Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48156

Bridging Education and Industry: Integrating Offshore Wind Knowledge into Curricula

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Title Bridging Education and Industry: Integrating Offshore Wind Knowledge into Curricula

Abstract: This paper introduces a novel strategy for incorporating offshore wind industry skills into the curricula at Farmingdale State College, facilitated by a grant from the New York State Offshore Wind Training Institute. In response to low enrollment in standalone wind certificate courses, we have adapted our approach to integrate vital knowledge from our applied research into various existing courses. This research focuses on advanced manufacturing techniques relevant to the industry. By embedding this content throughout the curriculum, we aim to provide broader exposure for all students, familiarizing them with the opportunities and challenges within the offshore wind sector. This integration also enhances faculty engagement, allowing instructors to gain insights into the essential equipment and resources, which positions us to pursue additional funding for long-term program sustainability. Our overarching goal is to create a strong talent pipeline of skilled professionals ready to meet the dynamic demands of the offshore wind industry. This integrated approach not only increases student awareness and interest but also improves the overall quality of education and training, supporting sustainable growth and expertise in renewable energy.

Introduction

The Offshore Wind Training Institute (OWTI) [1] awarded a grant to the Principal Investigators (PIs) at Farmingdale State College to address the emerging workforce needs in the offshore wind industry. This initiative builds upon prior foundational efforts to establish wind energy education and training programs on campus, including early collaborations with major industry stakeholders such as GE [2].

Manufacturing plays a pivotal role in supporting the wind energy supply chain. Across the United States, over 500 manufacturing facilities are dedicated to producing wind energy components such as blades, towers, and generators, as well as assembling complete turbines. As wind turbines have evolved—becoming larger, more cost-effective, and more reliable—the demand for highly skilled manufacturing professionals has grown accordingly. Since 1999, the average capacity of newly installed turbines has more than doubled, now exceeding 3 megawatts [3]. With the U.S. manufacturing sector expanding its presence in wind energy component production, the need for a workforce equipped with specialized technical skills has become increasingly urgent.

The project focuses on developing advanced manufacturing skills that are crucial for the sector's growth, specifically targeting students in applied technology and engineering programs. The overarching goal is to create a sustainable talent pipeline that will prepare students to meet the industry's evolving demands and contribute to its long-term success.

Building on the lessons learned from our initial efforts in onshore wind turbine training [2] and the successful implementation of stackable micro-credentials focused on wind turbine operation

and design [4], the current project represents the next phase in scaling up offshore wind workforce development. By adapting the curriculum and integrating offshore wind manufacturing skills into existing courses, the project aims to expand the reach of training opportunities and better align educational offerings with industry requirements.

This paper outlines the progress made to date, the outcomes achieved, and the strategic steps taken to ensure the continued relevance of the program. Through a combination of faculty engagement, curriculum innovation, and industry collaboration, the project seeks to provide a broad exposure to offshore wind opportunities while fostering sustainable workforce development.

To guide this work, a mixed-methods approach was employed. This includes curriculum mapping and revision, industry-partner feedback, implementation of pilot training modules, and student feedback collected through surveys and interviews. Metrics such as enrollment data, skill acquisition benchmarks, and industry engagement have been used to assess progress and inform iterative improvements.

Project Scope

The scope of the project includes the integration of advanced manufacturing skills specific to the offshore wind industry into the curriculum at Farmingdale State College, particularly within the Mechanical Engineering Technology (MET) and related programs. The project also seeks to foster collaborations with local manufacturers and offshore wind developers, ensuring that the curriculum aligns with the immediate and long-term needs of the industry. Key milestones achieved so far include:

1. **Curriculum Integration**: Manufacturing skills relevant to offshore wind infrastructure have been successfully integrated into various existing courses, ensuring broader student exposure to the sector.
2. **Faculty Engagement**: Faculty members have been actively involved in the development of new course modules and have attended workshops and networking events to stay updated on industry trends.
3. **Stakeholder Collaboration**: Partnerships have been formed with local offshore wind stakeholders to align training modules with industry needs, particularly around advanced manufacturing.
4. **Outreach and Recruitment**: Efforts to engage underserved communities, especially in high schools, are underway with planned outreach activities in the coming months.
5. **Funding Utilization**: Grant funds have been allocated for the development of course materials, faculty training, and outreach initiatives, with a focus on sustainability and long-term impact.

Incorporating offshore wind manufacturing skills into the curriculum involves various modules with specific courses and content. Table 1 outlines the integration of these skills into existing

courses at Farmingdale State College. It details the topics covered, the target courses, and the hours dedicated to each module.

For example, in MET 308: Machine and Product Design, a dedicated three-week module was developed to introduce students to gear systems as used in both onshore and offshore wind turbines. The module covers essential topics such as gear design, manufacturing processes, assembly, and maintenance practices specific to the wind energy industry. To reinforce theoretical learning, students participated in a hands-on project delivered over the past three semesters. In this project, students were tasked with designing and building a planetary gearbox similar to those used in utility-scale wind turbines. The project required integration of mechanical components such as shafts, bearings, keys and keyways, and various types of gears. Additionally, a nacelle trainer, acquired through a previous wind energy grant, was used extensively to demonstrate real-world applications and strengthen understanding of turbine drivetrain systems. Student feedback consistently highlighted the module as a highly engaging and informative experience, significantly enhancing their awareness of the wind industry and the critical role of manufacturing within it. In MET 415: Robotics and Automated Manufacturing, a dedicated two-week AI/ML-enhanced module was developed to prepare students for emerging automation needs in the offshore wind industry. The module introduced students to wind turbine blade inspection challenges and guided them through hands-on activities using a UR3 collaborative robot and Pixy2 vision sensor. Students learned how to control the robot through both manual and Python-based programming, detect simulated blade defects using computer vision, and perform coordinate transformation to enable automated robotic response. The lab experience emphasized practical skills in robotics, vision-based inspection, and real-world calibration techniques. Student engagement and feedback reflected strong interest in the integration of AI and robotics for wind energy applications.

As shown in Table 1, a total of 91 hours has been allocated to the development and delivery of these modules. To date, 45 students have successfully completed the program, with 35 students currently active. Additionally, we anticipate significant future enrollment, with an expected 338 students participating across various courses. This overview highlights the broad scope of the program and underscores the critical role our program plays in building capacity for advanced manufacturing jobs in the offshore wind industry at the college level. By addressing these needs, this project aligns directly with the priority focus areas outlined in the OWTI grant application, including curriculum expansion, workforce training for near-term industry needs, the development of a long-term talent pipeline, and the promotion of career opportunities among underrepresented populations.

Table 1. Curriculum Integration Overview

Target Course	Topics Title	Module Hours
MET 308: Machine and Product Design	Design and Manufacturing Gears	14
MET 305: Tooling for Composites	Manufacturing Turbine Blade Using Composite Materials	12
MET 205: Material Science	Analysis and Processing of Large-Scale Cast & Forged components of Offshore Wind Turbines	8
MET 301: 3D Printing Applications	Advanced Methods for Manufacturing Wind Turbine Blades	12
MET415: Robotics MET410W: Senior Project	Wind Turbine Blade Inspection Using Robotics	12
MET 127: Advanced Manufacturing Processes	Inspection Using Robots	5
MET 351: Computer Aided Manufacturing	Awareness of large-scale manufacturing for wind turbine components	1
ENV 302: Wind Energy	Supply Chains with an Emphasis on manufacturing Opportunities	5
Non-Curriculum Activity	Outreach to High School Students	12
Non-Curriculum Activity	Innovation in Renewable Energy	10

Current Initiatives and Future Directions

As part of our ongoing efforts, we planned and executed two major outreach events aimed at introducing high school students from underserved communities to career opportunities in the offshore wind and manufacturing sectors. These events, titled *Exploring Career Pathways in the Wind Industry*, brought together approximately 40 students from multiple high schools. The program featured a panel discussion with representatives from manufacturing firms, energy companies, and wind developers based in Long Island, who shared insights into various career paths within the wind energy industry. Following the panel, students engaged in hands-on activities designed to build foundational skills relevant to technical and engineering roles in the wind sector.

In the coming months, the project team will complete the development of educational modules, implement them within the curriculum, and collect feedback to ensure their effectiveness. Faculty will continue to be engaged through workshops and training sessions, and ongoing industry feedback will be incorporated into the curriculum. Additionally, outreach programs for underserved communities will be executed to raise awareness of career opportunities in the offshore wind sector. Efforts to secure further funding will also be prioritized to ensure the sustainability and expansion of the program beyond the scope of the initial grant. To provide a clear overview of the remaining steps and key deliverables, a detailed project timeline and milestones are outlined in Table 2.

Table 2. Project Timeline and Milestone

Task/Milestone	**Scheduled Completion Date**
Phase 1: Research of Needs/Gap Analysis	August 2024
Phase 2: Recommendations for Higher Ed	February 2025
Phase 3: Pilot Creation of Educational Modules	June 2025
Phase 4: Feedback after Implementation	May 2025
Phase 5: Engagement & Outreach	Fall 2024/Spring 2025

Conclusion

The ongoing efforts of the project are advancing towards the creation of a skilled workforce ready to meet the demands of the offshore wind industry. Through the integration of offshore wind manufacturing skills into existing courses, the project has made significant strides in addressing both immediate workforce needs and long-term industry growth. By engaging faculty, students, and industry stakeholders, we have laid the groundwork for a sustainable program that will contribute to the development of a diverse and capable workforce. As the project continues, the focus will shift toward completing the course modules, conducting outreach activities, and securing additional funding to ensure the long-term viability of the program.

References

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3. Wind Manufacturing and Supply Chain | Department of Energy
4. Shirvani, Khosro, Marjaneh Issapour, and Zachary Ross Licht. "Utilizing Micro-Credentials to Infuse Renewable Energy Concepts into Engineering Technology Curriculum." 2024 ASEE Annual Conference & Exposition. 2024.