2024

Preparing Manufacturing Technicians for the Challenges of Industry 4.0

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Executive Summary

Project Overview

The "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project aims to modernize the curriculum to align better with industry needs and build a pathway from high school to community college, preparing students to succeed in manufacturing technology programs. This initiative addresses the skills gap in the local workforce by integrating advanced technological training and fostering essential problem-solving abilities required for Industry 4.0. Collaborations with the Boys and Girls Club and local industry partners enhance student awareness of manufacturing career paths and ensure that training meets current industry standards. Through these efforts, the project seeks to increase student enrollment and retention in manufacturing programs and prepare a skilled workforce for high-demand technical positions.

Goals and Objectives The project is guided by three primary goals:

Prepare faculty to use Industry 4.0 equipment and teach relevant skills.

- **Objective:** Ensure at least 80% of faculty and staff are proficient in new technologies and can incorporate Industry 4.0 standards into their courses.

Recruit and retain underserved populations in mid-skill level education and employment opportunities.

- **Objective:** Increase Black male enrollment and overall degree program enrollment by 20% each year.

Enhance workforce preparation for students entering local industry sectors.

- **Objective:** Ensure 90% of graduates score at least 80% on ECC's updated outcome rubric and increase the hiring of program completers by 10%.

Accomplishments

In its first year, the project established a robust tutoring and mentoring program:

- **Tutor/Mentor Program:** Successfully hired and trained tutor/mentors to support students at the Boys and Girls Club, focusing on academic assistance and career counseling.

- **Surveys and Data Collection:** Conducted surveys to gather baseline data on student aspirations and academic performance, revealing significant insights into their career interests and educational needs.
- **Industry Partner Skill Gaps Identification:** Developed a baseline survey based on industry feedback to align the curriculum with the needs of entry-level positions in manufacturing. Advisory board meetings provided critical input on required skills for entry-level manufacturing positions, identifying gaps in technical skills, electrical/electronics knowledge, safety practices, and basic arithmetic and algebra skills.

Products

Key steps and deliverables achieved include:

- **Initial Responsibilities:** Outlined the hiring process, conducted background checks, and provided comprehensive training for tutor/mentors.
- **Ongoing Responsibilities:** Implemented a system for tracking and approving timesheets, ensuring accurate payment and continuous student support.
- **Final Responsibilities:** Planned assessment and feedback sessions to evaluate the impact of the tutoring and mentoring program.

Participants and Organizations

The project's success is driven by collaborative efforts from a diverse group of leaders and organizations, including ECC, BGTRR, and local school systems. These relationships are leveraged to build a cohesive community dedicated to preparing students for Industry 4.0 demands.

Impact

The project has a significant impact on ECC, students, and the broader community:

- **Institutional Growth:** ECC is gaining valuable experience in managing NSF grants, enhancing its capacity for future projects.
- **Strengthening Collaborations:** The project fosters lasting partnerships among educational and community organizations.

- **Student Preparedness and Career Awareness:** Early intervention through tutoring and mentoring improves student readiness for post-secondary education and career paths in manufacturing.
- **Community and Economic Impact:** The project supports regional economic growth by preparing a skilled workforce and promoting inclusivity.

Changes/Problems

Several challenges were encountered and addressed during the project's implementation:

- **Staff Turnover and Role Transition:** The retirement of the PI led to the transition of the Co-PI to the PI position.
- **Hiring and Payment of Tutor/Mentors:** ECC faced initial challenges in understanding hiring processes but resolved these with the help of the finance department.
- **New to NSF Grant Management:** ECC dedicated time to learning NSF grant requirements, building its capacity for future grants.

The first year has been crucial for testing, refining, and optimizing various aspects of the project, ensuring its continued success and sustainability. The lessons learned will be invaluable for future initiatives, contributing to the development of a skilled workforce ready to meet the challenges of Industry 4.0.

Project Overview

The "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project aims to modernize the curriculum to align better with industry needs and to build a pathway from high school to community college, preparing students to succeed in manufacturing technology programs. This initiative addresses the skills gap in the local workforce by integrating advanced technological training and fostering essential problem-solving abilities required for Industry 4.0.

To achieve these goals, the project collaborates with the Boys and Girls Club to raise awareness among students about manufacturing career paths and ensure they take the right courses in high school to succeed in this program. Additionally, the project involves local industry partners to provide insights and resources for curriculum development, ensuring that the training meets current industry standards and needs.

Through these collaborative efforts, the project not only aims to increase student enrollment and retention in manufacturing technology programs but also to enhance the preparedness of graduates for high-demand technical positions in the manufacturing sector. The goal is to create a skilled workforce that can thrive in the evolving landscape of Industry 4.0.

Goals and Objectives

The project is underpinned by a series of well-defined goals and objectives that collectively aim to enhance the scope, quality, and inclusivity of manufacturing education. These goals and objectives are designed to ensure that the project not only meets the immediate training needs of students but also contributes significantly to the broader aim of developing a skilled, diverse workforce equipped to thrive in the dynamic manufacturing industry. Emphasizing collaboration, inclusivity, and practical training, the project seeks to bridge educational efforts with real-world applications, benefiting students, the manufacturing industry, and the wider community.

Goal 1: Prepare faculty to use the equipment and be able to teach the skills needed in local industry 4.0 sectors.

- **Objective 1.1:** At least 80% of faculty and staff will report that they know how to use the new technology that aligns with local industry use.

- **Objective 1.2:** At least 80% of faculty and staff will report that their courses support Industry 4.0 standards through hands-on experiences via simulators or troubleshooting exercises.

Goal 2: ECC will more effectively recruit and retain underserved populations into mid-skill level education and employment opportunities.

- **Objective 2.1:** Increase Black male enrollment, currently at 5, to over 20 by the end of the project.
- **Objective 2.2:** Increase overall enrollment in the degree programs, currently at a cumulative enrollment of 17, by 20% each year.

Goal 3: Increase the workforce preparation for our students going into our local industry 4.0 sectors.

- **Objective 3.1:** 90% of graduates will score at least 80% on ECC's Instructional Programs' Outcome Rubric, which will be updated to reflect the curriculum changes.
- **Objective 3.2:** Increase by 10% the number of maintenance technicians being hired from the successful completers of these programs by the end of year 3.

By aligning these specific objectives with each goal, the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project outlines a clear and actionable roadmap. This approach not only addresses the immediate training needs of the students but also contributes significantly to broader objectives, such as developing a skilled, diverse workforce ready to meet the demands of the dynamic manufacturing industry.

The remainder of this Annual Report follows the PAPPG Guidance for reporting.

Accomplishments

Establishment of Tutoring and Mentoring Program

In the first year of the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project, several key accomplishments have been achieved, setting a solid foundation for the future. The project has successfully hired tutor/mentors to work with students at the Boys and Girls Club, focusing on guiding them towards successful post-secondary

educational pathways. These mentors play a crucial role in supporting students by providing targeted academic assistance and career counseling.

To better understand and serve the needs of these students, a comprehensive survey was conducted to gather baseline data on their post-secondary aspirations, course-taking patterns, and academic performance. The survey revealed several important insights:

Middle School Survey Findings:

Career Interests: Students expressed a wide range of career aspirations, often influenced by both ambition and a lack of awareness of practical career pathways.

Educational and Career Preparation: Many students indicated a strong desire for detailed guidance on potential career paths and the necessary high school coursework to achieve their goals. This underscores the importance of providing comprehensive career counseling and early mentoring to help students make informed decisions about their futures.

High School Survey Findings:

Post-High School Aspirations: A significant majority of students (88%) expressed a preference for continuing their education at four-year colleges in North Carolina, reflecting a strong inclination towards higher education. Unfortunately, most of these students were not on a pathway that would qualify them for enrollment in UNC system 4-year colleges.

Career Interests: Career aspirations varied widely, with many students showing interest in fields such as entertainment, military and law enforcement, graphic design, and business management. The feasibility of these career paths in rural North Carolina was noted, with some requiring students to seek opportunities beyond their immediate locality.

Educational and Career Preparation: The survey highlighted a critical need for support mechanisms, as 40% of students were enrolled in remedial math classes despite having strong math abilities based on previous scores. This indicates a misalignment between student potential and their current educational placement.

These findings provide valuable insights into the academic and career aspirations of the students, enabling the project to tailor its support strategies effectively. The data on course-

taking patterns and academic performance revealed that many students with strong math abilities were placed in remedial math classes. This information is crucial for the tutor/mentors as it guides them in providing the necessary support to help these students graduate from high school prepared to succeed in advanced manufacturing.

By addressing these gaps and providing targeted support, the project aims to better prepare students for success in post-secondary education and future careers in manufacturing technology. This initial data collection and analysis set the stage for informed decision-making and continuous improvement in the project's implementation, ensuring that the needs of the students are met effectively.

Industry Partner Skill Gaps Identification

Industry Partner Insights and Survey Development

The project team gathered information through advisory board meetings about what skills are important. This input was instrumental in shaping the project's focus and the development of a baseline survey aimed at understanding the industry's needs and aligning the curriculum accordingly. The skill gaps identified for entry-level positions in the manufacturing sector were categorized into four main areas: Technical Skills, Electrical/Electronics Knowledge, Safety Practices, and Basic Arithmetic and Algebra Skills.

Technical Skills: These encompass the practical, job-specific abilities necessary for performing tasks in manufacturing settings, including:

- Troubleshooting and controlling various systems such as power supplies, motor circuits, and industrial networks.
- Using diagnostic tools like digital and analog multimeters, portable oscilloscopes, and vibration analysis equipment.
- Understanding and maintaining hydraulic, pneumatic, and electromechanical systems.

Electrical/Electronics Knowledge: This area includes fundamental electrical and electronic concepts essential for entry-level technicians, such as:

- Calculating and solving voltage, current, resistance, and power.

- Grasping transformer and motor theory, as well as AC and DC principles.
- Recognizing and applying knowledge of components like resistors, capacitors, inductors, diodes, and transistors.

Safety Practices: Safety is a paramount concern in the manufacturing industry. The feedback emphasized the importance of understanding and adhering to safety protocols, which include:

- Knowledge of Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).
- Proper handling and use of Personal Protective Equipment (PPE).
- Adherence to safety protocols for operating machinery and handling hazardous materials.
- Emergency response procedures and maintaining a safe work environment.

Basic Arithmetic and Algebra Skills: Basic math skills are crucial for technical tasks in manufacturing. The survey included questions to assess the importance of:

- Basic arithmetic operations (addition, subtraction, multiplication, division).
- Solving for unknowns in algebraic equations.
- Understanding ratios, proportions, and percentages.
- Applying mathematical concepts to real-world problems, such as calculating dimensions, tolerances, and material requirements.

By incorporating feedback from industry partners into the baseline survey, the project ensures that the curriculum and training initiatives are closely aligned with the current demands of the manufacturing sector. This approach not only addresses the immediate training needs of the students but also contributes significantly to the broader objective of developing a skilled workforce capable of meeting the evolving challenges of Industry 4.0.

Equipment Purchased

Simulation equipment, Amatrol Skill Boss Assembly, was purchased to use with students at the Boys and Girls Club to introduce advanced manufacturing technology to them.

Amatrol Pneumatic Troubleshooting module 950-PT1 $ 0.0 and Amatrol Vibration Analysis module 95-ME5A have also been purchased.

Products

In the first year of the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project, significant progress was made in establishing a robust tutoring and mentoring program. The following steps and deliverables were achieved in collaboration with the ECC financial department to ensure the effective hiring and training of tutor/mentors.

Initial Responsibilities

- **Hiring Process:** Worked closely with the ECC financial department to outline the hiring process, including the development of job descriptions, collection of resumes, conducting background checks, and setting up training sessions for the new hires.
- **Training Sessions:** Conducted comprehensive training for the hired tutor/mentors, covering their roles, responsibilities, and expectations within the program. This training ensured that all mentors are well-prepared to support the students effectively.

Ongoing Responsibilities

- **Timesheet Management:** Established a system for tracking and approving timesheets to ensure accurate and timely payment for tutor/mentors. This process includes regular submission of timesheets by the mentors, which are then reviewed and approved by their supervisors.
- **Student Support:** Tutor/mentors began working with students, providing academic assistance, career guidance, and mentoring. This ongoing support is crucial for helping students navigate their educational and career paths successfully.

Final Responsibilities

- **Assessment and Feedback:** As part of their final responsibilities, tutor/mentors will participate in evaluation sessions to assess their impact on the students. This includes collecting feedback from students and supervisors to identify areas for improvement and ensure continuous enhancement of the mentoring program.

Updates and Next Steps

- **Tutor/Mentor Hiring:** All tutor/mentors have been successfully hired and trained. They are currently actively supporting students at the Boys and Girls Club.

- **Timesheet Submission:** The process for submitting and approving timesheets is fully operational, ensuring that mentors are compensated accurately and promptly.
- **Program Evaluation:** Regular evaluation meetings are scheduled to review the progress of the mentoring program, gather feedback, and make necessary adjustments to improve its effectiveness.

By establishing these foundational elements, the project has created a structured and supportive environment for both the tutor/mentors and the students. This approach ensures that the students receive the guidance and support they need to succeed in their educational and career pursuits, ultimately contributing to the development of a skilled workforce ready to meet the challenges of Industry 4.0.

Participants/Organizations

The success of the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project hinges on the collaborative efforts of a diverse group of leaders and organizations. These relationships are vital for building a supportive and interconnected community that will drive the project forward. The key participants and their respective organizations are outlined below:

Project Leadership:

- **Merdikae Williams, PI** – Principal Investigator, Edgecombe Community College
- **Ron Green** – CEO, Boys & Girls Club of Tar River Region (BGTRR), Collaborator
- **Bill Farmer** – Board Chair, BGTRR, Collaborator
- **Durell Petway** – – BGTRR Liaison to ECC
- **Dr. Andrew Bryan** – Superintendent, Edgecombe County Public Schools, BGTRR Board Member, Collaborator
- **Dr. Steve Ellis** – Superintendent, Nash County Public Schools, BGTRR Board Member, Collaborator
- **Viola Harris** – Edgecombe Community College, BGTRR Board Member, Collaborator

Leveraging Relationships to Build a Collaborative Community

The relationships between the project leadership, the Boys & Girls Club of Tar River Region (BGTRR), the local school systems, and Edgecombe Community College (ECC) form

the backbone of this initiative. By leveraging these connections, the project aims to create a cohesive and collaborative community dedicated to preparing students for the demands of Industry 4.0.

Collaboration with BGTRR: The involvement of Ron Green and Bill Farmer from BGTRR ensures that the project benefits from the organization's extensive experience in youth development and community engagement. Their leadership will facilitate effective communication and collaboration between BGTRR and ECC. LaMarr Walker and Durell Petway, serving as key liaisons from BGTRR to ECC, will play critical roles in maintaining a seamless flow of information and coordinating joint activities.

Integration with the School System: Dr. Andrew Bryan and Dr. Steve Ellis, both superintendents of Edgecombe and Nash County Public Schools respectively, bring valuable insights from the educational sector. Their involvement ensures that the project aligns with the needs and priorities of the local school systems. By integrating the project's goals with the curricula and programs of the schools, they will help create a clear and supportive pathway for students from high school to community college.

Institutional Support from ECC: Merdikae Williams, as the Principal Investigator, leads the project with a strategic vision and a deep understanding of ECC's capabilities. Viola Harris, another BGTRR Board Member from ECC, reinforces the college's commitment to the project. Their combined efforts will ensure that ECC's resources, faculty expertise, and facilities are effectively utilized to support the project's objectives.

Building a Collaborative Community

The synergy between these leaders and organizations will be leveraged to create a collaborative community that supports the project's success. Regular meetings, joint initiatives, and shared goals will foster a sense of ownership and mutual commitment among all stakeholders. By working together, the project aims to:

- **Enhance Communication and Coordination:** Establishing clear channels of communication between BGTRR, ECC, and the school systems to ensure that all activities are well-coordinated and aligned with the project's objectives.

- **Develop Comprehensive Support Systems:** Creating robust support systems for students, including mentoring, tutoring, and career counseling, to guide them through their educational and career pathways.
- **Align Educational and Industry Needs:** Ensuring that the curriculum and training programs are closely aligned with industry needs, thereby enhancing students' employability and readiness for Industry 4.0.

Through these collaborative efforts, the project will not only achieve its immediate goals but also lay the groundwork for a sustainable and integrated approach to workforce development in the region.

Impact

The "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project has a profound and far-reaching impact on Edgecombe Community College (ECC), the students, and the broader community. This initiative is not only about addressing immediate educational needs but also about creating a legacy of collaboration, enhanced capabilities, and improved workforce readiness.

Institutional Growth and Learning: ECC is relatively new to managing grants, especially NSF grants, and this project has been a significant learning experience. Through this process, ECC is gaining invaluable knowledge about grant management, compliance, and effective project implementation. This experience is building the college's capacity to handle future grants more effectively, thereby enhancing its ability to attract and manage additional funding sources. The skills and knowledge acquired during this project will serve ECC well in future endeavors, enabling it to undertake more complex and impactful projects.

Strengthening Collaborations: The relationships being forged among the project’s collaborating partners—including ECC, the Boys & Girls Club of Tar River Region (BGTRR), and the local school systems—are creating a strong, interconnected community focused on educational and workforce development. These partnerships are not just for the duration of the project but are expected to be lasting. The ongoing collaboration will continue to benefit the community, fostering a culture of cooperation and mutual support. The involvement of key stakeholders, such as the superintendents of Edgecombe and Nash County Public Schools,

ensures that these relationships are deeply rooted and will endure, providing a stable foundation for future initiatives.

Enhanced Student Preparedness and Career Awareness: One of the most significant impacts of the project is on the students themselves. By putting in place tutoring and mentoring programs for high school and middle school students, the project is ensuring that more students are prepared to succeed if they choose to enter the ECC program after graduation. Pre-survey data showed that students had very limited awareness of career possibilities. The support provided by tutors and mentors helps students improve their academic performance and gain the skills needed to be ready for post-secondary education, while also increasing their awareness of various career paths in manufacturing technology. This early intervention is crucial in helping students develop the foundational knowledge and skills required for success in the ECC manufacturing technology program.

Community and Economic Impact: The project is also making a broader impact on the local community and economy. By preparing a skilled workforce, the initiative helps attract and retain manufacturing industries in the region, which in turn creates job opportunities and stimulates economic growth. The project's focus on inclusivity and reaching underserved populations ensures that the benefits are widely distributed, helping to reduce socioeconomic disparities and promote social mobility.

Future Curriculum Enhancements: While the current focus has been on preparing students through tutoring and mentoring, the next phase of the project will involve changing the curriculum at ECC to better align with Industry 4.0 requirements. This future enhancement will ensure that the ECC program provides students with the most relevant and up-to-date training, further increasing their chances of success in the manufacturing sector. By gradually implementing these changes, ECC is setting the stage for sustained improvements in its educational offerings.

The "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project is more than just an educational initiative; it is a catalyst for systemic change. Through building institutional capacity, fostering lasting collaborations, enhancing student preparedness and career awareness, and driving community and economic development, the project is creating a legacy that will benefit ECC, its students, and the broader community for years to come. The knowledge

gained, relationships built, and students prepared through this project are testaments to its broad and enduring impact.

Changes/Problems

As the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project began its implementation, several obstacles were encountered, requiring thoughtful consideration and strategic adaptations to ensure the program's success and efficacy. The following challenges were identified and addressed to navigate the complexities and ensure the project's progress:

Staff Turnover and Role Transition

- **Challenge:** The Principal Investigator (PI) retired, leading to a gap in leadership and project oversight.
- **Adaptation:** The Co-PI was moved to the PI position. This transition took some time to ensure a smooth handover of responsibilities and to maintain continuity in project management.

Hiring and Payment of Tutor/Mentors

- **Challenge:** ECC initially faced challenges in understanding how to hire and pay the tutor/mentors. The process involved deciding on the type of employment (1099 vs. W-2) and determining the necessary records and contracts.
- **Adaptation:** ECC involved staff from the finance department to help decide on contracting, record-keeping requirements, and employment classification. Although this took a while to work out, the process was successfully completed, allowing the project to proceed with hiring and training the tutor/mentors.

New to NSF Grant Management

- **Challenge:** ECC's inexperience with managing NSF grants posed challenges in setting up accounts, learning about grant requirements, and ensuring compliance with NSF guidelines.
- **Adaptation:** ECC dedicated time and resources to learning about NSF grant management. This included training staff on grant requirements, setting up appropriate financial accounts, and establishing procedures to ensure compliance with NSF guidelines. This learning process has built ECC's capacity for handling future grants more effectively.

Implementation Adjustments

- **Challenge:** The initial phase required substantial adjustments to accommodate the unforeseen complexities in managing grant-funded projects.
- **Adaptation:** ECC adopted a flexible approach to address these challenges. By involving various departments and stakeholders, ECC ensured that all aspects of the project were thoroughly understood and managed. This collaborative effort helped in overcoming the initial hurdles and laid a strong foundation for future activities.

Recognizing these challenges as part of the project's evolutionary process, the first year has been crucial for identifying and addressing natural obstacles. This period has served as a vital opportunity to test, refine, and optimize various aspects of the project, from staffing and financial management to compliance with NSF requirements. The lessons learned during this phase will be invaluable for the continued success and sustainability of the "Preparing Manufacturing Technicians for the Challenges of Industry 4.0" project.