industry partners. Discussions and presentations focus on curriculum and program review and approval, professional development, student transfer, and outreach initiatives.

APPENDIX 3: NSF FUNDING

In 2004, the Connecticut College of Technology (COT) received its first of three National Science Foundation (NSF) Advanced Technological Education (ATE) awards to establish and continue the Regional Center for Next Generation Manufacturing (RCNGM), a National Science Foundation Center of Excellence. Within the framework of the grant's proposal, the COT-RCNGM concentrated on the following major goals: 1) Articulation/Pathways; 2) Student Recruitment/Retention; 3) Curriculum Development; 4) Professional Development; and 5) Regional Collaboration throughout New England.
The RCNGM continuously implemented new student recruitment and retention initiatives that also expanded articulation agreements and instructional collaboration among four-year universities, community colleges, and secondary schools. Developing a diverse advanced manufacturing workforce is a key focus of the COT and its NSF funding. Student activities included regional career expos that allow high school students to talk to local manufacturers regarding workforce needs, tours of community college campuses, and presentations on advanced manufacturing technologies. One example of outreach is the Greater Hartford Maker Faire, which brought 1500 attendees to Tunxis Community College in its first year. Marketing activities included the nextgenmfg.org website, social media, and DVDs with accompanying Teacher Guides. Over 10,000 copies of the “Manufacture Your Future 2.0” and “You Belong: Women in Manufacturing” DVDs have been distributed nationally and include “day-in-the life” scenarios of employees who represent different roles in a variety of manufacturing careers. The COT has also been invited to present on Women in STEM at international Gender Summits and an Epsilon Pi Tau International Honor Society Meeting. Since 2004, there has been a 131% increase of Black students and 263%

increase of Hispanic students enrolled in Engineering and Technology programs at Connecticut Community Colleges.
The RCNGM provided professional development opportunities for community college and high school faculty to upgrade their knowledge base of emerging technologies needed for next generation manufacturing. Faculty externships with local industries, workshops, seminars, and conferences all provided faculty with the tools and ideas needed to create curriculum that will meet current workforce needs. High school counselor workshops are also a key activity that exposed counselors and faculty to careers that they can bring back to students and parents.

Curriculum development and implementation was an integral aspect of the RCNGM. With the assistance of industry input, education/industry collaborations, and educator professional development opportunities, the RCNGM was able to ensure that students who enroll in the community colleges' COT pathway programs can transition from high school to higher education without loss of credit and obtain employment in cutting edge technologies in the region.
Additional NSF funding was awarded to create international programs for COT students. In 2012, twelve students traveled with faculty to Germany to learn about the German educational model and manufacturing industry. In 2019, funding was received for a similar program with France, which has been delayed due to the pandemic. In 2019 the COT also received funding to transition the RCNGM to the Resource Center for Next Generation Manufacturing.

In 2021, the Connecticut received $7.5M to fund the National Center for Next Generation Manufacturing (NCNGM), which expands upon the work of the RCNGM and includes national leadership in partnership with College of the

Canyons, Central Community College, Columbus State Community College, other NSF ATE centers and projects, Manufacturing Extension Partnerships (MEPs), Manufacturing USA Institutes; and EdAdvance and other nonprofits. The goals of the NCNGM are to: develop a national manufacturing network to establish best practices for educating the future advanced manufacturing workforce; identifying and disseminating best practices for student recruitment and retention; providing professional development for faculty, and creating a repository of advanced manufacturing education materials. The NCNGM is the only center for advanced manufacturing under the NSF and includes leadership from community colleges across the United States.

To date, Connecticut has received over $30M dollars in NSF grant funding as well as numerous awards and recognitions. These include being highlighted in the New England Council/Deloitte report: Advanced to Advantageous: The Case for New England's Manufacturing Revolution and was recognized in a MIT study commissioned by the National Academy of Sciences for best practices and as a national model for Technology Education. In 2012, the COT received the New England Board of Higher Education Award for Connecticut. In 2020, the COT-RCNGM received the High Impact Technology Exchange Conference (HI TEC) Innovative Program of the Year award. The COT Executive Director and the COT Site Coordinators have been invited to participate on numerous local and national boards and events such as the 2014 White House College Opportunity Summit.

APPENDIX 4: Providing Dual Credit Entry Point

a. Current State of Dual Credit/Enrollment Programs in CT:

As defined by the National Alliance of Concurrent Enrollment Partnerships, Concurrent and Dual Enrollment provide high school students the opportunity to take college credit-bearing courses. Concurrent enrollment as the subset of dual enrollment courses taught by college-approved high school teachers in a secondary environment, while Dual Enrollment is the umbrella term used for all experiences, whether in a highschool classroom or a college classroom, whereby highschool students are enrolled in college coursework.

Dual enrollment opportunities are available to students at many high schools in Connecticut. CT State, in its pre-2023 configuration for example, provided dual and concurrent enrollment opportunities in 12 distinct geographic regions, analogous with the 12 CT Community Colleges. Each community college independently administered their region, and provided dual enrollment opportunities to students aligned with programs they specifically offered. The integration of these institutions into the singular CT State CC has allowed CT State to provide dual enrollment opportunities system wide, which is a benefit to all CT high school students.

A number of Connecticut's colleges provide for dual enrollment, albeit with a patchwork of procedures and policies. Teacher credentialing, teacher observation and course review processes lack coherence. Additionally, student enrollment criteria, costs, and success criteria lack consistency. Furthermore, there is variance in rigor and expectations from institution to institution. While Connecticut

colleges generally have a stated aim to leverage dual enrollment to ensure greater access to post secondary opportunities for at-risk populations, the methodologies for achieving this goal are as diverse as the institutions represented. In addition to the varied procedures and policies impacting student opportunities, experience and outcomes in using dual enrollment, their prospects are further hampered by a lack of Connecticut state legislative guidance, best practice or statute, such as those that would encourage the use of dual enrollment for critical workforce needs in Connecticut. Creating a dual enrollment strategy at the state level to encourage high school students to take advantage of the rich industry specific training programs at the certificate and / or Associate Degree level that is offered by CT State and the CSCU system would meaningfully impact the qualified workforce capable base of candidates in Connecticut.

b. Comprehensive High Schools:

According to the National Center for Educational Statistics, Connecticut comprehensive high schools will graduate an estimated 34,120 students in 2024. Outcome opportunities for these graduates is disequitable in Connecticut. The persistent achievement gap is annually among the highest in the nation, and is a focus of the General Assembly Achievement Gap Task Force. The Achievement Gap indicates that Connecticut students underperform National Student Clearinghouse data - which reports 6 year college completion rates for bachelor degree programs at 62%, and at 40% for associate degree programs. Jonathon Russell, Associate Dean,Central Michigan University, writes for EAB in Closing the equity gap in retention and persistence rates that ‘many risk factors… can influence the equity gap including pre-college (financial factors, college prep), student experience (feelings of belonging, college transition), and academics

(advising, rigor). Simply, college is inaccessibly expensive for many, and many additionally don't feel academically ready. Relatedly, according the New England Association of Schools and Colleges, the 17 campus CT Votech School system has two applicants for every available seat, indicating that for the 11,000 students currently being trained in the VoTech system, there are another 11,000 students who have shown interest in pursuing STEM, trade, or technical careers who are currently being educated in comprehensive high schools. Connecticut needs to consider how to impact comprehensive high school students' postsecondary access and readiness needs, while also delivering to students the career and technical skill sets needed to enter into Connecticut's high wage / high skill industries, such as Manufacturing Engineering. Dual and Concurrent Enrollment to collegiate Certificates and Degrees in DOL identified shortage areas can drive positive outcomes - in a singular action - for both the achievement gap and high skilled workforce development needs.

c. Exemplar Models

The Hamden Engineering Careers Academy (HECA) is an instate model program. It has been identified by ReadyCT as exemplary in its approach of providing dual enrollment opportunities to an associate degree in manufacturing engineering and certificates in CAD to Hamden High School students through a partnership with CT State Gateway. The first cohort of students graduated in 2023, with 72% earning associate's degrees, and more than 80% earning certificates and participating in meaningful work based learning experiences. The program has more than 120 students enrolled, grades 9-12, and is approaching 50% Female enrollment. This PTECH modeled program was replicated by New Haven Public Schools in three of their high schools in 2022. An area of growth for the model is

its hyperlocalization, leading to disequitible outcome opportunities, as it is only available to students from districts who make the capital, personnel, and operational investments needed to run it. Consistent with the 2020 and 2022 CT governors report on workforce development, the autonomous working of each school district is a barrier to accessing comprehensive high school students on a regional or statewide scale for workforce development. EdAdvance is currently implementing a regional, and scalable, design of the HECA model in their College and Career Accelerator (CCA). CCA is a partnership with CT State NW, and is designed to be a complement to, and partnership with, school districts to both provide students with access and readiness to post secondary opportunities and Connecticut's high skill / high wage occupations. Importantly, when at scale, it has the capacity to drive industry 4.0 competent employees into the workforce.

An exemplary out of state program is the Ivy Tech system in Indiana. With 42 satellite campuses throughout the state, Ivy Tech partners with comprehensive high schools to provide instruction to students in high tech advanced manufacturing. Over 70,000 high school students are currently enrolled at Ivy Tech. With programs in Smart Manufacturing & Digital Integration and Advanced Automation & Robotics Technology, Ivy Tech is supplying Indiana with an I4.0 ready workforce.

d. Recommendations

Dual enrollment can be a key to driving workforce development in Connecticut, and it also provides a meaningful strategy for narrowing the achievement gap. CT State possesses the expertise to deliver the coursework, certificates and degrees

that industry needs in its workforce. There are thousands of students annually in Connecticut comprehensive high schools willing and able to participate in enhanced STEM / manufacturing programming, and dual enrollment is the key to unlocking access to them as a resource to fill workforce positions. There are exemplary models, and regionalizing the approach can serve to mitigate, if not eliminate, some of the greatest barriers to accessing these students. We recommend that the state look closely at the model being developed at EdAdvance and leverage their position as a RESC to implement a strategy statewide.

APPENDIX 5: Course Mapping

Course #	Course Title	Credits	Prerequisite
ROBO 110	Introduction to Robotics and Mechatronics	3	NONE
ROBO 210	Engineering Mechanics for Automation	4	PHYS 121 or PHYS 125
ROBO 220	Parametric Modeling and Simulation	3	NONE
ROBO 240	Electro-Mechanical Converters and Drivers	3	CET 236
ROBO 260	Programmable Controllers	4	NONE
ROBO 310	Data Acquisition & Processing	3	CET 270, CET 363
ROBO 320	Fluid Power Systems	3	ROBO210
ROBO 340	Modeling and Simulation in Mechatronics	3	ROBO 210, MATH 221, CET 236
ROBO 350	Applied Control Systems I	3	ROBO 260, ROBO 310, and MATH 221
ROBO 370	Mechanisms for Automation	3	ROBO 210, ROBO 220, and MATH 221
ROBO 380	Mechatronics	4	ROBO 240, CET 270
ROBO 460	Applied Control Systems II	3	ROBO 350, MATH 355 or instructor permission
ROBO 470	Robotics Systems Engineering and Analysis	3	ROBO110
ROBO 480	Industrial Robotics	3	ROBO 370, ROBO 390
ROBO 496	Industrial Internship	3	Senior standing and permission of instructor
ROBO 497	Capstone: Senior Project	3	Open only to Robotics and Mechatronics majors; senior standing, and permission of instructor

APPENDIX 5: CCSU RMET

The Robotics and Mechatronics Engineering Technology (RMET) program at Central Connecticut State University (CCSU) is a remarkable educational journey crafted in 2012 through the collaborative efforts of CCSU faculty and the Industrial Advisory Board (IAB) in shaping a curriculum that responds to the specific needs of diverse industries across Connecticut. In the spring of 2012, this innovative program received the green light from the State of Connecticut Board of Regents, empowering the Manufacturing and Construction Management Department at CCSU to confer a Bachelor of Science in RMET. The inaugural graduation of an RMET student in Fall 2015 marked a significant milestone, as the program was the first Robotics and Mechatronics Engineering Technology program in New England to gain ABET-ETAC accreditation.

Responding to evolving industry trends and stakeholder feedback, the RMET program underwent a significant update in Fall 2019. This revision incorporated the latest technological advancements in Robotics and Mechatronics, ensuring the curriculum remains at the forefront of engineering education. These enhancements were rigorously vetted and approved by various committees within CCSU, including the Department of Manufacturing and Construction Management and the School of Engineering, Science, and Technology, culminating in approval from the Board of Regents in June 2020. This forward-looking curriculum was designed with a vision spanning the next seven to ten years, addressing the rapid evolution in engineering, technology, and sciences.

The RMET program's distinctiveness lies in its experiential learning philosophy, combining hands-on, project-based learning with real-world applications. Students engage in theoretical classroom learning and practical laboratory experiences,

crafting projects that integrate theory and practice. This approach, encompassing high-impact educational practices like collaborative assignments, capstone projects, and internships, has led to a consistent demand for graduates among local employers and an impressive 100% job placement rate. Currently there are approximately fifty students in the Program and most students in the program receive job offers by the conclusion of their junior year.

RMET program remains committed to equipping laboratories with state-of-the-art equipment and resources, aligning with the evolving needs of the workforce, research demands, and academic rigor. This commitment extends to fostering partnerships with industry stakeholders, enhancing internship and research opportunities, and ensuring that graduates are well-prepared for the global workforce or further academic pursuits. Through this synergy of collaboration, consulting, and R&D activities, CCSU's RMET program stands as a beacon of innovation and excellence in engineering education.

The RMET program at CCSU is delivered through a blend of traditional lectures and laboratory sessions, available in both day and evening formats to cater to a diverse student body, including full-time workers and co-op students. Notably, the program is hosted exclusively at CCSU's main campus in New Britain, Connecticut, a unique feature among the Connecticut State Universities. Students from Tunxis Community College have a streamlined pathway to transfer to the Robotics and Mechatronics Engineering Technology (RMET) program at Central Connecticut State University (CCSU). This transfer process is facilitated by the "Connecticut College of Technology" pathway curriculum, established under Connecticut Public Act 92-126. This curriculum allows students to begin their academic journey at a community college and then seamlessly transition to CCSU's School of Engineering, Science, and Technology to complete their

degree.

The transfer process is designed to be smooth and efficient, ensuring that credits earned at Tunxis Community College are appropriately recognized and applied towards the RMET program at CCSU. This ensures a continuity of education and minimizes any potential delays in the completion of the degree.

The partnership between CT State-Tunxis and CCSU, particularly in the field of Robotics and Mechatronics, has the potential to create a significant positive impact on the workforce. This collaboration:

1. Enhances Skill Development: Students transferring from Tunxis to CCSU have the advantage of building upon a strong foundational knowledge in Robotics and Mechatronics. This ensures a workforce that is well-trained and adept in the latest technologies in this field.

2. Addresses Workforce Needs: With the rapid growth and evolution in the fields of engineering and technology, there is a growing demand for skilled professionals. This pathway ensures a steady supply of well-educated and trained graduates ready to meet these industry demands.

3. Promotes Industry-Academia Collaboration: The program encourages a closer relationship between academic institutions and industries. This collaboration can lead to curriculum enhancements, internships, and real-world project experiences, making the graduates more industry-ready.

4. Increases Accessibility to Education: The pathway makes it easier for students from diverse backgrounds to pursue advanced education in a high-demand field, thereby increasing the diversity and inclusivity within the industry.

5. Boosts Local Economy: By providing highly skilled graduates who are ready to enter the workforce, the program contributes to the local economy. These graduates often find employment within the local industries, thereby reinforcing the economic growth of the region.

6. Encourages Lifelong Learning: The transition from a community college to a university setting instills a culture of continuous learning and adaptability among students, which is essential in keeping pace with technological advancements.

In summary, the transfer pathway from CT State-Tunxis to CCSU's RMET program not only benefits the students by providing them with advanced educational opportunities but also positively impacts the workforce by supplying well-trained professionals equipped to meet the current and future demands of the industry.

Curriculum & Pathways

In 2021, the COT reviewed and aligned all of its certificates and A.S. degree curriculum among the 12 community colleges for approval from the Aligned Program Review Committee (APRC) and the Board of Regents (BOR) to ensure that it is included in the college catalog upon the merger to CT State Community College.

The alignment included the review of 2 A.S. Degree Programs – Engineering Science and Technology Studies, 15 Technology Studies A.S. Degree Options, and 88 individual courses.

The Advanced Manufacturing Center Working Group Curriculum Committee has reviewed the COT's aligned curriculum and mapped courses from COT credit certificates and A.S. degree programs to courses in the Robotics & Mechatronics Engineering Technology B.S. degree at Central Connecticut State University.

This course mapping can be used to determine pathways for students in various COT engineering and technology programs, including multiple manufacturing programs, to continue their education in the high-demand field of robotics and mechatronics.