

Board 186: A Hands-On, Dual-Credit Mechatronics Pathway Overview for Secondary & Post-Secondary Educators

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Dr. Karen Wosczyzna-Birch has been a champion of engineering and technology education for the past 30 years. Since 1995, she has been the State Director of the CT College of Technology (COT) where her leadership has been instrumental in creating nationally recognized seamless pathway programs in engineering and technology between all 12 public community colleges in CT with 10 universities and high schools. She is also the Executive Director and Principal Investigator of the National Center for Next Generation Manufacturing (NCNGM), a National Science Foundation (NSF) Center of Excellence and a Professor of Applied Technology at Tunxis Community College. Since 2004, she has received over \$30M in funding from the NSF, including two grants for international partnerships. Karen has implemented strategies resulting in an increase in the enrollment of underrepresented populations in STEM programs at the community colleges.

Karen has received numerous awards for her accomplishments as a professor and for her passion for increasing the diversity of the STEM population including the 2016 Distinguished Service Award from the international honor society Epsilon Pi Tau (EPT), the 2018 CT Women of Innovation Award in the Postsecondary Academic Innovation & Leadership Category, the 2012 New England Board of Higher Education Excellence Award for the State of CT and most recently, the 2020 HI TEC Innovative Program of the Year Award and 2021 ITEEA Special Recognition Award. In 2014, she was invited to the White House College Opportunity Summit recognizing leaders like Karen for their commitment to STEM education. She also serves on numerous local and national boards including the Epsilon Pi Tau Honor Society, Hartford High's Pathway for Engineering and Green Technology, and the Connecticut Technical Education and Career System.

Wendy Robicheau

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According to a study by Deloitte and the Manufacturing Institute [1], “Over the next decade, 4 million manufacturing jobs will likely be needed, and 2.1 million are expected to go unfilled if we do not inspire more people to pursue modern manufacturing careers.” The mission of the National Science Foundation Advanced Technological Education (NSF ATE) funded National Center for Next Generation Manufacturing (NCNGM) is to cultivate and nurture partnerships with advanced manufacturing stakeholders, creating a national network throughout the United States to further develop a diverse technical workforce. Through the collaboration of the NCNGM and the NSF ATE funded Independent Mechatronics Technical Curriculum (iMEC) 2.0 project, a series of mechatronics professional development workshops have been offered and expanded to include participants from twelve additional states and will continue to expand nationally to provide hands-on curriculum and recruitment opportunities for community college mechatronics programs. This paper will provide overviews of these NSF ATE grants, the related advanced manufacturing programs and dual enrollment pathway in mechatronics, and the professional development workshops offered to high school and community college educators.

About the NSF ATE grants

The NCNGM, which expands upon the work of the previous NSF ATE funding, is developing a national manufacturing network to establish best practices for educating the future advanced manufacturing workforce. The NCNGM leadership team is composed of community college faculty in advanced manufacturing disciplines from across the United States. In addition to overseeing overall grant initiatives, members of the leadership oversee Technology Teams tasked with identifying and disseminating, and developing when needed, best practices for student recruitment and retention, providing professional development for faculty, and creating a repository of advanced manufacturing education materials.

The NCNGM leadership team includes representatives from a community college that offers a mechatronics dual enrollment program with local high schools and, through its own NSF ATE project grant called iMEC 2.0, offered professional development workshops to share the best practices of their program. Workshops are attended by high school and community college educators who currently offer or are exploring offering a mechatronics program. During these workshops, participants learn about a pathway that gives high school students access to four online entry-level, hands-on mechatronics courses and best practices for delivering those courses. The four courses are Concepts of Electronics, Intro to Instrumentation, Intro to PLCs, and Application of Industrial Sensors. Participants also build a desktop mechatronics trainer based on which of the four courses the workshop is covering and keep it for use in their own classrooms. To accomplish this, the workshop instructors provide participants with all the components of the desktop trainers from metal bases to all electrical and mechanical parts. Participants go step-by-step through the process of assembling the trainers as their students would do including troubleshooting any issues. Each trainer works independently, but all four be attached to create. Finally, participants are provided with the curriculum that corresponds to the course.

Results of expanding professional development workshops to a national model

The NCNGM began its partnership with the iMEC 2.0 project by hosting an eight-hour Concepts of Electronics Workshop at the High Impact Technology Exchange Conference (HI-TEC) in Salt Lake City in 2022, which was attended by twenty high school and community college educators from across the country. In February 2023, a full four-day Concepts of Electronics Workshop was held for twenty high school and community college educators at Hillsborough Community College in Florida. During the summer of 2023, all four courses were held at Central Community College in Nebraska for both local participants as well as those from across the country for a total of eighteen participants. In March 2024, a workshop was held for three faculty members from Columbia Gorge Community College in Washington.

Overall, the workshops had 61 attendees from eleven states. Curriculum and trainers were implemented in six community colleges, thirty new courses were developed among these colleges, and dual enrollment programs were expanded. Four community colleges and one high school, each in a different state, have purchased additional mechatronics trainer kits for classroom use. This demonstrates the partnership between the NCNGM and iMEC 2.0 project has not only allowed for the dissemination of information, but also the expansion of this model professional development workshop and model curriculum at the national level. Currently, these results are based on the workshop attendees reaching out to the organizers for additional information and mechatronics trainer kits. Beginning with the summer 2023 workshops, participants will receive an additional survey approximately ten months after the workshops to determine impacts including if the mechatronics curriculum or pathway were implemented and any enrollment, completion, and workforce data improvements. The iMEC 2.0 project team is also available for additional recommendations for program implementation.

Results of Expanding Mechatronics Professional Development Workshops Nationwide	
States Reached	11
Community College & High School Educator Attendees	61
Community Colleges using Curriculum & Trainers	6
New Courses Developed by Attendees	30

Participants completed surveys immediately after the workshop to provide overall feedback on the workshop. To date, survey data collected and aggregated by the NCNGM's external evaluator reports that 80% of the workshop participants reported high school teachers would benefit from this mechatronics professional development and 93% of the high school teachers report that they don't often have access to mechatronics professional development opportunities.

Other activities for educator and student outreach in mechatronics

In addition to professional development workshops, the iMEC 2.0 project team organized, hosted, and participated additional outreach activities for educators and students to make them aware of the technologies, careers, and educational pathways in mechatronics and injection

molding. Activities for students and educators included presentations, technology demonstrations, Skills USA events, conference events, and lab tours. Through these activities, over 600 middle and high school students and over 350 educators were able to learn about these technologies and careers in an effort to build the future advanced manufacturing workforce.

[1] P. Wellener, V. Reyes, H. Ashton, C. Moutray, "Creating pathways for tomorrow's workforce today," *Deloitte Insights*, 4, May 2021. [Online]. Available: <https://www2.deloitte.com/us/en/insights/industry/manufacturing/manufacturing-industry-diversity.html/#executive-overview> [Accessed: 30, January, 2024].