

Math for Manufacturing

Workforce and Higher Education Partnerships



The University of Texas at Austin
Charles A. Dana Center

Case Study: East Texas

Tyler Junior College — The Tyler Economic Development Council,
and the Chamber of Commerce's Business Education Council

Key Takeaways

- The Tyler Economic Development Council played a key intermediary role between manufacturing employers and Tyler Junior College to strengthen education and on-the-job training programs.
- Tyler Junior College (TJC) designed a foundational industrial mathematics course focused on the necessary mathematics skills and competencies to meet the economic development needs of the community and the training requirements of local industry.
- TJC and local companies used a model that benefits students/employees, attracts new businesses, and contributes to the growth of the regional economy.

Spurred by the collapse of the energy sector in the 1980s, the Tyler/Smith County metro area in East Texas restructured its base economy from predominantly oil, gas, and agriculture to a variety of industries such as medical, education, manufacturing, and wholesale. The Tyler Economic Development Council has been central in attracting and retaining advanced manufacturing and technology firms to diversify its economy, ensuring that the area has a pipeline of trained workforce talent.

In 2018, Trane Technologies, an industry leader in heating, ventilation, and air conditioning (HVAC) product development and technology, approached Tyler Junior College (TJC), the Tyler Economic Development Council, and the Chamber's Business Education Council with a proposal to create a new apprenticeship-style training program to produce a



Themes Across Math for Manufacturing Case Studies

The Charles A. Dana Center published four case studies in 2022 as part of the Math Education for Manufacturing Initiative. The case studies highlighted innovative state, region, and local partnerships between manufacturing, higher education, and community leaders. The partnerships addressed a critical talent pipeline shortage for economic and workforce development, and identified necessary mathematics skills and instructional practices for successful entry-level to mid-level manufacturing employment.

The following themes emerged in the case studies.

1. Gaps in students' mathematics skills and application were not readily identified as a prevailing problem to successful entry-level to mid-level manufacturing employment. Revisions to mathematics requirements, curriculum, and/or pedagogy were a part of a holistic technical program redesign.
2. Manufacturing employers increasingly sought the inclusion of core competencies in technical program redesign. Competencies most often cited as critical to successful employment were interpersonal skills, creativity, teamwork, communication, problem solving, and leadership.
3. The ingenuity of state, region, and local partnerships amplified the availability of physical, human, intellectual, and financial resources to address the demand for skilled manufacturing employees with the appropriate mathematics knowledge and background to succeed in the workplace. Read the case studies:

<https://www.utdanacenter.org/our-work/higher-education/collaborations/math4-manufacturing>

skilled workforce for manufacturers in the area. That plan ultimately led to the creation of two successful but different employer-tailored educational and training solutions.

Background

Historically, the East Texas economy was based on extractive industries and agriculture. Cotton, cattle, and crude oil drove the economy from the mid-1800s to the 1980s. Coal mining and logging companies were also large employers. In the mid-1980s, oil and gas prices plummeted; consequently, thousands of high-paying jobs were lost, tax values declined, and populations dwindled. It became clear that East Texas could no longer remain a viable, resource-based economy.

The Tyler Economic Development Council took the lead, in partnership with the Tyler Area Chamber of Commerce and the Tyler Business Education Council, to shift the area's economy from natural resources extraction to medical services, higher education, advanced manufacturing, and more. Today, the Tyler/Smith County region, with a population of 230,000, has the fastest growing and most diverse economy in the area. A critical factor of this growth has been the educational opportunities that align with the region's evolving industry, especially in manufacturing. New career and technical programs in the area high schools provide students an early opportunity to learn about in-demand, high-paying jobs related to HVAC and industrial maintenance.

Several higher education institutions in the region have also seen significant growth. For example, Tyler Junior College (TJC) has grown dramatically over the past 30 years, currently enrolling more than 12,000 full-time students with an additional 20,000 continuing education students annually. It is one of the largest community colleges in Texas.

Its TJC West location is a comprehensive technology campus that offers a wide range of technical training, industry certifications, and skills development programs, including welding, automotive technology, computer programming, HVAC courses, electronic controls, and medical technology career paths. The state-of-the-art facility attracts students interested in the latest manufacturing processes and technology, while

the continual investment in education and training options attract employers who see how TJC can help meet their workforce needs.

Another higher education institution in the area is The University of Texas at Tyler, a four-year public university with over 10,000 students. Its College of Engineering offers bachelor's degrees in chemical, electrical, and mechanical engineering and in construction management. Tyler is also home to Texas College, a private, historically black college that enrolls about 1,000 students.



TJC West Campus Energy Center (Credit: John Jackson at Holland Engineering)

Partnership to Address Industry Needs and Skills Gaps

When Trane Technologies, a manufacturer headquartered in Tyler, approached TJC, the Tyler Economic Development Council, and the Chamber's Business Education Council in 2018, it proposed collaborating in developing a [Federation of Advanced Manufacturing Education](#) (FAME) chapter. FAME is a multi-state training initiative designed to provide a pipeline of skilled maintenance technicians to work in advanced manufacturing. Trane wanted to invest in the community with TJC to create an apprenticeship-style education and workforce training program.

The company helped to recruit other local businesses that would benefit from a FAME chapter. These businesses in manufacturing, food processing, distribution, communications, and the energy sector met with TJC to develop a plan using the FAME model. The FAME model is a rigorous, two-

year college degree program that includes aligned mathematics skills and competencies to industry needs, with paid, on-the-job training. Many of the companies, however, determined that the full FAME prescribed curriculum was not necessary to meet their workforce needs. Additionally, the college was unable to commit the required \$2 million investment in renovating its training facilities and allocating at least 2,000 square feet of manufacturing simulation space.

Although the original goal was not achieved, two separate initiatives were created from these collaborative discussions.

The first initiative involves Trane Technologies, who implemented the FAME model and is in partnership with The University of Texas at Tyler. New employees at the company work 30 hours per week as they complete their required coursework, primarily at the university's College of Engineering. After completion, employees have an associate degree and an advanced manufacturing technician (AMT) certification, and are guaranteed a full-time position with Trane.

The second initiative involves Tyler Junior College, who modified its existing Industrial Maintenance Technology (IMT) Associate of Applied Science degree to better align with existing industry skill needs. Input from businesses such as Tyler Pipe, Trane/Ingersoll-Rand, Sanderson Farms, Nestle, Target, and Eastman Chemical helped to inform those changes. Although TJC does not offer the comprehensive FAME program, its IMT program prepares students for a broad range of industrial maintenance-related careers in a variety of disciplines, including mechanical, electrical, and HVAC. Students are placed in paid industrial internships with local manufacturing employers in the summer between the first and second year of the IMT program. The college refined the IMT program to adopt FAME principles related to best practices for workers' soft skills such as attitude, communication, work ethic, and leadership

Collaborating to Identify Necessary Mathematics Skills and Competencies, Including Mathematics

Upon reviewing the IMT program course sequence, Tyler Junior College faculty determined that the

TECM 1301: Industrial Mathematics

Description: Math skills applicable to industrial occupations. Includes fraction and decimal manipulation, measurement, percentage, and problem-solving techniques for equations and ratio/proportion applications. **Outcomes:** Convert between decimals and fractions; use measuring tools; calculate ratios and proportions in a technical application; transpose linear equations to solve for unknowns.

curricular content and pedagogical practices could be strengthened to allow students to apply what they learned in the classroom to the real world.

Consequently, a new, program-specific industrial mathematics course (TECM 1301) was developed and will be required for the IMT program starting in fall 2022. Currently, students in the program must complete one of four general education mathematics courses offered at the college: College Algebra, Plane Trigonometry, Mathematics for Business & Social Sciences, or Contemporary Mathematics. The mathematics content covered in these four courses varies widely, and it was never intended to be tailored for, or connected to, the other required industry-focused coursework.

TECM 1301 intensely focuses on key mathematics concepts and applications used in the IMT program as well as on the job, including converting between decimals and fractions, using measuring tools, calculating ratios and proportions in a technical application, and transposing linear equations to solve for unknowns. Real-world manufacturing examples are incorporated into the lessons to help students understand how and why the core mathematics concepts are needed in advanced manufacturing jobs.

The college created multiple industry tracks in the IMT program to allow for specialization after one year of foundational courses. The tracks target specific employer needs. For example, one employer's second-year students may focus on advanced manufacturing while another employer's second-year students may focus on business/computer coursework or advanced welding and electrical. Offering a degree with multiple tracks, in addition to advanced manufacturing, provides students with greater flexibility to select a pathway that is more suited to their interests and skills and is better aligned with employers' needs. Additionally,

a degree with multiple tracks allows TJC to meet the needs of a larger group of local employers.

TJC continues to add labs and classroom space and to invest in the latest equipment. Newly added equipment includes robotic arms, 3-D printers, advanced manufacturing 3-D software, piping training systems, turning trainers, benchtop lathes, and hydraulics and pneumatics.

Promising Trends Towards Economic Prosperity

Since its inception in 2018, the IMT program has enrolled almost 200 students. Link Worthen, IMT program coordinator at TJC, shared, "The effects of COVID and the supply chain issue have complicated manufacturing production and the ability to find and hire qualified workers. More frequently, employers are requesting graduates with two-year technical degrees, so they do not have to teach the basics to new hires upon employment." The IMT program is well-positioned to meet this growing need, helping students obtain the training and education to fill such positions while also benefiting employers in East Texas.

The Tyler/Smith County model for diversifying the regional economy includes ensuring a skilled population of workers is available for in-demand jobs in industries such as advanced manufacturing. The Tyler Economic Development Council has helped broker partnerships between higher education institutions and local businesses to provide their community with excellent education and training pathways. This model not only helps individuals acquire the appropriate skills and competencies, including mathematics, but it also helps the Tyler community attract and retain new businesses. Other regions seeking to grow their economies can learn from Tyler's successful public-private partnerships.



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