

Math for Manufacturing

Workforce and Higher Education Partnerships



The University of Texas at Austin
Charles A. Dana Center

Case Study: The Innovation Hub at Kendall College of Art and Design of Ferris State University

Key Takeaways

- The Greater Grand Rapids area consistently ranks as one of the fastest growing economies due in part to its strong manufacturing sector and its very creative design industry.
- Kendall College of Art and Design (KCAD) of Ferris State University offers highly applied, project-based, and career-focused educational programs that leverage and contribute to the local community.
- The KCAD Innovation Hub creates educational experiences for interdisciplinary student teams and supports the diverse needs of community and industry partners, including manufacturers, through co-developed projects.

Manufacturers across the United States are looking for skilled individuals with a broad understanding of design and the ability to apply this knowledge to make a better product at a lower cost. The state of Michigan has an advantage, having such a strong, diverse manufacturing and design community and a growing pipeline of creative and innovative talent. Michigan has the largest number of industrial designers in the country and ranks sixth for its creative design talent, with the third highest job growth by volume between 2014 and 2019.¹

Kendall College of Art and Design (KCAD, located in the Greater Grand Rapids area, launched the Innovation Hub in 2019. The initiative encourages

¹ <https://www.michiganbusiness.org/news/2021/11/michigan-a-home-for-engineering-design-and-development/>



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>

community and industry partners to collaborate with KCAD and its parent institution, Ferris State University, on just-in-time projects with students who work under faculty leadership (or mentorship). KCAD is known for providing innovative, collaborative education that prepares students for work in art and design. Taking advantage of KCAD's urban location, the Innovation Hub invites industry partners to engage with the diversely talented student population at both KCAD and Ferris State University to enhance student learning while also supporting the economic and talent growth of local businesses.

This focus and the collaboration with local industry partners are common for a community college that supports economic and workforce development, although most four-year universities are not as community focused. However, KCAD and Ferris together provide a wide range of valuable higher education resources to the Innovation Hub, including outstanding facilities, expert faculty, creative student teams from across discipline areas, grant writing support, prototyping labs, and more.

Background

The Greater Grand Rapids/West Michigan area is known for its robust design industry that aligns with its booming manufacturing base. Grand Rapids, the state's second-largest city, was once known as the leading producer of fine residential furniture and today is the home of many top furniture manufacturers, including Steelcase and Herman Miller. A key reason for the thriving manufacturing economy is that the region supports a diverse mix of industries such as automotive, medical devices, food processing, and production technology. There are over 2,500 advanced manufacturing establishments in the Greater Grand Rapids area with a dynamic job growth rate of 29.1 percent, between 2011–2020, that significantly outpaced the national rate of 7.6 percent. In the region, manufacturing currently accounts for 19 percent of all jobs.²

Ferris State University is a public higher education institution serving over 10,000 students and offering

² <https://www.rightplace.org/regional-industries/advanced-manufacturing>

both two- and four-year degrees. Ferris has eight specialized colleges, including Kendall College of Art and Design (KCAD) and the College of Engineering Technology. Both colleges emphasize industry connections and applied learning that take advantage of Ferris's location in the Greater Grand Rapids area.

The College of Engineering Technology offers four area-focused industry programs: Automotive and Heavy Equipment; Built Environment; Engineering and Computing Technology; and Design and Manufacturing.

KCAD was founded in 1928 as a private art academy, which merged with Ferris in 2000. Currently serving about 800 students, the college primarily offers four-year degrees; a general art and design associate degree option was added in 2021. Course options for this newly added program include art history, drawing, fashion, graphic design, printmaking, product design, among others. KCAD uses a highly applied, project-based approach to teaching in its state-of-the-art studios and fabrication facilities.

Intentional Partnership to Stimulate Area Talent Development and Economic Growth

KCAD has a longstanding collaborative relationship with manufacturers in Grand Rapids. In 2017, for example, Spectrum Health Innovations received an economic development grant from the city to develop, in partnership with faculty and students from KCAD and another university, innovative medical devices to solve real-world health care problems. Jonathan Moroney, professor and chair of product design at KCAD, co-taught the class of industrial design and engineering students who worked on the Spectrum Health Innovations project. He recognized the power of “blending the college’s talent development goals with economic and workforce development support for the region,” creating benefits for all stakeholders involved.

In 2019, the KCAD Innovation Hub was launched to enhance student learning through intentional partnerships with industry employers. Students

engage in paid industry experiences while attending school to build their skills and open pathways to career opportunities. See Figure 1 to explore stakeholder-value opportunities for the unique partnerships established through the Hub.

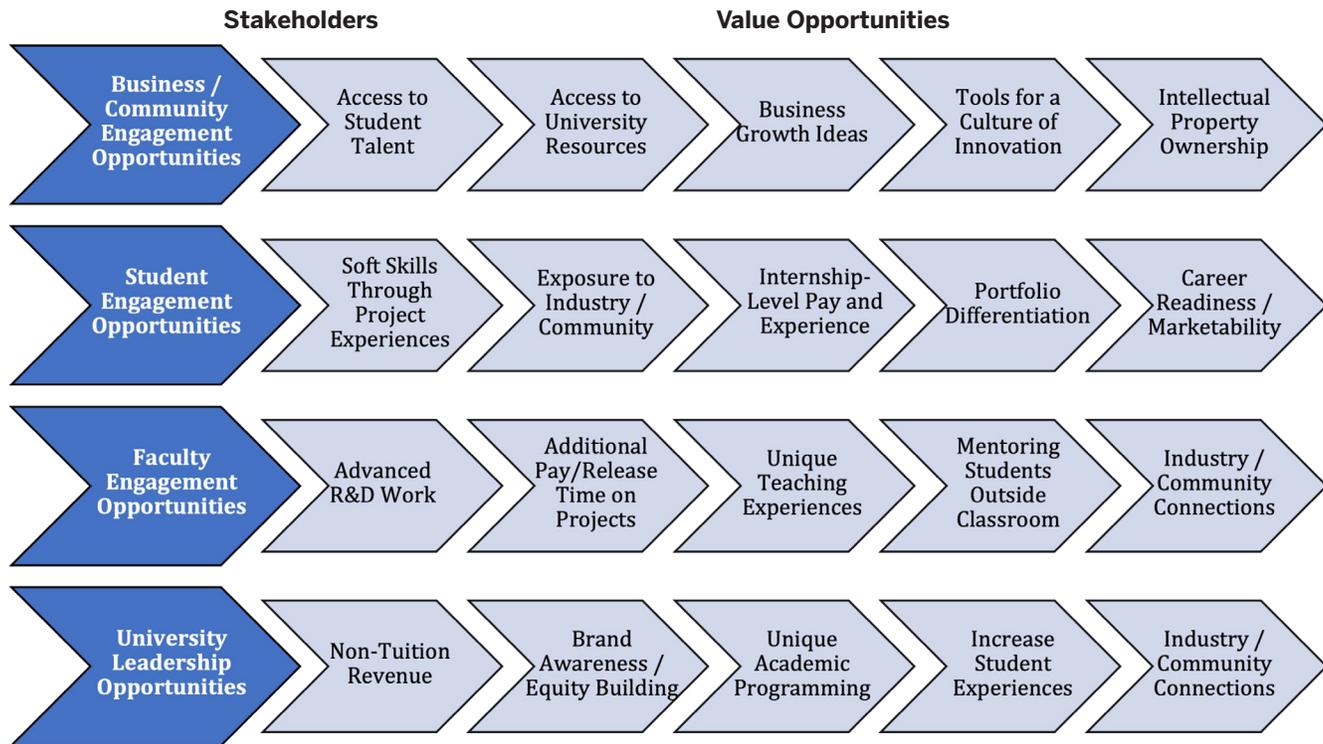
The community-sponsored, project-based work through the Innovation Hub has potential for promising partnerships. For example, a manufacturing company with fewer than 50 employees might have a small product development team and limited internal capacity. The company might seek help from KCAD/Ferris to expand its product line and add to its portfolio. The Innovation Hub can help the company identify its problem, consider its position in the market, gather relevant information, and then bring together a team of students from different areas of the college/university to help design or enhance a product, packaging, and marketing. KCAD/Ferris has the ability to respond quickly and offer customized solutions that draw on student and faculty talent and skills in areas ranging from product design and material science to app development and gaming.

When working with interested industry partners, the Innovation Hub first identifies a KCAD/Ferris faculty lead with relevant research and development expertise to develop the scope of the project and define project output and outcomes. The Innovation Hub then posts job notices to select interdisciplinary teams of undergraduate students to collaborate and support the industry partner as interns. Students apply and interview with the industry partner, the faculty lead, and Moroney. Selected students are hired by the Innovation Hub and paid a competitive wage for the duration of the project. In alignment with their KCAD/Ferris program of study and coursework, students complete industry assignments that mirror professional practice.

This academic and industry partnership has many beneficiaries.

- It provides **students** real-world experience in their program of study.
- It helps the **higher education community** to forge closer relationships with industry and community partners, and gives students an improved academic experience under the guidance and mentorship of faculty.

Figure 1. KCAD Innovation Hub Stakeholder—Value Opportunities



- It provides the **industry partner** with a personalized, action-oriented approach to strategically plan, design, and implement a solution to a defined problem with the support of a dedicated team of faculty and students. The industry partner can evaluate creative talent for hire as an intern or entry-level employee in the future.
- It builds and reinforces a **community** in which small businesses, including start-ups, are uniquely supported to problem-solve and grow.

Collaborating in Teams to Align the Necessary Mathematics Skills and Competencies for Project Engagement

The Innovation Hub selects teams of students who bring specific skills, interests, and competencies that best serve the industry partners' project needs. The process of forming interdisciplinary project teams reflects the approach taken in many workplaces and gives the students the opportunity to share their diverse talents and perspectives in an environment that encourages creative problem solving, teamwork, and communication.

In the case of manufacturing, industry partners benefit from teams that integrate design considerations and innovations with best practice in engineering and manufacturing processes. KCAD students excel in design thinking; they can make valuable contributions about the look, feel, color, material, finish, and usability of a product, skillfully sketching or building

models that present their ideas. These prototypes allow engineers to analyze certain aspects of designs before they are built.

While one may not always think of mathematics as core to art and design, it is embedded. According to Moroney, KCAD “embrace[s] the STEAM model—science, engineering, technology, arts, and mathematics” when teaching design and how to make products and compositions that are aesthetically pleasing to the eye and human-centered. He also noted that the required research methods class for KCAD students’ program of study introduces foundational statistical concepts. KCAD students must choose one mathematics or science course as part of their general education studies.

The Math in Art and Design course focuses on the study of the relationships between mathematics and the arts. It covers basic mathematical concepts such as number systems, logic, probability, basic statistics, algebraic formulas, geometry, and some trigonometry. Michael Marmo, an adjunct instructor who teaches the course, is a chemical engineer and enjoys finding ways to make mathematics relevant to the highly creative and artistically talented students.

Marmo pointed out that he avoids multiple choice assessments and prefers more complex word problems and applications that require multiple steps and calculations. At the end of the course, students complete a project that showcases the relationship between mathematics and the arts, submitting a report on a selected topic in mathematics that has an artistic dimension. Marmo highlighted a project in which a student used John Coltrane’s music that followed the Circle of Fifths, a musical method to organize 12 chromatic pitches as a sequence of perfect fifths, to describe his creation of a collection of cocktail tables.

Moroney is currently integrating lessons learned from early work with the Innovation Hub into curriculum development. In spring 2022, KCAD will pilot an elective course on interdisciplinary product development that will allow students to work as part of engineering and design teams for four specific, company-sponsored projects within a

single industry area. The goal is for students to apply their academic learning with peers in an incubator-like environment in which cross-project ideas can be shared and refined. To students, the course will feel more like an internship and a professional experience than a typical college class. As the Innovation Hub evolves, KCAD may consider how best to integrate complex mathematics skills and knowledge into the overall learning experience.

Promising Trends Toward Economic Prosperity and Talent Development

KCAD and Ferris State University have positioned themselves as core partners in providing a pipeline of graduates who can bring innovative solutions to the robust manufacturing and design communities of Greater Grand Rapids. Essential to this work are interdisciplinary teaching and the integration of the most in-demand workforce skills such as critical thinking, complex problem solving, and creativity.³ According to Moroney, “The Innovation Hub provides an opportunity to apply those skills in an advanced project working in real-world context.”

³ <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/>

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