Building an Academic Pathway for Industrial Engineering Operations Technicians

Addressing the industry need for educating qualified Industrial Engineering Technicians by creating an interdisciplinary curriculum pathway with a specialization in logistics that integrates information technology, industrial engineering, and supply chain operations.

Project Overview

Columbus State Community College in collaboration with Eastland-Fairfield Career Center and its 16 associated school districts, Franklin University, and key regional industry partners, will research and **develop a new multi-disciplinary academic pathway in Industrial Engineering Technology with a focus in the logistics sector.** This project will research, design and develop a high school pre-industrial engineering technology curriculum and an associate degree curriculum that incorporates engineering, information technology and logistics operations principles delivered through a blended delivery model that integrates learning objects methodology. Instructional and student support systems will be designed to provide the optimal environment for student success. The overall project goal is to create a career pathway for industrial engineering technicians with the STEM and subject matter knowledge to support the increasingly complex technology needs of the supply chain sector while providing program graduates opportunities in a variety of industries.

Intellectual Merit

The initiatives in this proposal will result in a **new educational pathway** for supply chain Industrial Engineering Operations Technicians by creating a high school certificate program and an Associate of Applied Science degree that incorporate a multi-disciplinary academic foundation in computer science, industrial engineering, and supply chain principles and methodologies. These will prepare program graduates for meaningful positions in a variety of industries and with several employment-ready exit points. The project deliverables will provide a blueprint for other high school and 2 year programs throughout the country. This initiative will design and promote 2+2+2 articulation pathways, creating a pipeline of technical education from the high school to community college to four-year institutions.

The program will be delivered in a **blended format that incorporates online instruction and classroom/laboratory training**. The College has been a leader in the development of distance learning and is the largest provider of this type of instruction in Ohio. It has over 15 years of experience delivering entire certificates and degree in a totally online or blended environment. More than half of their academic programs are delivered totally at a distance. Additionally, the College has been proactive in incorporating learning objects and other state-of-the-art methodology into the college's existing Blackboard course management system.

Broader Impacts

The logistics sector offers career ladders to family-supporting occupations that employ 9% of the regions workforce in central Ohio. Labor data projects that this industry in the central Ohio region is experiencing growth that is expected to increase at 11.8% over the next seven years with over 200 annual openings. This proposal will provide students another associate-degree level career pathway in this critical sector, one for which national research data and local employer input evidence significant need. The high school outreach program will enable this curriculum to be available at institutions that have historically been unable to afford the faculty and equipment expenses associated with such a program. Finally, the project will focus on advancing outreach to underserved populations including minorities, women, and veterans in the region thereby increasing the talent pool for industry and providing these populations opportunities in a high demand, high growth sector.

Building an Academic Pathway for Industrial Engineering Operations Technicians
Project Narrative

Introduction

Columbus State Community College in collaboration with Eastland-Fairfield Career Center and its 16 associated school districts, Franklin University's Operations Engineering program, the Columbus Region Logistics Council and its more than 100 member companies representing the logistics operation function in multiple industrial sectors, and several other industry partners, will develop a new multi-disciplinary 2+2+2 career pathway in Industrial Engineering Operations Technology, pre-college education initiative, and a curriculum design to optimize emerging techniques and technologies in distance education including integrated learning objects, virtual simulations, and a STEM-intensive curriculum that incorporates education in industrial engineering, information technology, and operations to prepare a technical workforce appropriately educated to support the increasingly complex supply chain operations infrastructure.

By developing career pathways for Industrial Operations Technicians, and meeting the industry need for this skilled workforce, this proposal will achieve three critical goals:

- Establish an academic model for STEM-intensive programs that can be used to support a variety of technical occupations and sectors.
- Provide access to careers that offer significant earnings potential in the central Ohio area and provide flexible skill sets to meet the needs of many industries.
- Increase diversity in the workforce through intensified outreach to underserved populations such as women, minorities, and veterans.

Description of Prior NSF Support

In 2001, Columbus State Community College partnered with the Engineering Technology program at Miami University Middletown Campus (Middletown, Ohio) and was awarded an NSF ATE support grant.

Project Title	Award #	Amount	Start Date	End Date
Engineering Technology Pipeline Partnership	0101607	$350,000	05/01/2001	04/30/2004

The project resulted in multiple articulation agreements with inner city high schools in the central Ohio region and the development of multiple pre-college outreach initiatives such as Invention Convention, FIRST Robotics, and LEGO Challenge. With the purpose of continuing the work of the NSF grant, Columbus State Community College applied for and was awarded a $1 million U.S. Department of Labor grant. A key outcome of that grant was the design and installation of an Integrated Systems Technology simulation laboratory on its Columbus Campus. One of the few remaining in operation, this laboratory has been updated and expanded and continues to serve the educational needs of engineering students.

Motivating Rationale

The need for additional, more advanced technical skills arose, in large part, from discussions with key executives from approximately 25 organizations representing a variety of sectors. These discussions led to the following insights regarding future workforce skill needs:

- Understand how to assess/measure current supply chain engineering and how to develop technical training models that anticipate and plan for future needs
- Be familiar with supply chain information systems and identify system needs for planning, warehouse management, and engineering models
- Understand supply chain engineering performance measurement and how to map performance metrics and measures

- Comprehend the fundamental components of industrial simulation models and how to build them using commercially available software

Further research has shown that these capabilities best align with an industrial engineering framework. Additionally, development of these skills is predicated on a strong foundation in mathematics and physics. These insights echo national workforce surveys citing the lack of technical skills as a key gap in the logistics sector workforce. (Manpower Group, Sixth Talent Shortage Survey)

1. **The operations sector is critical to the continuing growth of the central Ohio area. Attracting and retaining a competent technical workforce will be a must for the continued economic stability of the region.**
   - Operations is a key industrial sector in the central Ohio area. As the need for a workforce with increasingly sophisticated technology skills increases, the need for a curriculum that provides individuals with foundational STEM knowledge as well as integrated technical skills in industrial engineering, information technology and operations becomes equally important. As a major academic provider of workforce development for the region, Columbus State Community College seeks to expand its academic programs to reflect these advanced technical skills.
   - The logistics industry's future growth will depend in large part on industrial engineering optimization of supply chains. According to the Motorola Warehouse Vision Study (Motorola, 2013), "approximately two-thirds of the company respondents plan to increasingly automate processes by equipping staff with new technology solutions." Additionally, industry professionals project a move from traditional tracking processes to mobile solutions including mobile computers and tablets by 2018.
   - According to the National Center for Supply Chain Technology Education (Foundational Skills of the Supply Chain Technician, 2013), technicians in supply chain oversee a variety of software and equipment related to mechanical, applied electronics, manufacturing, automated systems and information technology.

2. **While national, 'best practices' models exist, none are available in the central Ohio area and none is offered at the community college level**.
   - According to the Ball State University *Manufacturing and Logistics Report Card* (Ball State University, 2013), Ohio is one of only two states with an "A" grade in the importance of its manufacturing and logistics sector. However, the same report shows that Ohio merits only a "C" in development of human capital. It is this significant gap for trained Industrial Engineering Operations Technicians that this grant will seek to ameliorate.
   - Review of the academic offerings in the region evidences an absence of academic programs that develop complementary competencies in industrial engineering, computer science and operations along with a STEM-based foundation at a 2-year level.
   - Approach benchmark best practices identified the Bachelor of Science in Industrial Engineering program at the Georgia Institute of Technology as an important and relevant model for the goals of this proposed project. This program combines industrial engineering, computer sciences, and operations courses with a strong foundation in STEM skills. Specialization opportunities in various sectors, including operations engineering, provide program graduates the flexibility to pursue careers in multiple sectors. (Georgia Institute of Technology, 2013) All of these factors indicate a significant need for what we have termed **Industrial Operational Engineering Technicians as well as an academic model adaptable to the needs of the community college environment.**

3. **There is a long history of a collaborative working relationship between Columbus State and the logistics sector.**
   - A unique asset of the region is the existence of The Columbus Region Logistics Council. Designed by government and supported by the industry, this Council has existed for over 20 years

and has developed a proactive relationship with area academic institutions. It serves as the catalyst for the growth of the central Ohio region's operations sector and leads the implementation of a strategic roadmap that will continue to grow this tremendous asset. Columbus State Community College has been a Council member from its inception and has a leadership role in its workforce-development activities. The support and commitment of the Columbus Region Logistics Council and its nearly 200 members will help optimize the development of the curricular pathways and assure industry commitment to the proposed educational programs.

- While the Columbus Region has diversified economic sectors, it is home to a large and growing logistics industry. There are 4,152 supply chain establishments with more than 70,000 employees in the area. The operations sector is a targeted sector for the region and for the state. (QCEW, 2011) In the past decade, the fastest growing sectors have included logistics/ transportation and utilities with a +26% growth. (Columbus 2020, 2013) Continued investment in many areas of the region's logistics sector as well as the complementary growth in retailing, pharmaceutical and advanced manufacturing sectors predict a continued demand for college graduates with a strong technical engineering education.

4. **Job openings for educated Industrial Engineering Operations technicians is anticipated to remain strong and will continue to offer an attractive wage.**
   - Considering only targeted occupations for Industrial Engineering Operations Technicians, central Ohio boasts a steady expected **growth of 8.3% between 2012 and 2020 with 1,599 jobs, compared to a national increase of just 4.9%.** (EMSI, 2013) The median earnings for these occupations are just under $32.00 per hour. For all of these reasons, the demand for Industrial Engineering Operations Technicians will continue for the foreseeable future.

Although supply chain and logistics have become critical technology-driven, multi-dimensional components in many operations (particularly in the central Ohio area), they remain largely underrepresented in the curriculum of the state's community colleges. While there are many reasons for this gap, fiscal limitations and lack of appropriately educated faculty are key factors.

By building on existing academic assets and adding the considerable academic and technical resources of both community college and universities, significant opportunities exist to increase awareness of the Industrial Engineering Operations Technician career ladder among students, faculty, and businesses; to expand career opportunities; and, to expand the student pipeline coming from area high schools and technical centers. (OCCIN, 2010)

Located in the business, academic and governmental center of the state, **Columbus State Community College** is a comprehensive urban community college serving more than 25,000 students (Autumn 2012 data) at its two campuses and nine off-campus locations. It has been serving the central Ohio area for more than fifty years.

Columbus State Community College has an 18-year history of offering supply chain education. It has a well-established educational pipeline with high school programs and baccalaureate institutions. Its faculty members have helped establish statewide academic standards in the field and serve as academic advisors to other academic institutions seeking to add this program of study to their programs.

The College has been awarded **previous grants** at the state and Federal levels in related topics. In 2006, Columbus State Community College's Supply Chain program received a two-year $160,000 U.S. Department of Education Title VIB grant for its **Project EAGLE** (Expanding Access to Global Logistics Education - Project P153A05) proposal. The work performed in this project led to the development of several majors in international trade and the establishment of articulation relationships at the

baccalaureate level with Cleveland State University and Franklin University. Project EAGLE allowed the College to engage public and private sector organizations and businesses in mutually productive relationships.

Additionally, Columbus State Community College, in close collaboration with area businesses, developed a nationally recognized workforce education program entitled **LogisticsART**. The program was designed to attract, train and retain qualified individuals in the field of logistics. Funded by a $4.6 million dollar U.S. Department of Labor grant, the program provides training tailored to meet the workforce needs of organizations at entry to mid-level positions within warehouse, distribution, and related logistics positions. To-date, this program graduated 915 participants with a 75% employment placement rate.

Eastland-Fairfield Career & Technical Centers serve 16 school districts in Franklin, Fairfield, and Pickaway counties. The technical high school district has two main campuses with satellite locations at five of its associate high schools. As a long-time high school partner, Eastland-Fairfield Career Center offers dual enrollment programs in various disciplines including engineering, information technology and logistics/IT. Franklin University is a long-time partner with Columbus State Community College in the growth of supply chain education in central Ohio. Franklin's Operations & Supply Chain coursework immerses students in industrial engineering quality methodology and production practices like LEAN and Just-in-time (JIT). Students are equipped to direct and manage transportation, logistics, outsourcing, and other technical engineering operations.

Goals, Objectives, and Deliverables

The **goal** of this project is to develop an education program for Industrial Engineering Operations Technician in Supply Chain at Columbus State Community College to meet the increased demand by central Ohio industry for Industrial Engineering Operations Technicians. The **project objectives** include:

1. To conduct a comprehensive DACUM in Central Ohio on the Industrial Engineering Technician occupation.
2. To develop an Industrial Engineering Operations Technology associate degree and certificate curriculum that is aligned with industry through guidance of an established Industry Advisory Committee.
3. To design curriculum that includes virtual simulations that use learning object methodology
4. Create a hands-on learning experience at a state-of-the-art facility that will provide the real-work experience in designing and using Industrial Engineering Operations Technology-related software and hardware.
5. To launch an Industrial Engineering Operations Technology Pre-College Initiative to increase the number of students matriculating from high school by educating students, faculty and advisors.
6. To establish an Industrial Engineering Operations Technology career education 2+2+2 pathway by establishing model articulation agreement from high school to community college and then to university level baccalaureate programs.

Deliverable #1	Conduct a DACUM for the Industrial Engineering Operations Technician in Central Ohio.

Activities:

- Working with The Ohio State University, plan and host a DACUM -- a nationally accepted curriculum development model -- to provide an in-depth understanding of the skills required in industry of Industrial Engineering Operations Technicians.

- Compile results into a DACUM findings report.

A **DACUM** will be completed in the first year of the project to provide a foundational industry review of the Industrial Engineering Operations Technology occupations including industrial engineering technician and industrial engineer. In use for more than 40 years and based on research completed at The Ohio State University's College of Education and Human Ecology, a DACUM (Developing A CurriculUM) is an occupation job analysis performed by expert practitioners. (Norton, 2008) The outcome is a detailed occupational chart that can be used as a solid foundation for instructional program planning and curriculum development.

Deliverable #2	An integrated curriculum for the 2+2+2 career pathway for Industrial Engineering Operations Technicians in supply chain technology that is industry driven and allows seamless articulation from high school diploma, to associate degree and certificates, to baccalaureate degree.

Activities:

- Develop a new Industrial Engineering Operations Technology Certificate and Industrial Engineering Operations Technology Associate's Degree program at Columbus State Community College.
- Complete industry and educational partner peer review of curriculum with Industry Advisory Committee.
- Provide faculty opportunity to participate in professional development and certification
- Develop and deliver hands-on training experiences delivered by industry experts in a fully-automated real-life industry environment
- The Industrial Engineering Operations Technology program will create a flagship lab space housed on campus in the Integrated Systems Technology lab. The Integrated Systems Technology Center provides a hands-on experience using industry standard equipment that recreates the industrial engineering environment in the classroom.
- Perform outreach to recruit students at each level of the pathway.
- Establish a template curriculum with Eastland Fairfield Career Center that can be replicated with other high schools and career centers.
- Finalize articulation with Franklin University to serve as a model for working with additional baccalaureate partners.

The supply chain industry continues to be impacted by and is increasingly dependent on technology to effectively manage its operations. As a result, the demand for skilled technicians with technology, engineering as well as supply chain industry knowledge is ever-increasing. To fill the void, the project will develop a career pathway for **Industrial Engineering Operations Technicians** that integrates technology applications (e.g. programming; data mining and simulation modeling) with engineering systems (e.g. automation systems, controls logic, stochastic processes, 3D/CAD modeling, electro-mechanical and industrial engineering) and how these technologies integrate into supply chain operations. Coursework in advanced mathematics and physics will provide a strong STEM-based foundation.

Benchmark research identified Georgia Institute of Technology's B.S. in Industrial Engineering with a Supply Chain sector emphasis as a best practice model. With a strong foundation in STEM disciplines, this program offers students a broad industrial engineering education as well as the ability and flexibility to pursue a variety of career options in several key industrial sectors, including Supply Chain. Using this as an evidence based approach, the projected plan of study for the proposed Associate of Applied Science Degree in Industrial Engineering Operations Technicians will include foundational STEM coursework as

well as courses engineering, computer science, and supply chain. The faculty representatives from these disciplines will collaborate to design and align the optimal curriculum for this project. While a draft plan of study was developed, it is anticipated that the DACUM, industry review, and collaborative meetings with the faculty will lead to significant modifications.

The program will be developed for blended delivery combining hands-on experiences in a laboratory environment and distance-based learning. Columbus State has been offering distance learning courses and degrees for more than a decade and is the acknowledged leader in Ohio in distance learning-education. The current logistics degree has been available completely at-a-distance for nearly a decade. Virtual simulation software will developed to allow for fully distance delivery as the program progresses. The creation of the online curriculum will include embedded learning objects that will be created during the project using best practices. Faculty members have been trained on massive open online course (MOOC) environment learning and will build the learning objects that are iterative, interactive, visual, and incorporate pedagogy from educational leaders.

Learning objects are integral to the MOOC movement that is built upon much smaller units of learning, typically ranging from 2 minutes to 15 minutes that can be used independently within a course and aggregated along with traditional teaching methodologies to deliver an interactive, self-paced, learning experience. Learning objects are particularly valuable "as support tools in a project-based action learning environment. This environment depends on student immersion in real-world problems with scaffoldings of various kinds to support their inquiry…and perhaps most critically …social interaction among peers." (Orrill, C. H. 2000) **The development of relevant learning objects and their integration into the curriculum for both online and traditional students will be a key objective of this grant.**

The proposed curriculum will be designed to optimize the use of simulations. While simulations have long been a part of the teaching process, most recently they have been recognized as critical components especially in engaging younger generations of students who are not "verbal, nor even just a visual, but … a virtual generation of students." (Proserpio, L and Gioia, D. 2007) Computer simulations will be used within the curriculum for both instructional purposes and as a means to encourage a collaborative/team-based approach to problem solving by students. Research into simulations shows that they challenge students to analyze available information and make critical decisions and encourage them to synthesize and integrate what they've learned to deal with situations whose inputs over time and thus much closer to the challenges faced in real-world situations. This instruction will be delivered using **Applied AutoMod** graphical simulation software. AutoMod is a leading graphical simulation software that provides true-to-scale 3-D simulation of manufacturing and distribution operations from any angle. It is the only simulation tool on the market that can model large, complex manufacturing and automation systems, whether in operation or in the planning stages. The AutoMod Student Version software has all of the design capabilities and controls of the full version though it limits the number of simulation entities that can be defined (i.e., queues, resources, vehicles, conveyor sections, etc.).

STEM Foundation Courses: A strong foundation in STEM based courses is a required component to the program and necessary for students to be successful as an Industrial Engineering Operations Technician. Specifically, mathematics and physics will be needed as the student progresses through engineering and technology coursework.
Existing courses: Elementary Algebra, Intermediate Algebra, Elementary Statistics, and Introduction to Physics.

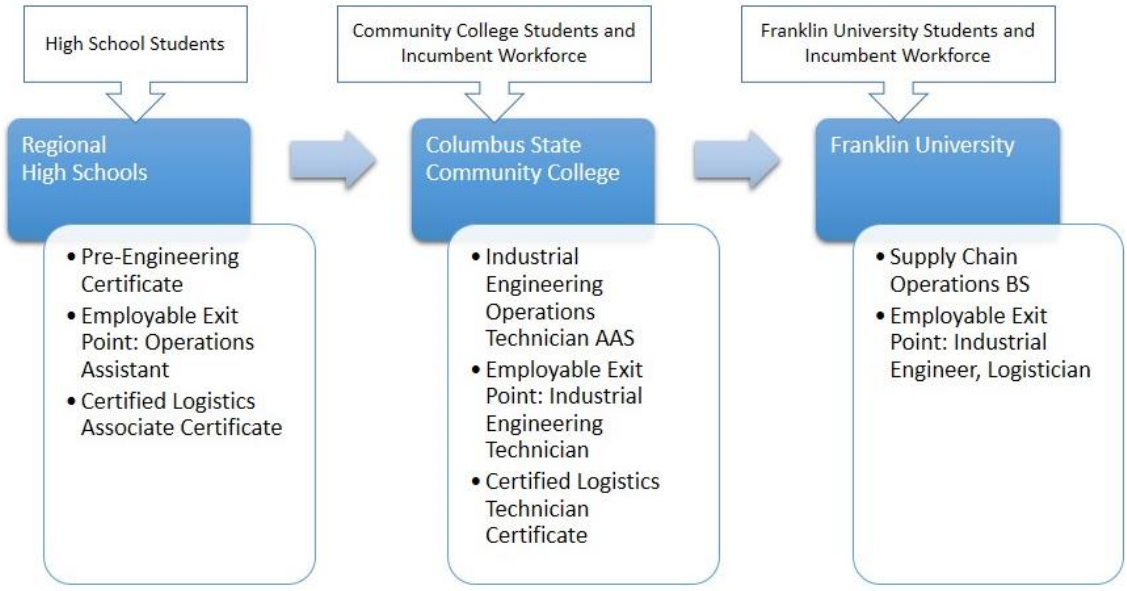
Engineering Technology Courses: The Industrial Engineering Operations Technician also requires a strong foundation in engineering technology. Columbus State's Engineering program includes aspects of Industrial Engineering, Mechanical Engineering Technology and Electronics Engineering Technology programs. The skills electro-mechanical technicians possess are used in virtually every industry–from

manufacturing, to environmental control, to food and pharmaceutical production, to power plants. Students will learn statistical methods to determine reliability, the effectiveness of data analysis, the use of simulations, and ways to improve system performance.
Existing courses: Fundamentals of Engineering, Motors & Controls Logic, Control Logics & PLCs
Adapted courses: Industrial Engineering, Introduction to Stochastic Processes

Computer Science Courses:
Computer technology is an integral part of every organization. As a result, today's Industrial Engineering Operations Technician must possess fundamental programming skills, simulation modeling, and database programming.
Existing courses: Computer Concepts & Applications, Programming Logic, Data Mining Fundamentals
Adapted courses: Simulation Modeling

Supply Chain Courses: The academic foundation for the program will be in engineering and computer science; however, these competencies will be targeted to apply in the supply chain industry sector. Therefore, the students must also understand the intersection between the STEM based education and its application in supply chain operations. The supply chain curriculum will also certify students as **Certified Logistics Technicians**. The purpose of the Certified Logistics Technician (CLT) program is to recognize through certification individuals who demonstrate mastery of the core competencies of material handling at the front-line (entry-level through front-line supervisor) through successful completion of the certification assessments.
Existing courses: Information Technology in Logistics, Certified Logistics Technician Prep Course, Supply Chain Internship Practicum/Seminar
Adapted courses: Foundations of Supply Chain Modeling

The following graphic depicts the curriculum 2+2+2 pathway with target audiences, degrees attained, and employable exit points for students.



Currently, the College has numerous articulation agreements with Franklin University; it is a primary destination for Columbus State graduates interested in completing a bachelor's degree. The new Industrial Engineering Operations Technology program will be built in collaboration with Franklin University's Operations & Supply Chain faculty. Columbus State Community College will also reach out to other four-year partners to provide additional baccalaureate degree pathways.

Deliverable #3	Industrial Engineering Operations Technology Pre-College Initiative for high school teachers, advisors, and students.

Activities:

- Develop a plan for pre-college activities with Eastland-Fairfield Career Center along with collaborating regional high schools.
- Plan and host an Annual Educator Institute on Industrial Engineering Operations Technology.
- Launch a high school student summer camp for future Industrial Engineering Operations Technicians.
- Host high school career advisors briefing sessions.

Pre-college activities will be planned with a three pronged approach...

1. An annual institute for high school faculty on Industrial Engineering Operations Technology will focus on content and project-based pedagogy and be delivered in a "train-the-trainer" format.
2. For students, the project will launch an accelerated high school summer camp focused on careers in industrial engineering operations that consists of classroom component and site visits/shadowing to regional leaders in supply chain.
3. Finally, the pre-college activities will look to educate the people the influence high school students' decision making: advisors and parents. Columbus State and its partners will host high school career advisors briefing sessions that will include information on careers in Industrial Engineering Operations Technology and outreach materials that can be shared with students and parents.

The project will leverage its existing relationship with Eastland-Fairfield Career Center to create an additional dual enrollment program that will directly articulate to the associate degree at Columbus State. Subsequently, this model will be offered to other career centers and high schools with particular emphasis on Project Lead the Way high schools, which focus on recruiting students in STEM-related academic programs and careers.

Audiences and Outreach

This program will target potential audiences at each step in the program pathway. The pre-college activities will target high school students and educators in central Ohio. The relationship with Eastland Fairfield Career Center provides access to nearly 16 school districts, inclusive of their students and faculty, along 6,000 adult education students. These adult students along with the incumbent Industrial Engineering Operations Technician-related workforce in central Ohio logistics account for more than 10,000 potential students. Along with outside participants, the program looks to perform outreach with current Columbus State Community College students and graduates in engineering, computer science, and supply chain--a population totaling more than 5,000.

The project will conduct outreach and communicate across audiences with special emphasis on the recruitment of underserved populations. A comprehensive project website will be created and include identification of the project and opportunities, the ability for discussion and interaction with educators, potential students, and advisors, and integrate social media outreach including Facebook, Twitter, and LinkedIn. The project will also leverage its partnership with the Columbus Region Logistics Council to connect with industry in central Ohio. Physical materials, such as brochures and flyers, will be distributed at Columbus State campuses and regional centers, at partner high schools, and Franklin University campuses and centers. Regional publications and workforce organizations will assist in communication efforts to help build the student base for the program.

Project Component	Year 1	Year 2	Year 3	Total
Industrial Engineering Operations Technology Associate Degree	5	15	25	40
Industrial Engineering Operations Technology Certificate	5	20	30	50
Pre-college: High School educator institute	5	20	20	60
Pre-college: High School student summer camp	0	50	100	150
Pre-college: High School advisor briefing sessions	5	20	30	55

Serving Underrepresented Populations

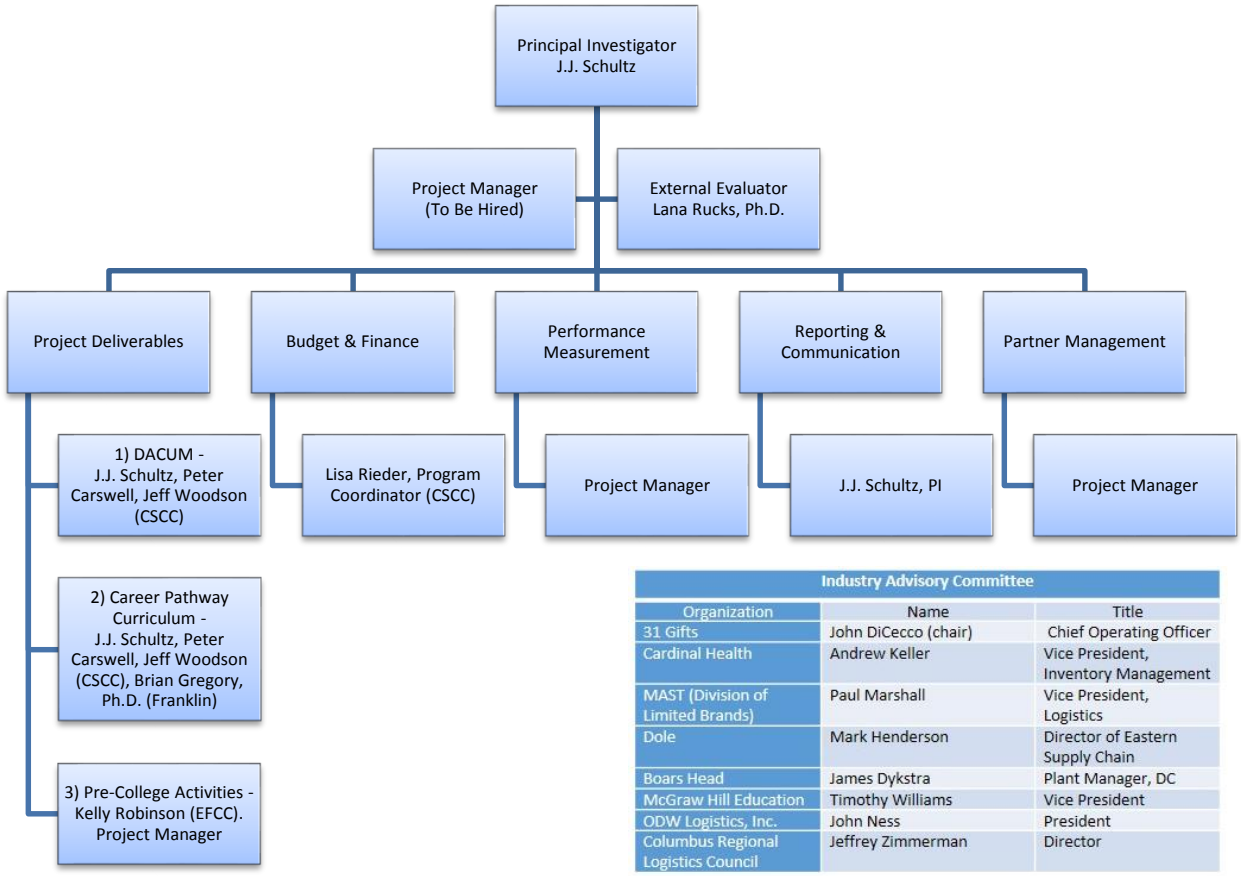
As part of its long-standing commitment to diversity, Columbus State Community College undertakes activities and programs that result in increased retention and graduation rates of minority students; implements orientation and professional development programs related to diversity and inclusion for administrative, instructional, professional, and support personnel of the College; and markets Columbus State Community College as an attractive institution of higher education for people of diverse backgrounds to pursue their career and educational goals. These strategies and activities that have been used to attract and retain underrepresented student populations will inform the activities undertaken in this grant. Outreach to underrepresented populations in STEM, namely diverse females and males of color will be coordinated the College's Perkins Program's focus on promoting nontraditional STEM career-technical education (CTE) pathways, and the STEM Equity Pipeline™, which is focused on increasing the participation and completion of females and other under-represented students in high tech, high wage, high demand STEM CTE pathways.

Underserved Population	Description
Underrepresented African-American Minority Students from the inner city	The Diversity Programs Department is committed to the recognition and value of the entire college community. Columbus State Community College serves underrepresented populations as an urban located institution, attracting both geographically and ethnically underserved populations, with 32% of enrollment being minority students.
Underrepresented Students in Geographically Rural Areas Surrounding Columbus	The partnership with Eastland-Fairfield Career & Technical Schools serves 16 school districts in Franklin, Fairfield, and Pickaway counties, many of which are rural populations. It covers an area of 700 square miles, and is the seventh largest career and technical district geographically in the state.
Underrepresented U.S. Military Veterans	Outreach to the military, active duty and veterans, is coordinated through the Veterans Affairs Office on campus. The center provides individualized enrollment and referral services to assist community members in successfully meeting their educational and career goals.
Underrepresented Female Students	The Ohio Department of Education "WE are IT" grants were a statewide initiative to engage middle and high school female students to consider information technology related career fields and encouraging their transition to college. In 2011, the focus of this campaign shifted to "WE are STEM". Columbus State

	Community College has maintained strong participation in this initiative averaging over 20 high schools and 150 students per event since 2006.

Project Deliverables	2014				2015				2016			
	7/1—9/30	10/1—12/31	1/1—3/31	4/1—6/30	7/1—9/30	10/1—12/31	1/1—3/31	4/1—6/30	7/1—9/30	10/1—12/31	1/1—3/31	4/1—6/30
1.1 – Plan and host DACUM												
1.2 – Compile results into a DACUM findings report.												
2.1 - Design and align a new Industrial Engineering Operations Technology degree program curriculum												
2.2 – Execute industry peer review of curriculum												
2.3 – Identify faculty/Participate in professional development												
2.4 – Develop an operations simulation laboratory.												
2.5 – Perform outreach.												
2.6 – Create model university articulation agreement.												
2.7 – Replicate model articulation to additional institutions.												
3.1 – Develop a plan for pre-college initiative												
3.2 - Plan and host an annual institute on Industrial Engineering Operations Technology												
3.3 - Launch an accelerated high school summer camp												
3.4 – Host briefing sessions with high school career advisors												
3.5 – Expand high school curriculum to additional schools.												
Project dissemination												
Formative evaluation												
Summative evaluation												

Management Plan



Industry Advisory Committee		
Organization	Name	Title
31 Gifts	John DiCecco (chair)	Chief Operating Officer
Cardinal Health	Andrew Keller	Vice President, Inventory Management
MAST (Division of Limited Brands)	Paul Marshall	Vice President, Logistics
Dole	Mark Henderson	Director of Eastern Supply Chain
Boars Head	James Dykstra	Plant Manager, DC
McGraw Hill Education	Timothy Williams	Vice President
ODW Logistics, Inc.	John Ness	President
Columbus Regional Logistics Council	Jeffrey Zimmerman	Director

Roles and Responsibilities of PI, Co-PIs, and Senior Personnel

The project management functions are based upon the successes of previous grants and have been identified as vital for the successful implementation of NSF ATE projects (Siefert, 2003). The three-year project will be divided into a series of discrete activities with a leader, deliverable, timeline, tasks, and budget. The project will be managed using activity-based budgeting to track activities against a rigid timeline and budget. The PI will monitor performance of the activity teams, conduct quarterly reviews of evaluation data, and manage the external evaluator and the Industry Advisory Committee. All PIs and Senior Personnel will maintain a high level of national visibility for the project. Each will be responsible for disseminating the results.

Columbus State Community College, the fiscal agent for this project, has extensive experience in managing large federal, state, and privately-sponsored grants. Columbus State has managed multi-million dollar projects from the U.S. Department of Education and U.S. Department of Labor. In accordance with OMB Circular A-133, all expenditures are audited annually. The College is considered a low-risk auditee.

Name	Role	Responsibilities
J.J. Schultz, Instructor, Supply Chain Faculty	PI	• Serve as the Principal Investigator and oversee the project planning, implementation, and sustainability. • Deliverable #1 – Labor Market Study • Deliverable #2 – Career Pathway Curriculum
Peter Carswell, Instructor, Computer Science Faculty	Co-PI	• Computer science faculty lead for curriculum development

		• Deliverable #2 – Career Pathway Curriculum
Jeffrey Woodson, Professor, Engineering Technology	Co-PI	• Engineering faculty lead for curriculum development • Deliverable #2 – Career Pathway Curriculum
Brian Gregory, Ph.D., Franklin University	Senior Personnel	• Serve as the Franklin University liaison for articulation and as a content expert. • Deliverable #2 – Career Pathway Curriculum
Kelly Robinson, Eastland-Fairfield Career Center	Senior Personnel	• Serve as the Eastland-Fairfield Career Center liaison to the high school population. • Deliverable #3 – Pre-College Activities
Larry Miller, Ph.D., Instructor, Engineering Technology	Senior Personnel	• Deliverable #2 – Career Pathway Curriculum
Project Manager, To Be Hired	Other Personnel	• Will coordinate partner management activities between faculty, grant stakeholders, and educational and industry partners • Conduct outreach to students and educators. • Measure performance and assist in grant reporting. • Deliverable #3 – Pre-College Activities

- *Industry Advisory Committee*:

  The Industry Advisory Committee (IAC) will guide all program activities, including evaluation. Formed by the College, the IAC will be chaired by John DiCecco, Chief Operating Officer of 31Gifts, and include representatives of all key grant constituencies including:

  - Principal Investigator
  - Project Manager, to be hired
  - representative(s) from the Central Ohio Regional Logistics Council
  - multiple representatives from industry representing regional and national-level interests

The IAC will meet quarterly to review and monitor progress toward accomplishment of the program's objectives and will file a formal report on a bi-annual basis.

Sustainability Plan

Sustainability of the program will be a focus of the project from the beginning. The project has been designed to require a minimum investment to institutionalize and sustain. After the **Industrial Engineering Operations Technician curriculum** and both physical and virtual laboratory components are created, standard institutional processes will be used to maintain currency. The responsibility of continuously reviewing and making improvements process is the responsibility of PI J.J. Schultz and will be supported by Columbus State faculty. Students will pay tuition to take courses, and low-income students will receive scholarships and tuition vouchers (Individual Training Accounts) from local Workforce Investment Boards. The connection with the Veterans Affairs Office on campus will assist with students receiving veteran's tuition benefits. The **simulation laboratory equipment** will be funded through college repair and replacement capital equipment process and establishes a replicable model that may be adapted nationally. The College will periodically review and maintain **articulation agreements** with high schools and Franklin University through the Office of Articulation and Transfer.

The **project website** will be hosted by Columbus State and continue to serve as a gateway for Industrial Engineering Operations Technology education. The College and partners will use this project as foundational research for additional future initiatives to serve workforce readiness and industry training needs in the rapid fields of advanced manufacturing, logistics, and technology.

Evaluation Plan for Building an Academic Pathway for Industrial Engineering Operations Technicians Proposal

The Rucks Group, a research and consulting firm that gathers, analyzes, and interprets data to enable our clients to make quality strategic decisions, will serve as the external evaluator for this project**.** Dr. Lana Rucks, Owner of the Rucks Group, will manage the overall project evaluation. Dr. Rucks has extensive professional and educational experience within research, program evaluation, and measurement. She has led several evaluative initiatives including projects funded by the National Science Foundation and the Center for Disease Control. Dr. Rucks has attended the annual NSF ATE PI Conference and has delivered numerous webinars on evaluation strategies. She possesses deep expertise in rigorous research methodology, evaluation design & implementation, and data analysis (including qualitative and quantitative analysis). She holds a doctorate degree in Social Psychology with a concentration in quantitative methods from The Ohio State University (OSU). Dr. Rucks also holds two Master of Arts degrees within Social Psychology and Experimental Psychology from OSU and the University of Dayton, respectively.

What is provided below is a general outline of the formative and summative evaluation approach that will be utilized. At project initiation, the Rucks Group will meet with the project PI/Co-PI(s) and other key individuals to fully detail the evaluation questions, design, plan, and overall work plan. (See attached logic model.)

Quantitative and qualitative data will be collected through a mixed methods approach (Stevens, Lawrenz, and Sharp, 1992; Frechtling & Sharp, 1997). Data will be collected in cooperation with the institutional research officer as well as from internal evaluators conducted. Attempts will be made to include comparison groups in order to increase the interpretability of the impact of the project whenever possible. Additional data will be collected using the following methods:

- **Surveys and questionnaires**.
- **Focus groups and interviews** (of academic managers participating in testing and training events) to determine for example satisfaction with the decision-support tool and perceived decision-making gains resulting from using the tool.
- **Document studies** (internal evaluation reports, college reports, minutes from project meetings, *etc.*).

The overall evaluation will be driven by evaluative questions that will be fully detailed at project initiation. The general topics of the evaluation questions are as follows:

- How anticipated results were met.
- How the original activity objectives were achieved.
- How the products were disseminated.
- Projected budget vs. actual expenditures.
- The estimated return on the investment of federal funds.
- Met stated goals and objectives. (this could be moved to the formative evaluation component)
- Had significant unanticipated outcomes.
- The impact of the developed and tested a decision-support tool.
- Improved administrative decision-making.
- Facilitated on-going use and institutionalization of the decision-support tool within partner colleges.
- Successfully involved other colleges in adopting and adapting the decision-support tool.

The Rucks Group will communicate with the project team both through periodic meetings as well as written interim and annual reports that will provide information and an analysis of the project tasks, project outcomes, and an interpretation of results. A final report at the end of the project will describe:

Formative Evaluation

During each year of the grant, staff members of the Rucks Group will employ extensive formative evaluation methods. Ongoing procedures will ensure that milestones within the implementation strategies are met and that the activities are within budget. The formative evaluation will be a neutral, candid assessment of the likelihood of successful completion of the objectives based on past progress. Formative evaluation will focus on giving feedback to personnel as the grant progresses as to how processes might be improved. Baseline data for each objective will be collected during the first year of the grant. Progress will be tracked against the baseline for future years.

Summative Evaluation

Summative evaluation will occur as outcomes data becomes available which is anticipated to be at the conclusion of the grant fiscal year. Staff members of the Rucks Group will manage the summative evaluation, analyze the outcomes, and assess the level of integration of the decision-support tool at the partner institutions. The summative evaluation will be a neutral, candid assessment that will focus on whether the project will meet the following:

Summary Evaluation Matrix		
Deliverable #1: Conduct a DACUM for the Industrial Engineering Operations Technician in Central Ohio		
Data Collection Method	**Schedule**	**Evaluation Type**
Survey faculty & review progress	7/2015, 4/2016	Formative/Summative
Deliverable #2: An integrated curriculum for the 2+2+2 career pathway for Industrial Engineering Operations Technicians in supply chain technology that is industry driven and allows seamless articulation from high school diploma, to associate degree and certificates, to baccalaureate degree.		
Data Collection Method	**Schedule**	**Evaluation Type**
Survey faculty & review progress	1/2015, 1/2016, 1/2017	Formative
Focus groups with faculty	3/2015, 3/2016, 3/2017	Summative
Interview industry advisory committee	4/2015, 4/2016, 4/2017	Formative/Summative
Review student enrollment data for trends before and after project activities	6/2015, 6/2016, 6/2017	Summative
Deliverable #3: Industrial Engineering Operations Technology Pre-College Initiative for high school teachers, advisors, and students.		
Data Collection Method	**Schedule**	**Evaluation Type**
Survey high school faculty & review progress	6/2015, 6/2016	Formative
Survey student gains using the SALG (Student Assessment of their Learning Gains) tool	3/2016, 6/2016	Formative
Survey high school career advisors current briefing sessions	9/2015, 9/2016	Formative

Each year of the project, the External Evaluator will develop and submit an annual evaluation report. A comprehensive summative evaluation report will be created during the final year of the project.

Dissemination Plan

The PI, Co-PIs, and Senior Personnel will actively disseminate information about project activities, publications, research findings, and manufacturing engineering education to specific audiences.

Target Audience	Method
• Pre-college students • College students	• Disseminate regional career information, job openings, company information through high school counselors/career advisors, the semi-annual CRLC Industry Job Fair on campus, and site visits. • Post information to the project website as well as popular social media sites maintained by Columbus State: Facebook, LinkedIn and Twitter. • Host "Future Industrial Engineering Technician" Summer Camp for high school students.
• Deans, chairs, and faculty of supply chain, engineering technology, computer science, and STEM • Pre-college master teachers	• Offer pre-conference and concurrent session presentations at strategic conferences; hold in conjunction with other associations using their marketing, registration, and logistics; targeted conferences include: o Hitech Conference o League for Innovation in the Community Colleges o Materials Handling Institute o National NSF ATE PI conference
• High school faculty and career advisors	• Annual Educator Institute on Industrial Engineering Operations Technology • Etech Ohio Educators conference booth • Post curriculum materials to the project website under educator tools. • Host high school career advisors briefing sessions.