

Math for Manufacturing

Workforce and Higher Education Partnerships



The University of Texas at Austin
Charles A. Dana Center

Case Study: KY FAME Initiative

Jefferson Community and Technical College and Manufacturing Industry Partners

Key Takeaways

- Manufacturing, a crucial industry to the Kentucky economy, needs a growing number of trained advanced manufacturing technicians to operate today's advanced machinery.
- Manufacturers in the Greater Louisville area partnered with Jefferson Community and Technical College to implement the Federation for Advanced Manufacturing Education (FAME). This national program combines education and paid, on-the-job training, giving students an opportunity to earn an associate of applied science degree and an advanced manufacturing technician certification as they gain valuable work experience.
- Jefferson Community and Technical College continually adapts its technical mathematics course and other elements of the FAME education curriculum, emphasizing real-world application and the needs of the industry.
- The FAME program at Jefferson boasts a high graduation rate with many students accepting jobs, with business sponsors and earning higher salaries than those of non-FAME program graduates.

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>

Background

In 2015, a group of manufacturers in the Louisville, Kentucky, area formed a partnership with Jefferson Community and Technical College to design an “earn and learn” program to supply a pipeline of advanced manufacturing technicians (AMTs) to meet industry demand. The employers (known as business sponsors) and the college collaborated in designing a rigorous, apprenticeship-style AMT program with relevant curricular and instructional practices, including mathematics skills and competencies, and on-the-job training that would ensure successful employment in entry-level to mid-level manufacturing jobs.

Manufacturing is an important industry for Kentucky, generating 18.6 percent of the state's total gross domestic product (GDP) and employing 13 percent of the state's workforce.¹ Manufacturers in the state rely on maintenance technicians to operate machinery and robotics efficiently. These technicians use complex problem-solving skills and technical knowledge to service and repair the machines. As the manufacturing industry evolves and the use of advanced manufacturing technology becomes more widespread, the need for skilled maintenance technicians increases.

Jefferson Community and Technical College (JCTC), a public community college located in Louisville, has an estimated enrollment of 18,000 students. It is the largest of the 16 colleges in the Kentucky Community and Technical College System (KCTCS). JCTC offers a wide range of career and technical training programs, and many businesses in the area rely on the college as an education and training site. One of these programs is the Kentucky Federation for Advanced Manufacturing Education (KYFAME), a chapter of the national initiative that combines coursework with paid workplace experience. In the two-year program, students receive a holistic learning experience, attending classes two days per week and working three days per week. Upon completion, students obtain an Associate of Applied Science (AAS) degree and an AMT certification.

The KY FAME program was first launched in 2009 in central Kentucky through a collaboration led

¹ <https://www.nam.org/state-manufacturing-data/2020-kentucky-manufacturing-facts/>

by Toyota and other manufacturing company partners. The program then expanded to other KCTCS colleges. Currently, 13 KY FAME chapters connect manufacturers with students interested in manufacturing jobs and careers.

Partnership to Address Manufacturing Skills Gaps

In 2015, a number of local manufacturers formed the Greater Louisville chapter of KY FAME in partnership with JCTC. These companies—some large, some small—had similar workforce needs that could be met through the AMT program. For example, Elaine Gravatte, chief executive officer of DDW, The Color House, shared that her company had “trouble finding skilled technicians to repair and maintain our food coloring machines” and needed a new training model “to meet our particular skill needs.” Now as a business sponsor for the KY FAME program, DDW connects with students who have in-demand technical skills and knowledge of manufacturing best practices, such as safety, machine reliability, and lean manufacturing. The company in turn mentors and prepares these students with critical professional behaviors such as resourcefulness, leadership, communication, and teamwork.

Each year, the Greater Louisville chapter recruits a cohort of students, typically recent high school graduates. As students work toward an AAS degree in advanced manufacturing technology at JCTC, they also work for a local manufacturing employer and earn a competitive wage of \$12 to \$13 per hour with opportunities for raises.

Gene Fife, current KY FAME director at JCTC, serves as an intermediary between the college instructors and the business sponsors to coordinate the partnership effectively. JCTC stays in touch with these sponsors through monthly FAME meetings and regular visits to the worksites. Fife noted that “it is through these meetings and visits that we find out about new initiatives and projects going on in industry as well as new challenges. . . . If employers are using new training ideas and solutions, we want to make sure we are up to speed.”

“How we deliver content and the learning outcomes must be flexible and adaptive to the needs of our sponsors and students.”

Gene Fife

KY FAME Director

Jefferson Community and Technical College

Collaborating to Identify Necessary Mathematics Skills and Competencies

Collaboration between JCTC instructors and business sponsors is essential in developing a highly applied program for students. Such collaboration allows instructors to modify coursework to reflect the skills and knowledge needed in the manufacturing industry.

For the technical mathematics course (Math 116 at JCTC), for example, the instructor, Brandon Elmes, worked closely with the KY FAME director to translate the mathematics needs of the employers and determine course topics. Much of the initial focus was on selecting the appropriate contextual applications of mathematics and manufacturing control systems. Program students needed skills in blueprint reading, conversions, rate of failure calculations, and application of lean manufacturing processes, as AMT jobs require quick mathematical thinking as problems arise.

Additionally, Elmes, who has an industrial engineering background, selected an application-driven textbook, which he supplements with real-life manufacturing examples to help the students connect their learning to their on-the-job training. Instead of merely teaching straightforward rules about fractions or geometry, the instructor presents skills and competencies in an applied scenario so that students conceptually understand and apply their skills (e.g., students determine the amount of material needed for a bricklaying or construction project). Elmes noted that “projects work better for students with math anxiety who get nervous about taking a one-shot test. With projects, students complete a series of smaller assignments and if they get off track, I can redirect them and provide support where needed.”

Jefferson Community and Technical College, Technical Mathematics Resources

- MATH 116 (Technical Mathematics) syllabus, Spring 2022
- MATH 116 (Technical Mathematics) sample lessons

<https://utexas.box.com/s/k5mex83nz47nqcthoocc577x7gd60pi6>

JCTC adjusts the technical mathematics course based on evolving manufacturer insights and feedback. For example, right triangle trigonometry is still included; however, elements of advanced trigonometry content were dropped as they were not regularly used across the business sponsors' workplaces. Additionally, because KY FAME students use voltmeters to measure voltage levels at job sites, Elmes added a unit on circuits to help students understand how circuits work and the mathematics behind them. To emphasize the importance of quality control in manufacturing, the course included greater focus on how to calculate and analyze process-related data, including statistics, to help drive continuous improvement.

Impact

The KY FAME program at JCTC has made a significant impact on local manufacturing employers, the higher education community, and the students. Employers benefit from having a steady talent pipeline. As Wes Kawata, vice president of leadership and organizational development at DDW stated, the public-private partnership between the manufacturing employers and the college is one that "actually works" because it is focused on solving a collective need. "It's not bureaucratic," Kawata said. "The dialogue with JCTC is easy. We didn't have a lot of upfront costs." Although the employer collective is not static and manufacturer partners exit and enter the program as needs change, KY FAME and JCTC rely on a core group of employers that guide decision making.

The college benefits from the program as well, attracting students who are highly motivated by the opportunity to attain a degree and gain paid work

experience simultaneously. To date, 58 students have graduated from the program; 21 percent of graduates are minority students. The program has a 95 percent graduation rate, while the two-year graduation rate of non-FAME technical program students at JCTC is 19 percent. A recent report found that five years after program completion, KY FAME graduates across the state were earning \$98,000 compared to roughly \$52,782 earned by non-FAME participants. Moreover, 97 percent of graduates stated that "enrolling in FAME was the right decision" for them.²

One of the many benefits for students includes receiving feedback from their sponsors on specific skills sets such as their leadership, technical competency, teamwork, and other essential workplace qualities. Most graduates are offered jobs with one of the KY FAME sponsors; they can also choose to continue their studies in advanced manufacturing business or advanced manufacturing engineering.

Fife noted that even though manufacturer partners change over time, the partnership has maintained employer commitment. "No one person is the key to success. From our students to our instructors, our college administration, our great sponsors—it has been a team effort that is still evolving."

² <https://opportunityamericaonline.org/-content/uploads/2020/10/KY-FAME-final-final.pdf>

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