



Ecc Lorain County Community College

LCCC is proposing an applications-oriented bachelor of applied science program in Smart Industrial Automated Systems focused on integrating, operating, modifying, and troubleshooting smart manufacturing systems based upon modern "off-the-shelf" industrial equipment. This proposal responds to the rapid development of disruptive technologies that are shaping advanced manufacturing in our region.

Proposing a Bachelor of Applied Science in Smart Industrial Automated Systems Engineering Technology & Offered for under \$15,000

Presented by:

Dr. Marcia Ballinger, President Lorain County Community College 440-366-4050; mballinger@lorainccc.edu

Proposal Contact:

Kelly Zelesnik, Dean, Engineering, Business, and Information Technologies Division Lorain County Community College 440-366-7557; kzelesni@lorainccc.edu

LORAIN COUNTY COMMUNITY COLLEGE

BACHELOR OF APPLIED SCIENCE IN SMART INDUSTRIAL AUTOMATED SYSTEMS ENGINEERING TECHNOLOGY

SECTION 1: EVIDENCE OF NEED

1.1 Program Information

A. Provide the name of the proposed program:

Smart Industrial Automated Systems Engineering Technology

Smart Industrial Automated Systems Engineering Technology (Smart Manufacturing) represents a multidisciplinary engineering field concerned with the design, modeling, analysis and control of predominantly computer-based automated systems or processes. Automated systems typically contain a mixture of sensors, equipment, devices, software, hardware and humans. The discipline requires knowledge of elements of electrical engineering, mechanical engineering, software programming, networking, security, and human factors engineering. The program will be designed to meet the Accreditation Board for Engineering & Technology (ABET) requirements.

Current bachelor's degrees which are related to Smart Manufacturing have not closed the skills gap of our region or the state of Ohio. To meet the needs of our service area, Lorain County Community College (LCCC) proposes the creation of the Bachelor of Applied Science in Smart Industrial Automated Systems Engineering Technology. The development of this program follows logically from the series of innovative programs LCCC's faculty has recently developed that provide students with the knowledge and skills for current in-demand jobs as well as those of the future. These programs include associate degrees in Digital Fabrication, the Industrial Internet of Things, Cyber and Internet Security, Blockchain, Data Analytics, Automation, and Micro Electromechanical Systems (MEMS), and a bachelor's degree in Microelectronic Manufacturing. The proposed Bachelor of Applied Science in Smart Manufacturing provides a mechanism for automation technicians to advance to positions where they design, integrate, manage and supervise these functions.

Program goals include:

- 1. Implement and evaluate secure industrial networks
- 2. Demonstrate the ability to program advanced industrial automation systems
- 3. Design and integrated automated systems that apply to real world situations and challenges
- 4. Apply additive manufacturing, rapid tooling, and simulation (virtual / augmented reality) to industrial situations

- 5. Apply knowledge of advanced sensor technologies such as machine vision or Radio Frequency Identification to make automated system more autonomous
- 6. Integrate collaborative robots and human machine interfaces to make systems that are safer and more user friendly.

LCCC's program will include its Earn and Learn model of embedded work-based learning (WBL) which:

- gives students insight into the world of work and career prospects
- develops job skills and on-the-job performance
- develops interpersonal and social skills
- enhances employment prospects for graduates
- increases industrial contacts for college teachers
- improves attitudes toward supervision, self-confidence, job knowledge, job-seeking skills, and practical reasoning
- helps students to integrate well into the work environment
- develops greater maturity in students
- enables students to make more positive contributions and demonstrate more positive attitudes in class

B. Provide the six-digit CIP code (format: XX.XXXX) of the proposed program, if known:

This proposed degree covers a range of technologies so it is difficult to pinpoint just one. The following CIP Codes are relevant to the degree:

- 15.0405 Robotics Technology/Technician.
- 15.0406 Automation Engineer Technology/Technician.
- 15.0613 Manufacturing Technology/Technician.
- 15.0403 Electromechanical Technology/Electromechanical Engineering Technology.

Other.

- 15.0499 Electromechanical and Instrumentation and Maintenance
- Technologies/Technicians,
- 15.9999 Engineering Technologies/Technicians, Other.
- 11.0401 Information Science/Studies.

C. Provide the names of the ATS, AAB, and/or AAS programs upon which the proposed program is intended to build.

AAS in Automation Engineering Technology – Maintenance/Repair #6210 AAS in Automation Engineering Technology – Systems Specialist #6211

1.2 Workforce Need and Workforce Gap Not Being Met by Existing Programs (See Appendix A)

A. Describe the workforce needs and required skills of a regional business or industry and indicate how the proposed program is particularly suited for preparing graduates for careers in that regional business or industry. To substantiate that the need is in an indemand field with long-term sustainability, submit regional data from the Governor's Office of Workforce Transformation In-Demand Jobs List (topjobs.ohio.gov) and the regional or local workforce board data as an appendix item.

Why is industrial automation so important?

The industrial world is facing many technological changes which increased the urgent demand for the premium quality products and services that can only be supplied by a high level of productivity. This requirement needs process engineering systems, automated manufacturing and industrial automation. Smart automation systems also have the ability to provide product and process traceability, ensuring high quality standards and operational efficiency. Hence, industrial automation plays a key role in solving the requirements of companies. It is extremely significant to face the tasks of:

- Globalization global industrial automation market demands superior, practical services
- **Productivity** automation companies want to enhance their productivity by producing a higher level of automation; key factors include costs, time and quality

On the other hand, industrial automation is all about working smarter, faster, and proficiently. This makes automation more powerful, and that's why customers are looking for pioneering, end-to-end technologies with open, modern architecture and new data from new connections. As the industrial automation industry comprehends the advantages of the Internet of Things (IoT), it is becoming essential that organizations adopt these technologies.

Industrial Automation Becomes a 'Solutions' Business

Industrial automation is important, as it becomes a solutions business. Industrial automation refers to the categorization of software and hardware and a mechanism that combines them. Moreover, it involves the process of rolling out new features using advanced technology in business to reduce limitations. Automation can be achieved by installing automated devices or embedded systems as well as automation software performing the logical tasks and control the operation processes.

Implementation of these devices, software, and hardware will be the 'solutions' to deliver the operation to be automated. These solutions are widely used today to enhance efficiency and productivity of businesses.

Widespread adoption of Industry 4.0 (I4.0) technologies will enable the development of integrated manufacturing processes that combine the efficiency of mass production with the flexibility of custom manufacturing. As industry continues to develop Industry 4.0 technologies, the skills gap has become the primary limiting factor for manufacturers seeking to adopt them. Consequently, it is essential that community colleges become more agile and aligned to the speed of industry, filling the pipeline of skilled workers at the necessary pace via well-developed curricula and programs developed in close collaboration with industry.

America's world preeminence in defense related advanced manufacturing, for example, depends on supporting agile digital factories as well as the development of people skilled to operate them. The National Security Strategy states, "The ability of the military to surge in response to an emergency depends on our Nation's ability to produce needed parts and systems, healthy and secure supply chains, and a skilled U.S. workforce. Today, we rely on single domestic sources for some products and foreign supply chains for others, and we face the possibility of not being able to produce specialized components for the military at home. Support for a vibrant domestic manufacturing sector, a solid defense industrial base, and resilient supply chains is a national priority."

The COVID-19 pandemic has brought into stark focus the risks to United States' health caused by offshoring the production of critical medical equipment and supplies. This crisis has also highlighted the inability of the American manufacturers to quickly ramp up production of complex systems and devices. Though recent federal legislation has shifted manufacturing resources toward solving immediate equipment shortages, the responsiveness of industry would have been much more effective if manufacturers were "Industry 4.0 ready." I4.0 uses automation and data exchange across manufacturing technologies to give manufacturers the flexibility to rapidly switch production output. These and other exponential technologies called out in the National Defense Strategy include Big Data Analytics, Artificial Intelligence, and Robotics. Other exponential technologies supporting the I4.0 vision include additive manufacturing, blockchain and augmented/virtual/mixed reality. These capabilities will allow manufacturing plants to be converted in a matter of hours to produce critically-needed products – whether for a national defense emergency, the next medical pandemic or natural disasters such as hurricanes and earthquakes.

Reimagining Education in Advanced Manufacturing

LCCC's proposed Smart Manufacturing BAS degree is a key component of its work reimagining education in advanced manufacturing. Through support of a Department of Defense Grant, LCCC is designing in collaboration with industry an education and training pathway model which ensures that programs are aligned with industry demand and offer predictable transitions for students as they move from secondary and postsecondary institutions and organizations and from certificates and the associate degree to the applied bachelor's degree. Goals for this grant work include: • Early Engagement I4.0 Pathways

Shared campus training model Community Colleges + High Schools and Technical Centers:

- We will develop and implement a low-equipment needs introduction course for implementation at any school, as well as develop and pilot a shared campus model where regional students will travel to LCCC to take advantage of advanced technology labs and training in college level courses.
- Teacher Professional Development
 - We will first address the primary deterrent to training access, which is the shortage of available teachers trained in Automation & Robotics.
- Dedicated Multi-Purpose Advanced Manufacturing Classroom
 - The establishment of a dedicated multi-purpose classroom is critical to enable the above objectives.

LCCC will also:

- develop and expand training for job positions requiring higher level skills with flexible, stackable opportunities for certifications and degree pathways and embedded, industry-validated credentials.
- incorporate the Earn and Learn model in cooperation with local employers.
- develop a credentialing strategy which would be recognized and validated by Industry. The primary focus is on certification/credentialing for automation and robotics, laser materials processing, and digital thread technologies; other complementary fields are also of interest, including supply/sourcing, maintenance, repair and overhaul, and technical data. This effort will include working with relevant manufacturing research institutes (e.g. Advanced Robotics for Manufacturing [ARM]; Digital Manufacturing Institute [MxD]; etc.) to leverage existing industrial certifications and curricula to the greatest extent practical.

Development of a Bachelor of Applied Science in Smart Industrial Automated Systems Engineering Technology



Graduates with the Smart Manufacturing BAS degree will be an important part of the workforce for manufacturers that are adopting automation and robotics technologies. The degree provides a mechanism for automation technicians to advance within organizations and provide more value. Since it will be based on an Earn and Learn model where students work throughout, employers will be able to develop important relationships with future employees and employees will gain hands-on experience sought after by employers.

Individuals with this degree will play an important role in helping local small to mediumsized businesses adopt I 4.0/Smart technology to advance their business. Many of these businesses are part of Ohio's large and growing supply chain that supports automotive, aerospace and other Department of Defense industries.

This degree aligns well with work being done by the Ohio Manufacturer's Association and ARM Institute around stackable credentials and micro-credentials in the I4.0 space. It is recognized that I4.0 Smart manufacturing requires a differentiated skill set from previous degrees to meet industry demand. I4.0 is accomplished by developing an interconnected, interoperable system and by ensuring those working in that space have a strong IT foundation and a deep, working understanding of the relationships between automated manufacturing areas.

As referenced earlier, now more than ever employers are setting the expectation of hands-on experience required as a critical base for any new employee. In a review of job postings for Automation positions from local employers in the Lorain County area, 100% of the employers listed hands-on experience as a requirement. LCCC recognizes and supports this important, practical part of learning through the Earn and Learn model, which will be readily replicated for this degree. This component is an important differentiator from existing degrees and fills a critical need employers are not only asking for locally, but nationally as well.

Some current roles that can skill up with this degree are:

- Mechatronics Technician
- Industrial Maintenance Mechanic
- Industrial Manufacturing Technician
- Robotics Technician
- Automation Technician

Some job roles individuals with this degree can fill are:

- Automation Engineer
- Automation Controls Engineer
- Controls Engineer
- Automation Process Engineer
- Automation Controls Specialist
- Manufacturing Execution Systems Engineer
- Systems Engineer

In 2020, over 21,000 individuals were employed in Northeast Ohio within the occupations listed above, and overall, 72% (8,378 of 11,587) of occupations in Northeast Ohio related to Smart Manufacturing/Automation require a bachelor's degree as typical entry level education, and as technology and systems advance, this is expected to increase. During the past year there were 7,643 postings for jobs within these occupations requiring either an associate's degree or a bachelor's degree. The job postings were from over 500 employers that included Cisco, Anthem Blue Cross, Lincoln Electric, General Electric, and the Cleveland Clinic, among many others. These employers cut across multiple industry sectors, including:

- Administrative and Support Services
- Professional, Scientific, and Technical Services
- Insurance Carriers
- Computer and Electronic Product Manufacturing
- Machinery Manufacturing

Demand in these areas is expected to grow in the coming years, largely due to an aging workforce. Emsi forecasts 8,750 openings in these occupations in the next 5 years. Additionally, an aging workforce is heightening need for workers in these occupations. Overall, more than 28% of workers in these target occupations are nearing retirement age. See **Appendix A: Workforce Needs in Northeast Ohio** for detailed information documenting regional workforce need.

B. Prior to submission, this proposal must be discussed at a meeting of the community college's regional educational providers. Discussions among institutional members should address regional workforce needs, benefits to the region, concerns about potential duplication and program overlaps, and options for articulated pathways (2+2 or 3+1), as appropriate. Attach a fact-based summary of the discussion and related documentation (including comments both in favor of and opposed to the program) as well as supportive employers' data on the collective employment needs as an appendix item.

Open Forum: Lorain County Community College's Bachelor of Applied Science in Smart Industrial Automation

On February 26, 2021 (8 to 9 a.m.), Lorain County Community College in partnership with TeamNEO (our region's JobsOhio lead) with support from seven other regional and state partners hosted a virtual open forum to share details about LCCC's proposed Bachelor of Applied Science in Smart Industrial Automation (BAS). The forum provided an opportunity for participants from higher education, industry and economic development to ask questions and provide feedback about the program. The open forum was marketed broadly to the mentioned stakeholders for a period of three weeks. LCCC's Associate Provost for the

University Partnership made personalized outreach to appropriate leaders at regional higher education institutions that have programs most closely aligned to LCCC's proposed BAS to ensure their awareness of the opportunity and to encourage them to attend.

Forty-five individuals registered for the program and 38 attended representing industry (23), other higher education partners (5), economic development organizations (8) and government (2).

The open forum was structured to provide context on the economic growth opportunity presented at the regional and state level in the area of smart manufacturing, the current and future talent needs of this industry sector and details about LCCC's proposed BAS degree to address this need. About half the program time was dedicated to open discussion and questions, which mostly occurred with questions and comments submitted via the Zoom chat feature. The comments and questions centered around specific technologies the program would address, design of the program to include work-based learning, portability of the program to work directly with employers, inquiries on how both manufacturers and higher education partners could be supportive and involved, flexibility of the program to be designed for working age adults, and more. No comments from any participants voiced concerns about the program's duplication or merit. Additionally, the discussion portion of the program was recorded and available upon request.

See the following materials in Appendix A: Workforce Needs in Northeast Ohio:

- February 26, 2021 Open Forum Participant List
- PowerPoint Presentation shared during the Open Forum
- Chat log of comments and questions

C. Describe the specific workforce need and skills gap that is not being met by existing college or university programs (public or private) in your region. List similar bachelor's degrees at public and private colleges and universities in your region and identify, in detail with specific program examples, how they do not meet the regional business and industry needs.

The increased complexity of Industrial Automated Systems including system interoperability, remote system management and data analysis requires application knowledge in robotics, automation, cybersecurity, programming and sensors/data management. This program develops technologists and application engineers to implement and maintain complex automated systems. These positions are now being recruited /filled with a wide array of job postings at the engineering level (design oriented) as positions do not routinely exist to describe the job function.

This regional workforce demand is not currently met because an application-oriented bachelor's degree program is not currently available to the people of Lorain County. No other college or university in our region has the equipment and application-focused academic program to prepare students to meet this workforce need. The BGSU degree in Mechatronics Engineering Technology, for example, focuses more on automated machine design. In contrast, the proposed LCCC Smart Industrial Automated Systems Engineering Technology degree would focus on integrating, operating, modifying and troubleshooting smart manufacturing systems based upon modern "off-the-shelf" industrial equipment.

Another challenge facing working adults in Lorain County is that many do not have the resources to travel to a four-year college or university outside of the county. Transportation is a significant obstacle for many LCCC students. This is one reason why only 36% of adults in Lorain County have a college credential, significantly below the state and national averages. The proposed Smart Manufacturing degree would make another bachelor's degree program accessible to our community, would contribute to a significant workforce need, and would contribute to the Ohio's goal of having 65% of adults with a college credential by 2025.

SECTION 2: INDUSTRY PARTNERSHIP

2.1 General Partnership Information (See Appendix B)

To be approved to offer an applied bachelor's degree, the college must enter into at least one agreement with a regional business or industry to train students in an in-demand field and to employ students upon successful completion of a program.

A. Provide the name(s) of the regional business/industry partner for the proposed program.

We expect the same level of support from business and industry that we received from our application for the Bachelors of Applied Science in MEMS and support from the following companies: Absolute Machine Tools; AgriNomix; A.J. Rose Manufacturing; Eaton; Jergens; Lincoln Electric; The Manufacturing Advocacy and Growth Network (MAGNET); MCPc; The Ohio Manufacturers' Association (OMA); Parker Hannifin; Recognition Robotics; Team NEO; The Technology House; and Thogus.

B. Submit a copy of the agreement(s) or of the expectations for the agreement as an appendix item. If an agreement will not be available until after approval by the chancellor, provide a letter from the potential partner that states key expectations to be in agreement.

LCCC has already established an efficient process that engages commitments from industry. This infrastructure will be modified upon approval and used to extend through the Smart Manufacturing BAS. In Appendix B.2, you will find sample forms used for this purpose demonstrating that industry partners are committed to:

- sponsor a student in an Earn and Learn WBL program, starting third semester (students work three days a week at a \$10 minimum per hour).
- allow the use of company logo in candidate recruitment and promotional materials.
- participation on an industry advisory council at LCCC to drive curriculum development, embed industry recognized credentials and establish hiring requirements.

C. Describe the current and future employment opportunities with the business/industry partner(s) within the region. Include the data points that will be collected to track employment outcomes.

In 2020, over 21,000 individuals were employed in Northeast Ohio within the occupations listed above in section 1.2 (A), and during the past year there were 7,643 postings for jobs within these occupations requiring either an associate's degree or a bachelor's degree. The job postings were from over 500 employers that included Cisco, Anthem Blue Cross, Lincoln Electric, General Electric, and the Cleveland Clinic, among many others. These employers cut across multiple industry sectors. As mentioned previously, demand in these areas is expected to grow in the coming years, largely due to an aging workforce. EMSI forecasts 8,750 openings in these occupations in the next five years. Additionally, an aging workforce is heightening need for workers in these occupations. Overall, over 28% of workers in these

target occupations are nearing retirement age. Detailed data on current and future employment opportunities is included in Appendix A.

As part of the academic program review process, LCCC conducts a survey of all graduates from the academic year 6-9 months after the credential is awarded. This survey asks graduates about the status and nature of their employment. Program faculty are provided aggregate responses from program graduates. Information from the survey includes:

- Graduate demographic information
- Employment status
- Their annual salary
- Their place of employment and job title

Data collected from the graduate survey is enhanced by data obtained through an agreement with Ohio Department of Jobs and Family Services. This data includes weekly earnings of employees reported on a quarterly basis. This information provides a more complete picture of graduate employment outcomes as it includes all employers in the state.

D. Submit letters of support from specific business/industry partners indicating their commitment to train students in an in-demand field and to employ students upon their successful completion of the program as an appendix item. Support letters are expected to detail the partner's current and future employment needs and to specifically describe the partner's level of involvement with the proposed program (e.g., participation in curriculum development, participation in program advisory boards, and commitment to providing work-based learning opportunities for students). See Appendix B.1.

2.2 Workplace-Based Learning Experience

A. Describe the workforce-based learning experience(s) embedded in the program. Include commitments from business and industry partners as an appendix item.

This degree program will be designed around the Earn and Learn model that the institution has utilized in its first approved applied bachelor's degree program. This program requires a student to complete two semester credit hours (300 hours) of WBL to earn their degree. Students continue to work each semester beyond the WBL requirement with additional opportunities to translate classroom theories into practical applications on the job and gain experience. The program allows students to see the immediate impact of their classroom learning on real-life job experiences. Students must show an understanding of what they have learned, how they have grown and the effect on their career development through goals sheets, weekly logs to faculty, evaluations, and a final report. All documents are completed in partnership with faculty and the industry partner. Four key pillars provide a strong foundation for the program.

1. Academic rigor is learning in which students demonstrate in-depth mastery of challenging concepts through thought, analysis, problem solving, evaluation or creativity.

- 2. **Relevant work experience** refers to practical training. It permits students to apply the knowledge, concepts and skills they have learned in the classroom to real world situations.
- 3. **Funding** refers to money from government and nongovernment agencies, education institutions and businesses that support learn-and-earn programs. Financial assistance is a term reserved for money given to students participating in the programs. The importance of significant funding and financial assistance cannot be overemphasized. A 2002 report from the Advisory Committee on Student Financial Assistance stated "…financial barriers prevent 48 percent of college-qualified, low-income high school graduates from attending a four- year college, and 22 percent from attending any college at all, within two years of graduation. Their peers from moderate-income families are hardly better off 43 percent are unable to attend a four-year college, and 16 percent attend no college at all."
- 4. **Strategic alignment** keeps the student engaged in learning and the stakeholders invested in the program and its outcomes. Abraham (2006) referred to it as the concept of "everyone rowing [the boat] in the same direction. The tighter the linkage and the better the alignment, higher the likelihood of flawless execution."

LCCC has a strong record of employer engagement with the Earn and Learn model. LCCC's Applied Bachelor's Degree in Microelectronic Manufacturing and its Associate Degree in Micro Electrical Mechanical Systems (MEMS) have successfully engaged many industry partners, attracted a diverse pool of students, placed adult students in work-based learning, and graduated students. Within three years of launch, the employer partners for the associate degree program grew from 6 to 58, with 58 work-based learning opportunities were available through 24 different industry partners, and 100% of graduating students received a full-time position within the field. With the support of a U.S. Department of Education Title III grant, LCCC is expanding this model to 10 additional programs. LCCC embedded the Earn and Learn WBL model into its Automation Engineering Technology associate degree program this past year, and the strong support employers have expressed for the program will provide sufficient opportunities for students in both the AAS and BAS programs to secure paid internships.

B. Describe the relationship of the individuals working with students in the workplacebased learning experience to those in the on-campus program (e.g., are they members of the on-campus faculty who also participate in the off-campus experience, or are they individuals employed by the off-campus facility who agree to supervise/mentor students)?

LCCC has strong capacity in designing and implementing successful WBL models in applied programs. LCCC runs credit-based WBL courses as a joint effort between industry, program faculty and the Career Services department. WBL is an experiential learning method in which the student integrates skills, knowledge, and training received at Lorain County Community College with a work experience while working in a supervised paid internship. The internships are typically accomplished during a school semester while the student takes classes. The work accomplished during the internship is related to the content of the degree. By means of feedback from an advisory committee of supporting industry representatives, the content of the degree is often tailored by the industry to meet these needs which gives rise to two important values:

- 1. Students learn and improve on industry-related skills which is accomplished both on the job and in classes.
- 2. By a company assisting in tailoring the content of the degree, a talent pool of workforce is formed which the company can use to promote trained talent growth.

The WBL Student handbook can be found in the WBL documents folder in the appendix. The handbook contains all of the forms, instructions, contacts and information necessary to have a successful WBL experience.

The following is the standard course management schedule followed by the student.

- 1. When a student accepts a WBL experience they are required to fill out a WBL Learning Goals Agreement which is agreed upon by the student, industry supervisor and faculty advisor.
- 2. Each week the student is required to submit a log of job activities, accomplishments and skills used to the faculty advisor.
- 3. The student contacts the faculty advisor during the third week of work to ensure that the experience is on track.
- 4. Sometime after completing fifty percent of the required work hours (1 semester credit course requires a minimum of 150 paid hours, a 2 semester credit course requires a minimum of 300 paid hour and a 3 semester credit course requires a minimum of 450 hours) the student schedules a site visit between the student, faculty advisor and work supervisor. During the site visit, the supervisor is given the Employer Evaluation of Student form which should be completed, shared with the student and returned to the faculty advisor a week prior to the last week of required work hours.
- 5. Upon completion of the minimum required work hours the student will submit the written Final Report, completed Work Log and Student Evaluation to the faculty advisor.

The faculty advisor is normally a full-time faculty member from the division that houses the college program. In this case, the program would be part of the Engineering, Business & Information Technologies division. Since the WBL experience is part of a credit course the instructor will be paid following the colleges defined guidelines. (LCCC's Student WBL Handbook is available upon request.)

C. Provide a description of the mechanisms used to measure the success of the workplace-based learning experience. Indicate how faculty members on the main campus are involved in monitoring and improving the experience.

The mechanism used to measure the success of the WBL experience is the evaluation. For the written Final Report, students complete a Work Log, Student Evaluation and Employer Evaluation of Student which is submitted to the faculty advisor.

The success of this Earn and Learn approach has been demonstrated by its implementation in our Microelectronic Manufacturing (MEMS) program. Since the start of the AAS degree in 2013, all students who have graduated with an associate degree in MEMS have been offered at least one full-time job from the company they have interned with through WBL. WBL learning was recently embedded within our Automation Engineering Technology associate degree programs and will be embedded within the BAS as well.

Through the Earn and Learn approach, LCCC also maintains ongoing communication with students and employers to track employment outcomes. Since the start of our MEMS AAS degree in 2013, all students who have graduated with an associate degree have been offered at least one full-time job from the company they have interned with through WBL.

SECTION 3: INSTITUTIONAL CAPACITY

A. Describe the faculty capacity for the proposed program. Include numbers for existing faculty, and faculty that will be hired.

LCCC has one tenured faculty member delivering the AAS program in Automation Engineering Technology, and four Master's level tenure track faculty members (Electrical Engineering, Industrial Engineering, Engineering Technology, Cybersecurity) assigned to deliver course content in the bachelor's program. LCCC will need to hire a full-time faculty member at the Masters level to lead the BAS program, an additional full-time tenure track faculty member credentialed to teach at the Associates level, and 1 adjunct faculty member credentialed at the Masters level. In addition, Laboratory Instructional staff members (one full time and one part time) will be required to maintain multiple lab spaces for program delivery.

B. Describe the financial capacity for the proposed program.

For over 20 years, LCCC's has operated its highly-successful University Partnership Program, which currently offers over 50 bachelor's and master's degrees from 14 colleges and universities. Over 50% of the bachelor's degrees through the University Partnership Program are delivered as 3+1 programs, allowing students to take three years of courses from LCCC at LCCC's tuition rate (second lowest in the state) and one year from the partnering college or university. This saves students on average \$50,000 on the cost of a bachelor's degree.

LCCC has designed the proposed Bachelor of Applied Science Degree in Smart Manufacturing as a 3+1 program as well, leveraging the experience we've had with our University Partnership Program. This will enable the BAS program to be delivered at a cost of less than \$15,000.

The vast amount of expense of this program is within the facilities and equipment needed to provide students with the hands-on, applied experience. These capital costs have already been supported and put in place by the Ohio Third Frontier, Ohio Department of Higher Education, U.S. Economic Development Administrations, and by contributions from industry partners, equipment suppliers and philanthropic donors. The associate degree in Automation Engineering Technology feeding the applied BAS in Microelectronic Manufacturing has already been created and is flourishing. Furthermore, the embedded Earn and Learn workbased learning experience in our programs has been strongly supported by industry and has proven successful.

Because of all of the efforts that have taken place over the previous five plus years in developing the facilities, equipment and Associate Degree program, creating the BAS in Smart Industrial Automated Systems Engineering Technology only requires a small incremental investment and makes the program financially feasible for quick launch and immediate impact to meet industry needs.

C. Describe the facilities and equipment capacity for the proposed program.

With support from a state Small Campus Grants Initiative and funds from private donors, LCCC created the Campana Center for Ideation and Invention, which provides students and local businesses access to cutting-edge digital and additive manufacturing labs, interactive collaboration space, and hands-on education programs. For businesses this access to equipment, such as the Digital Manufacturing Line, is designed to enhance their companies–without a large-scale investment. The Campana Center Digital Manufacturing Line includes the following objectives:

- Provide practical hands-on experience with full-size industrial equipment to better prepare students for careers in automation and digital fabrication. This system will be used for credit courses, apprenticeship programs, and customized industrial training.
- Serve as a resource for local industry and provide opportunities for faculty, staff, and students to work together with local companies.
- Utilize a variety of equipment and capabilities to enable users to prototype, test, and evaluate using a variety of materials and different processes.
- Provide quick change over, which will allow the system the flexibility to be changed over for multiple users, for multiple purposes, and with minimal time and effort.
- Offer flexibility so the system can easily be upgraded and have processes added as needed by using:
 - quick changing tooling and computer operated equipment that can modify operation via software. Also enable the use of quick change end of arm tooling (EOAT) that is not hard wired for a specific purpose.
 - network based distributive I/O for the utmost flexibility in machine communications.
 - automatic identification and vision technologies to allow for variation in part presentation, placement, and orientation.
- Offer the ability to use the entire system, just individual stations, or to operate the individual machines manually.
- Offer the ability to temporarily integrate host machines and equipment for research and development.
- Allow for the use of simulation software to reduce development time and the likely hood of damage, while also allowing quick experimentation with different setups.
- Provide practical hands-on experience with safety equipment and safety procedures.

Overview:

By 2020, it is estimated 60% of jobs will require some advanced training and education. Employers not only need the workers to match labor gaps, but want validation of skills and experience. Lorain County Community College is committed to keeping curriculum updated and relevant to the employer-identified skills. LCCC partners with local employers to develop their talent plans identify needed skills and talents, help recruit, screen and hire the right talent to ensure success of both LCCC graduates and employers. The Engineering, Business and Information Technologies Division houses the Nord Advanced Manufacturing & Emerging Technology Center, where students are able to learn through stackable, portable certificates and earn degrees for both additive and subtractive manufacturing technologies that lead to high paying manufacturing related jobs. In a recent capital project, the CIM/multi-purpose lab was zoned for instructional activities of the various engineering disciplines, including a future Advanced Digital Manufacturing space which would include an updated computer Integrated Manufacturing (CIM) cell with multiple process options (e.g. Welding, Pick-and-Place, etc.) and network communications equipment. The Advanced Digital Manufacturing space increases the process capability of the Digital Fab-Lab to

include multiple additive processes. In addition, it provides enhanced multi-axis computeraided machining processes that can be used for small manufacturing pilot runs.



As designed by LCCC faculty, with significant input from our regional industry partners, the Digital Manufacturing Line includes the latest full-size industrial technology, and provides learning opportunities for credit courses, apprenticeships, and industrial training, in a format unique in our region. It offers the next level of programming and automation knowledge that industry is seeking and employers prefer. Additionally, the Digital Manufacturing Line is also an excellent test bed for local companies to experiment and test different processes and techniques without having to sacrifice their own production time and equipment. The Digital Manufacturing Line is like a sandbox for automation engineers, providing an invaluable learning and hands on experience. The LCCC Digital Manufacturing Line is a flexible automated system capable of quickly being changed over to accommodate a wide variety of applications. Ultimately, it utilizes a CNC machine, a Welding Cell, Laser machine, (3) Industrial Robots, Conveyors, Automatic Tool Changers, PLCs (Programmable Logic Controllers), HMIs (Human Machine Interface) and other equipment. The system can be used all together as one integrated multi-function system, as individual stations, or as manually tended machines as needed for optimal flexibility. The Laser, CNC machine and welding cell all have the ability to be tended by a robot, or, for projects where a completely automated process is not needed, it can be manually loaded and unloaded for small jobs, prototypes, and one off projects.

Overview of the Digital Manufacturing Line placement in the CIM lab:

- From the diagram there is a good view of the system from the hallway windows
- Located adjacent to the automation lab
- Space around the system allows groups and individual students to program various pieces of equipment
- Room for tour groups to view the entire process





Overview of equipment placement

The following diagram depicts and labels equipment used in the Digital Manufacturing Line.



Overview of Work Envelopes:

- Robots can be moved in such a way that they can work on the same part concurrently with each other, providing enhanced capabilities and flexibility.
- Also allows the robots to share the end of arm tooling and fixtures.



• The graphic below shows increased work envelope of rail robot. The rail increases the working range of the robot to over three times it standard range, allowing it to tend to multiple machines and interact with two other robots. It will also be able to tend guest machines that are brought in.



Appendix C.3 provides a list of equipment currently installed within the Campana Center.

D. In addition to allowable tuition, will additional program fees be required for students in the proposed program? If so, please describe.

The additional program fees that would be incurred by students would be the cost of the industrial certifications that the program prepares them to take and the cost of lab fees and books for the courses. Through the efforts of the LCCC Foundation, industry-sponsored scholarships and awards are being created to help students with these costs using a performance-based model to incentivize the students to excel in their classes and work. The College also supports industry partners to access resources such as TechCred in support of worker training, where that makes sense.

Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science

Note: Some software, costs associated with credentials and course expenses have not been determine yet. This is a Draft of fees and expenses for the 4 year program

Program Year	Lab Fees	Course Fees	Optional Cert. Fees	Approx. total:	Lab fees cover:	Course fees cover:	Optional Certification fees cover:
Year 3	\$ 70.00	\$ 350.00	\$ 60.00	\$480.00	Consumables such as wires, raw materials and parts that are used while running the automated systems for training	FANUC eLearning: Vision and Collaborative Robot and Rockwell eLearning	NOCTI FANUC Robot Technician (FCR-T1 & FCR-T2) Certification
Year 4	\$ 130.00	\$ 100.00	\$ 30.00	\$260.00	Consumables such as wires, raw materials and parts that are used for running the automated systems and for use with capstone projects	E-Learning -TBD	NOCTI FCSM-T1 FANUC / Rockwell CSM System Integrator*: TBD
Total for 2 yrs \$740.00							

E. Please provide a budget that addresses the up-front investment required to establish the proposed program.

Much of the up-front investment necessary to deliver the program has been made thanks to state support through RAPIDS grant funding and a Small Campus Grant (Digital Manufacturing Line, PLC equipment, Industrial 3D printers, waterjet, and laser cutting system). We estimate we will need \$1.9 M in additional equipment to support the program with the support of the Department of Defense ARCTOS grant, \$1.6M will be used to purchase this equipment, which will provide students with meaningful hands-on experience based upon the latest industrial automation equipment and software. We are exploring pre-configured systems from vendors, but we are also looking into a custom solution to meet our needs for flexibility and capability. This includes a modular system comprised of technology to teach levels 1-3 of I4.0, Automation and Robotics.

Additional equipment needed includes the following:

Collaborative Robots (Co-Bot)

Co-Bots are a safer version of the true industrial robot. Their design and the technology used allows collaborative robots to work alongside humans without needing expensive safeguarding. They accomplish this by using a combination of software and force sensing.

• Industrial robots

The powerhouse of many automated systems. Industrial robots come in a variety of sizes and capabilities. The most widely used robot is a 6 axis configuration, which mimics the human arm. They are used to perform many applications from material handling, assembling, welding, painting and more. The newer robots have many technological improvements that allow them to utilize vision systems, to use software to limit speed and reach for safety, networked I/O, quick change tooling and more.

• Safety devices (area scanners, light curtains, controllers...etc.)

Safety devices are an important aspect of any type of automated solution. Safety devices can range from area scanners and light curtains, to safeguarding, e-stops, safety controllers and more. These technologies help keep personnel safe while working around automation.

• Software (MES, SCADA, VR and Augmented reality)

With Industry 4.0, software applications have become more available and capable. We can know fully design and test run an automated solution in a computer simulation, which is known as a digital twin. You can also use the latest augmented reality and VR equipment to help troubleshoot and setup an automated system. There are more applications such as MES, SCADA, etc. that we will also be exploring and implementing.

• IO-Link sensors, Smart Sensors

With the continual improvement in electronics and technology, we now have smart sensors that can provide a lot of new capabilities. With smart sensors, we can now configure them over the network, receive real time data, and more.

• RFID, Barcode, NFC

RFID, Barcode, NFC and others enable the possibility of tracking parts and products through a manufacturing process. RFID can also be used on machines to help operators and alert the user if they have a wrong tool or configuration.

• Networking, Managed switches...etc.

With the advancements in networking technology, we now have more capabilities and opportunities to expand its use. An example of this is our current system that sends signals for the safety aspects over the network. One piece of equipment we are looking into is managed switches; they help manage the traffic on a network; they allow NAT capability; they implement certain security practices and more. We also will have several networking security devices and others.

Vision Systems (FANUC iRvision, Cognex)

Vision systems gives your robots or system "eyes" to see what's going on around them. They allow robots to see parts and adjust their movements, so they can accurately place or pick objects. It also allows random part picking from bins or part feeders. We are looking into systems that utilize AI (artificial intelligence) in the software to make a more capable and adaptable visions system.

Processes for Digital Line/New equipment (Ex. Palletizing, machine tending, pick and place, assembly...etc.

We are looking to our local and regional companies for processes that they use. This is so we can tailor certain parts of our equipment to meet the needs of our local industry. If a major part of our industry does assembling or material handling, then we would implement that into a system to train students. Current processes that we are exploring are palletizing, pick and place (utilizing parts feeders, vision, etc.), material handling, machine tending, assembly and others.

• Programmable Logic Controllers (PLCs)/ Programmable Automation Controller (PAC)

PACs are the brains of most automated systems. They are a specialized industrial hardened computer which executes the code that tells the system exactly what to do. We will be utilizing the latest PLC/PAC technology that Rockwell Automation has to offer.

• Human Machin Interface (HMI)

HMIs allows operators and personnel to interact with an automated systems. They provide real time updates, status, alerts and more. They can be used to change jobs, troubleshoot a system, and more.

A table providing a detailed list of needed equipment and estimated costs appears in **Appendix C.4** of the proposal.

F. Please provide revenue and expense information that tracks how many years it will take for revenue derived from the program to exceed program expense.

Instructions: Complete all vellow-shaded sections: hlue-shaded sections	nc aut	tomatically ca	lculat	e: calmon-char	hol	actions are non	ulat	ed by the		
Contro	oller's c	office	cuiut	e, suimon-snuc	ieu s	ections are pop	uiuti	eu by the		
Program/ Subject Name	New Program Grants Software Development									
		Year 1		Year 2		Year 3		Year 4		TOTAL
. Projected Enrollment										
Head-count full time		8		10		12		12		4
Head-count part time		10		14		16		18		5
-ull Time Equivalent (FTE) enrollment (1FTE = 30 Credits)		16.33		21.67		25.33		27.00		90.33
II. Projected Program Income										
Fuition (paid by student or sponsor)	\$	61,946	\$	82,173	\$	96,079	\$	102,400	\$	342,598
Estimated state subsidy	\$	-	\$	35,457	\$	82,915	\$	132,556	\$	250,928
Externally funded stipends, as applicable	\$	-	\$	-	\$	-	\$	-	\$	-
Other income (if applicable, describe in narrative section below)	\$	-	\$	-	\$	-	\$	-	\$	-
Total Projected Program Income	Ś	61.946	Ś	117.630	Ś	178.995	Ś	234.956	Ś	593.526
	Ŧ		Ŧ	,	Ŧ		Ŧ		Ŧ	
II. Program Expenses										
New Personnel										
 Instruction (technical, professional and general education) 										
Full <u>X</u>	\$	62,380	\$	82,749	\$	96,753	\$	103,119	\$	345,002
Part Time X	\$	26,766	\$	35,505	\$	41,514	\$	44,245	\$	148,030
 Non-instruction (indicate role(s) in narrative section below) 	<u> </u>									
FullX	\$	38,000	\$	38,000	\$	38,000	\$	38,000	\$	152,000
Part timeX	\$	2,000	\$	2,000	\$	2,000	\$	2,000	\$	8,000
New facilities/building/space renovation	~		è		ė		ċ		ć	
if applicable, describe in narrative section below)	Ş	-	Ş	- The second	Ş		Ş	-	Ş	-
Scholarship/stipend support (if applicable, describe in narrative section below)	\$	4,336	\$	5,752	\$	6,726	\$	7,168	\$	23,982
Additional library resources (if applicable, describe in narrative section below)	\$	-	\$	-	\$	-	\$	-	\$	-
Additional technology or equipment needs	s	7 500 00	Ś	7 500 00	Ś	7 500 00	Ś	7 500 00	Ś	30.000
if applicable, describe in narrative section below)	Ŷ	7,500.00	Ŷ	7,500.00	Ŷ	7,500.00	Ŷ	7,500.00	Ŷ	50,000
Other expenses (if applicable, describe in narrative section below)	\$	1,000	\$	1,000	\$	1,000	\$	1,000	\$	4,000
Total Projected Program Expenses	\$	141,982	\$	172,507	\$	193,493	\$	203,032	\$	711,013
Total Projected Net Gain (Loss)	\$	(80,036)	\$	(54,877)	\$	(14,498)	\$	31,924	\$	(117,487
						•				
Calculated Total Credits		490		650		760		810		2.710

Additional Inputs:			
Enter Part-Time Credit Hours/Program per Year	25	PROGRAM	used to calculate part-time FTEs
NEW PROGRAM /SUBJECT Select YES or NO	YES	PROGRAM	used to pro-rate SSI for new programs
Enter Average Class Size (typically 12)	12	PROGRAM	used to estimate ILUs
Current Year Base Tuition/Credit Hour	\$ 126.42	Controller's Office	used to calculate estimated tuition
Current Year Budgeted SSI	\$ 29,299,693	Controller's Office	
FTEs reported in most recent IPEDS (prior year)	5,968	Controller's Office	
Estimated SSI per FTE	\$ 4,909	Calculated	
Current Highest Adjunct Rate	\$ 1,107	Controller's Office	
Adjunct Rate including 18.425% Benefits	\$ 1,311	Calculated	
For FT Faculty-Current Highest Overload Rate	\$ 1,290	Controller's Office	
FT Overload Rate including 18.425% Benefits	\$ 1,528	Calculated	

We project that by year 4 our revenues will exceed program expense. This is based upon our projection that initially 10% of our base of 188 associate degree students will pursue the bachelor's program. We anticipate that enrollment will grow each year thereafter as the Learn & Earn model and employer engagement expands.

SECTION 4: PROGRAM INFORMATION

A. Provide the learning outcomes of the program. Note: if existing bachelor's degree programs might appear to be duplicative, please list them and describe how the learning outcomes of the proposed program differ from the learning outcomes of existing program(s). (See Appendix C)

LCCC's proposed Smart Manufacturing BAS degree aligns with the proposed Industry 4.0 pathways model recommended by the Ohio Manufacturer's Association and created by ARM – the Advanced Robotics for Manufacturing Institute, which is a public private organization supported by the US Department of Defense and private industry. LCCC's stackable technical certificate, associate's degree, and bachelor's degree would advance students along a coherent career pathway, providing them with the skills and knowledge to address the interconnectivity and continuing evolution of an Industry 4.0 environment.



Level 3 – Integrator – Proposed Smart Industrial Automated Systems Engineering Technologies, Bachelor of Applied Science

Level 2 – Specialist - Associate of Applied Science in Automation Engineering Technologies – Systems Specialist Curriculum Code #6211

Level 1 – Technician - Maintenance Technician Short-Term Certificate Curriculum Code #6181

Employability Pyramid

- Project management
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Critical thinking
 - \circ Infused in many technical courses, I1 Critical thinking
- Planning
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Problem solving
 - TECN 111 Technical Problem Solving
 - Applied in most technical courses
- Time Management
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Adaptability
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
 - AETC 3xx Work Based Learning I
 - AETC 4xx Work Based Learning II
- Attention to detail
 - QLTY 122 BASIC QUALITY TOOLS AND APPLICATIONS
 - o QLTY 224 LEAN MANAGEMENT PRINCIPLES & PRACTICES
- Technical learning ability
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
 - All technical courses
- Interpersonal
 - BADM 251 PRINCIPLES OF MANAGEMENT
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Communications
 - ENGL 161 COLLEGE COMPOSITION I
 - ENGL 164 COLLEGE COMPOSITION II WITH TECHNICAL TOPICS
 - \circ Also infused in many technical courses, I2 Communications
- Technology aptitude
 - Advanced AETC courses
- Teaming
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Safety
 - SAFE 235 Machine Guarding Basics
 - Also covered in applicable technical courses

LCCC Smart Industrial Automated Systems 4 yr. degree – draft program outcomes

- 1. Implement and evaluate secure industrial networks
- 2. Demonstrate the ability to program advanced industrial automation systems
- 3. Design and integrated automated systems that apply to real world situations and challenges
- 4. Apply additive manufacturing, rapid tooling, and simulation (virtual reality / augmented reality) to industrial situations
- 5. Apply knowledge of advanced sensor technologies such as machine vision, Radio Frequency Identification to make automated system more autonomous
- 6. Integrate collaborative robots and human machine interfaces to make systems that are safer and more user friendly

As mentioned above, during our review of programs offered at colleges and universities in northeast Ohio, we concluded that no other college or university in our region has the equipment and application focused academic program to prepare students to meet this workforce need. The BGSU degree in Mechatronics Engineering Technology, for example, focuses more on automated machine design. In contrast, the proposed LCCC Smart Industrial Automated Systems degree would focus on integrating, operating, modifying, and troubleshooting smart manufacturing systems based upon modern "off-the-shelf" industrial equipment.

Another challenge facing working adults in Lorain County is that many do not have the resources to travel to a four-year college or university outside of the county. Transportation is a significant obstacle for many LCCC students. This is one reason why only 36% of adults in Lorain County have a college credential, significantly below the state and national averages. The proposed Smart Manufacturing degree would make another bachelor's degree program accessible to our community, would contribute to a significant workforce need, and would contribute to the Ohio's goal of having 65% of adults with a college credential by 2025.

B. Provide the proposed course sequence and course descriptions.

See Appendix C for a list of program skills and competencies, embedded industry certifications, a draft curriculum guide, and a program scorecard highlighting the unique features of LCCC's proposed program.

C. If students will earn industry-recognized credentials as a part of the program, please identify those credentials.

LCCC is collaborating with national leaders to explore an industry-endorsed certification process. Such leaders include members of the Digital Thread Advisory Group, MxD, ARM Education working group, OMA Automation Task force, and the national industry associations, such as the National Association of Manufacturing. Industry recognized certifications identified through the Lt. Governor's Automation Task Force will be

embedded in the associate degree and applied bachelor's degree to eliminate unnecessary time and costs for students seeking degrees. The goal is for the stackable micro-credential model to be industry-recognized and transferable. The matrix below demonstrates the integrated approach to embedding credentials within the pathway.

Integrated I	4.0, Embedded Cre	edentials: Roles &	Skills Matrix for A	dvanced Manufactı	uring in Ohio
				Level 3:	Robotics Integrator
Advanced Product ID	HMI	Advanced Robotics	Advanced PLC	Smart Maintenance	Cyber Security
Vision Technology II Near Field Communications RFID II Potential & Impact	Manufacturing Processes Programming Creating Visual Awareness Recipe Creation Data Acquisition	Collaborative Robots Augmented Reality IRA Safety Standards Integration of PLC's w/Robotics Virtual Commission	Sensors III OPCUA w/MES & PLC I/O Condition Monitoring Advanced Networking & Connectivity	Predictive Maintenance Data Analysis LEAN & Visual Awareness Top Floor Shop Floor Communication	Data Corruption: Understanding Risks & Consequences Preventing Cyber Attacks
				Level 2:	Robotics Specialist
Product ID Fundamentals	Applied Fluid Power	Applied Mechanical Systems	Applied PLC	Applied Robotics	Applied Industry 4.0
Vision Technology 1 RFID 1 Bar Coding 1	Maintenance & Troubleshooting Energy Efficiency Vacuum Technology	Gear Drives Bearings & Gaskets, Seals Clutches & Brakes Ball Screws and Linear Bearings	Sensors II PLC Technology II Basic Networking CoDeSys	Programming & Editing Maintenance & PM Welding Material Handling Palletizing	Introduction to MES Introduction to HMI Introduction to Data Safety Introduction to 3D Modeling
				Level 1:	Robotics Technician
Electricity Fundamentals	Fluid Power Fundamentals	Mechanical Systems	PLC Fundamentals	Robotics Fundamentals	Industry 4.0 Fundamentals
Electricity AC Electricity DC	Basic Hydraulics Basic Pneumatics	Mechanical Drive Systems Components & Calculations Belts, Chains, & Lubrication Maintenance & Installation of components	Sensors I PLC Technology 1	Introduction to Robotics	Introduction to Industry 4.0

OMA Automation & Robotics Task Force

Though defining and integrating industry certifications within the pathways will be ongoing, certifications currently proposed to be embedded in the BAS include:

Allen Bradley

ControlLogix® Programmer - Assessment: T-CLXPT ControlLogix® Maintainer - Assessment: T-CLXMT Motion Control Fundamentals: CCN130 EtherNet/IP Configuration and Troubleshooting - CCP183 Industrial Network Architecture: Foundation - INA201 Industrial Network Architecture: Intermediate - INA202 Industrial Network Architecture: Advanced Part 1 - INA203 Industrial Network Architecture: Advanced Part 2 - INA204

FANUC

Advanced iRVision Operation and Programming - 2D Advanced TPP Programming Dual Check Safety V7.50 & Newer Ethernet IP Setup & Functionality HandlingPRO Intro Plus HandlingTool Operation and Programming iRPickTool Operations & Programming w/iRPickPRO V-iRVision Operation and Programming - 2D

COGNEX

DataMan Standard In-Sight Installation & Operation In-Sight EasyBuilder Standard In-Sight Spreadsheet Standard In-Sight EasyBuilder Advanced In-Sight Spreadsheet Advanced

SACA

Certified Industry 4.0 Automation Systems Specialist I Certified Industry 4.0 Automation Systems Specialist II Certified Industry 4.0 Production Systems Specialist II

D. Is programmatic/specialized accreditation available for the program? If so, please indicate the accreditor and the time line for seeking accreditation.

LCCC will pursue ETAC of ABET accreditation for the Smart Automation BAS program. LCCC will follow a similar timeline to the Micro Electronic Manufacturing BAS program. The Engineering Technology Accreditation Commission (ETAC) of ABET requires two years of graduate data prior to application. In addition, the Automation Engineering Technology Associate of Applied Science program will also be required to apply for ETAC of ABET accreditation. LCCC will follow a predefined Assessment plan with data collection beginning with the initial cohort of baccalaureate students once approved by HLC and ODHE. LCCC will provide annual updates to ODHE on its progress towards ETAC of ABET accreditation and will submit notification to ODHE of initial ETAC of ABET program application.

APPENDICES

List the appendix items that are included with the request, in the order of which they are in the proposal. Appendix items should be clearly labeled and submitted electronically as PDF documents or as Microsoft Office documents (e.g., Word or Excel).

Appendix A:	Workforce Need in Northeast Ohio1. Detailed Information Documenting Need2. February 26, 2021 Open Forum Presentation
Appendix B:	 Industry Partnerships Letters of Support Work-Based Learning Form Employer Survey
Appendix C:	 Institutional Capacity Program Skills, Competencies, and Draft Curriculum Guide LCCC/University Program Scorecard List of Existing Equipment

- 4. List of Equipment to Be Purchased
- 5. Student Fees



Appendix A: Workforce Need in Northeast Ohio



Smart Industrial Automated Systems Engineering Technology

Occupations Analyzed

SOC Occupation

- 15-1212 Information Security Analysts
- 15-1244 Network and Computer Systems Administrators
- 17-2071 Electrical Engineers
- 17-2072 Electronics Engineers, Except Computer
- 17-2112 Industrial Engineers
- 17-2199 Engineers, All Other
- 17-3023 Electrical and Electronic Engineering Technologists and Technicians
- 17-3024 Electro-Mechanical and Mechatronics Technologists and Technicians
- 17-3026 Industrial Engineering Technologists and Technicians
- 17-3027 Mechanical Engineering Technologists and Technicians
- 17-3098 Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other
- 49-2094 Electrical and Electronics Repairers, Commercial and Industrial Equipment
- 51-9162 Computer Numerically Controlled Tool Programmers

In 2020, more than 21,000 individuals were employed in Northeast Ohio within these occupations

Annual Openings

SOC	Occupation	Average Annual Openings
15-1212	Information Security Analysts	120
15-1244	Network and Computer Systems Administrators	273
17-2071	Electrical Engineers	184
17-2072	Electronics Engineers, Except Computer	56
17-2112	Industrial Engineers	365
17-2199	Engineers, All Other	161
17-3023	Electrical and Electronic Engineering Technologists and Technicians	103
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians	26
17-3026	Industrial Engineering Technologists and Technicians	116
17-3027	Mechanical Engineering Technologists and Technicians	90
17-3098	Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other	113
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	62
51-9162	Computer Numerically Controlled Tool Programmers	104
		1,774

Demand is Clear

 7,643 postings for jobs within these occupations requiring an Associate's Degree or a Bachelor's Degree
 (January 1, 2019 – December 15, 2020)

Postings from over 500 employers

• Top posters include Anthem Blue Cross, Cleveland Clinic, Bendix Commercial Vehicle, Rockwell Automation, and Cisco, among many others

• Employers cut across multiple industry sectors:

- Manufacturing
- Administrative and Support Services
- Professional, Scientific, and Technical Services
- Finance and Insurance
- Health Care and Social Assistance

Top Titles


Skill Clusters in Demand



Maintenance, Repair, and Installation: Equipment Repair and Maintenance Information Technology: Microsoft Office and Productivity Tools Information Technology: Technical Support **Business: Project Management** Maintenance, Repair, and Installation: Basic Electrical Systems Engineering: Electrical and Computer Engineering **Business: Business Process and Analysis** Customer and Client Support: Basic Customer Service Information Technology: System Design and Implementation Manufacturing and Production: Machinery Information Technology: Cybersecurity Architecture and Construction: Electrical Construction Engineering: Drafting and Engineering Design Industry Knowledge: Industrial Engineering Industry Knowledge Information Technology: Network Configuration Information Technology: Operating Systems Information Technology: General Networking Manufacturing and Production: Computer-Aided Manufacturing Manufacturing and Production: Machine Tools Information Technology: Systems Administration Manufacturing and Production: Manufacturing Processes Maintenance, Repair, and Installation: Electrical and Mechanical Labor Maintenance, Repair, and Installation: Schematic Diagrams Human Resources: Occupational Health and Safety Administration: Scheduling

Skills in Greatest Demand



Employers with the Most Job Openings





Demand is expected to grow in the coming years, largely due to an aging workforce

- Emsi forecasts over 8,750 openings in these occupations in the next 5 years
- Additionally, an aging workforce is heightening need for workers in these occupations:
 - Overall, over 28% of workers in these target occupations are nearing retirement age



72% (8,378 of 11,587) of Occupations in Northeast Ohio related to Smart Manufacturing/Automation require a Bachelor's Degree as Typical Entry Level Education; as technology and systems advance, this is expected to increase

Source: EMSI Data for Cleveland-Elyria MSA

SOC	Description	2020 Jobs	2029 Jobs	2020 - 2029 % Change	Age 55-64	Age 65+	Avg. Annual Openi ngs	Age 55-64 % of Occupation	Age 65+ % of Occupatio n	Median Hourly Earnings	Typical Entry Level Education	2020 - 2029 Openings	2020 - 2029 Replacem ent Jobs	Annual Replacem ent Jobs	Annual Replace ment Rate
15-1212	Information Security Analysts	920	1,099	19%	150	24	86	16%	3%	\$45.04	Bachelor's degree	855	590	66	0.065
15-1244	Network and Computer Systems Administrators	2,072	2,126	3%	291	45	128	14%	2%	\$38.67	Bachelor's degree	1,282	1,098	122	0.058
17-2071	Electrical Engineers	1,269	1,293	2%	333	93	81	26%	7%	\$39.62	Bachelor's degree	808	683	76	0.059
17-2072	Electronics Engineers, Except Computer	445	460	3%	118	29	29	27%	7%	\$42.69	Bachelor's degree	291	241	27	0.059
17-2112	Industrial Engineers	2,262	2,377	5%	614	143	151	27%	6%	\$37.88	Bachelor's degree	1,508	1,236	137	0.059
17-2199	Engineers, All Other	1,410	1,411	0%	342	130	86	24%	9%	\$46.42	Bachelor's degree	860	752	84	0.059
17-3023	Electrical and Electronic Engineering Technologists and Technicians	503	514	2%	145	34	44	29%	7%	\$29.23	Associate's degree	442	380	42	0.083
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians	96	97	2%	26	<10	9	27%	Insf. Data	\$24.53	Associate's degree	85	72	8	0.083
17-3026	Industrial Engineering Technologists and Technicians	534	524	(2%)	147	33	46	28%	6%	\$24.23	Associate's degree	458	397	44	0.083
17-3027	Mechanical Engineering Technologists and Technicians	568	556	(2%)	151	36	48	27%	6%	\$27.22	Associate's degree	482	422	47	0.083
17-3098	Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other	662	653	(1%)	172	38	56	26%	6%	\$28.21	Associate's degree	557	493	55	0.083
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	335	336	0%	73	12	24	22%	4%	\$25.06	Postsecondary nondegree award	236	206	23	0.068
51-9162	Computer Numerically Controlled Tool Programmers	510	543	6%	115	18	50	22%	4%	\$24.27	Postsecondary nondegree award	500	412	46	0.087
	Totals	11,587	11,989	3%	2,677	642	837	23%	6%			8,365	6,982	776	



Open Forum: Lorain County Community College's Bachelor of Applied Science in Smart Industrial Automation

On February 26, 2021 (8 to 9 am), Lorain County Community College in partnership with TeamNEO (our region's JobsOhio lead) with support from seven other regional and state partners hosted a virtual open forum to share details about LCCC's proposed Bachelor of Applied Science in Smart Industrial Automation (BAS). The forum provided an opportunity for participants from higher education, industry and economic development to ask questions and provide feedback about the program. The open forum was marketed broadly to the mentioned stakeholders for a period of three weeks. LCCC's Associate Provost for the University Partnership made personalized outreach to appropriate leaders at regional higher education institutions that have programs most closely aligned to LCCC's proposed BAS to ensure their awareness of the opportunity and to encourage them to attend.

Forty-five individuals registered for the program and 38 attended representing industry (23), other higher education partners (5), economic development organizations (8) and government (2). (See attached participant list.)

The open forum was structured to provide context on the economic growth opportunity presented at the regional and state level in the area of smart manufacturing, the current and future talent needs of this industry sector and details about LCCC's proposed BAS degree to address this need. (See attached PowerPoint presentation.).

About half the program time was dedicated to open discussion and questions, which mostly occurred with questions and comments submitted via the Zoom chat feature. (See attached chat log.). The comments and questions centered around specific technologies the program would address, design of the program to include work-based learning, portability of the program to work directly with employers, inquiries on how both manufacturers and higher education partners could be supportive and involved, flexibility of the program to be designed for working age adults, and more. No comments from any participants voiced concerns about the program's duplication or merit. Additionally, the discussion portion of the program was recorded and available upon request.

Appendices:

- February 26 Open Forum Participant List
- PPT Presentation Shared During the Open Forum
- Chat log of comments and questions

Attended	Sector	Name (First)	Name (Last)	Organization Name	Job Title
YES	Economic Development	Kyle	Sossi	Advanced Robotics for Manufacturing	EWD Project Manager
YES	Economic Development	Linda	Wood	ARM Institute	Senior Certification Manager
YES	Economic Development	Mike	Yost	Clean Energy Smart Manufacturing Institute	Adviser
YES	Economic Development	Jessica	Borza	Mahoning Valley Manufacturing Council	
YES	Economic Development	Erica	Fitzpatrick	Team Neo	Program Manager, Industry and Innovation
Yes	Economic Development	Jay	Foran	Team NEO	Senior Vice President
YES	Economic Development	Sara	Tracey	The Ohio Manufacturers' Association	Workforce Director
Yes	Economic Development	Eric	Burkland	The Ohio Manufacturers' Association	President Emeritus
YES	Government	Susan	Foltz	Ohio Development Services Agency	State Director Ohio MEP
YES	Government	Olivia	Helander	Summit County	Business Development Specalist
YES	Higher Education	Chris	Littman	Case Western Reserve University	Executive Director of Professional Programs
YES	Higher Education	Joanne	Belovich	Cleveland State University	Interim Dean
YES	Higher Education	CAE Faculty		College of Aeronautics and Engineering at Kent State University	
YES	Higher Education	Cher	Hendricks	University Of Akron	Chief of Staff to the Provost
YES	Higher Education	Sukanya	Kemp	University of Akron	Acting Associate Dean
YES	Industry	David	Zunis	Absolute Machine Tools, Inc.	Director, Service & Application Engineering
YES	Industry	Oliver	Theiss	Andonix	CRO

ATTENDEES: Open Forum for Lorain County Community College's Bachelor of Applied Science in Smart Industrial Automation

YES	Industry	Roger	Sanders	APT Manufacuring Solutions	Application Engineer
YES	Industry	ΤJ	Zawodniak	Charter Steel	HR Partner
YES	Industry	John	Mohorcic	Delta Systems Inc	Lead Digital Factory Engineer
YES	Industry	Matt	Hoover	Embedded Planet, Inc.	CEO
YES	Industry	Jeffrey	Ohlemacher	EMC Precision	CEO
YES	Industry	James	Vosmik	Everett Industries, LLC	CEO/President
YES	Industry	Mark	Lamoncha	Humtown Products	CEO
YES	Industry	Tim	Zarkovacki	InTec Consultants LLC	Solutions Architect
YES	Industry	Gabe	McCready	IST Ohio	Director of Operations
YES	Industry	Dan	Kasper	Kasper Consulting, LLC	President and CEO
YES	Industry	Albert	Green	Kent Displays	Advisor to the Board
YES	Industry	Ed	Yenni	LogiSync LLC	President
YES	Industry	Todd	Waddle	M Holland	Director
YES	Industry	Peter	Buca	Parker Hannifin	VP Sustainability & Innovation Processes
YES	Industry	Mike	Laurich	Parker Hannifin	Leader Digital Technologies
YES	Industry	Patrick	Retko	Parker Hannifin	Human Resources Leader
YES	Industry	Helge	Nornis	Pepper1+Fucks, Inc	Regional Technical Dirictor - Americas
YES	Industry	Marzelli	Brown	Rockwell	Design Partner
YES	Industry	Michael	Cook	Rockwell Automation	Dir Global Academic Organization
YES	Industry	Lisa	Lufkin	Saint-Gobain Crystals	Operations Director, North America
YES	Industry	Sara	Siegler	Sara Elizabeth Siegler (SES)	CEO/Owner



Advancing Northeast Ohio's Competitiveness Through Smart Manufacturing Capabilities



Agenda

- I. Welcome
- II. The Opportunity of Smart Manufacturing
- III. Talent Needs to Advance Smart Manufacturing
- IV. Building the Smart Manufacturing Talent Pipeline
 - Regional Foundation of Programs and Providers
 - Meeting an Industry Identified Gap: Presentation of Lorain County Community College Bachelor of Applied Science in Smart Industrial Automation Systems Engineering Technology
 - Feedback, Questions and Discussion
- V. Other/Next Steps



Economic Opportunity of Smart Manufacturing

National, State and Defense Imperative:



OHIO: Home to 20 of the top Defense Contractors Over 1,800 small and medium manufacturers in the supply chain. [Source: Ohio Defense Manufacturing Community]



NORTHEAST OHIO: Potential impact of SMART Manufacturing will have on NEO's manufacturing sector by 2025: \$13 billion dollars, taking region's total manufacturing from \$49B to \$62B by 2025



[Source: Team NEO]

III. Talent Needs to Support Smart Manufacturing

Talent – An Asset for Economic Growth

2001 - 2018 IN NORTHEAST OHIO

Population dropped by 155,000 to 4.278 million Labor force dropped by 146,000 to 2.111 million

Looking Ahead

The post COVID-19 economy will demand even more credentialed workers.

As our population and labor force continue to shrink, it is imperative to *educate talent* for the jobs of the future.



PREPARED BY Team NEO

IN PARTNERSHIP WITH Delta Denta



A DELTA DENTAL

WITH GENEROUS SUPPORT BY



Allance Solutions Group

Preparing Diverse Talent Aligned to In-Demand Jobs

Gap Between Education Required by 2025 & Educational Attainment of Population 2018 Northeast Ohio 34% 21% 45% (18 county) 2025 PROJECTED DEMAND: 65% 35% 20% Ohio 45% United States 38% 21% 41% n 10% 20% 30% 40% 50% 60% 70% 80% 00% 100% Some Postsecondary Some College* No Postsecondary Education Credential

In the short term, **alignment** of credentials with in-demand jobs will be even more important.

*"Some College" Includes both those who have started, but not completed, a college degree program and those who may hold a certificate or other training credential that is not a degree.



PREPARED BY Team NEO IN PARTNERSHIP WITH Delta Dental



WITH GENEROUS SUPPORT BY

Smart Manufacturing – Disruptive Across Occupations Occupations Analyzed

SOC Occupation

- 15-1212 Information Security Analysts
- 15-1244 Network and Computer Systems Administrators
- 17-2071 Electrical Engineers
- 17-2072 Electronics Engineers, Except Computer
- 17-2112 Industrial Engineers
- 17-2199 Engineers, All Other
- 17-3023 Electrical and Electronic Engineering Technologists and Technicians
- 17-3024 Electro-Mechanical and Mechatronics Technologists and Technicians
- 17-3026 Industrial Engineering Technologists and Technicians
- 17-3027 Mechanical Engineering Technologists and Technicians
- 17-3098 Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other
- 49-2094 Electrical and Electronics Repairers, Commercial and Industrial Equipment
- 51-9162 Computer Numerically Controlled Tool Programmers

In 2020, over 20,000 individuals were employed in Northeast Ohio within these occupations

Smart Manufacturing – Current and Growing Demand for Skilled Talent

 7,643 postings for jobs within these occupations requiring an Associate's Degree or a Bachelor's Degree (January 1, 2019 – December 15, 2020)

Postings from over 500 employers

 Top posters include Bendix Commercial Vehicle, Rockwell Automation, Parker Hannifin, and Cisco, among many others

Employers cut across multiple industry sectors:

- Manufacturing
- Administrative and Support Services
- Professional, Scientific, and Technical Services
- Finance and Insurance
- Health Care and Social Assistance

Smart Manufacturing – Current and Growing Demand for Skilled Talent

Demand is expected to grow in the coming years, largely due to an aging workforce

- Emsi forecasts over 8,750 openings in these occupations in the next 5 years
- Additionally, an aging workforce is heightening need for workers in these occupations:
 - Overall, over 28% of workers in these target occupations are nearing retirement age



IV. Building the Smart Manufacturing Talent Pipeline

Regional Programs: Working Together to Meet NEO Workforce Needs in SMART Manufacturing



Bachelor of Science in Automated Manufacturing Engineering Technology



Bachelors of Science in Technology – Degree in Mechatronics Engineering Technology



Bachelor of Science in Systems and Control Engineering



Bachelor of Science Electronics Engineering Technology



Bachelor of Science in Mechatronics Engineering Technology





of Lorain County Community College

<u>2018</u>

Bachelor of Applied Science in Microelectronic Manufacturing

Forthcoming

Bachelor of Applied Science in Smart Industrial Automation Systems Engineering Technology



SMART BAS: 14.0 Integrated Systems Focus Thread



Bachelor of Applie	d Science Smart Ind	ustrial Automated Sy	stems Engineering T	echnology L	evel 3: Robotics Integrator				
Advanced Product ID	HMI	Advanced Robotics	Advanced PLC	Smart Maintenance	Cyber Security				
Vision Technology II Near Field Communications RFID II Potential & Impact	Manufacturing Processes Programming Creating Visual Awareness Recipe Creation Data Acquisition	Collaborative Robots Augmented Reality IRA Safety Standards Integration of PLC's w/Robotics Virtual Commission	Sensors III OPCUA w/MES & PLC I/O Condition Monitoring Advanced Networking & Connectivity	Predictive Maintenance Data Analysis LEAN & Visual Awareness Top Floor- Shop Floor Communication	Data Corruption: Understanding Risks & Consequences Preventing Cyber Attacks				
Bachelor of Applied Science Smart Industrial Automated Systems Engineering Technology and Specialist Certificate Level 2: Robotics Specialist									
Product ID Fundamentals	Applied Fluid Power	Applied Mechanical Systems	Applied PLC	Applied Robotics	Applied Industry 4.0				
Vision Technology 1 RFID 1 Bar Coding 1	Maintenance & Troubleshooting Energy Efficiency Vacuum Technology	Gear Drives Bearings & Gaskets, Seals Clutches & Brakes Ball Screws and Linear Bearings	Sensors II PLC Technology II Basic Networking CoDeSys	Programming & Editing Maintenance & PM Welding Material Handling Palletizing	Introduction to MES Introduction to HMI Introduction to Data Safety Introduction to 3D Modeling				
Associate of Applied Science in Automation Engineering Technologies – Systems Specialist evel 1: Robotics Technician									
Electricity Fundamentals	Fluid Power Fundamentals	Mechanical Systems	PLC Fundamentals	Robotics Fundamentals	Industry 4.0 Fundamentals				
Electricity AC Electricity DC	Basic Hydraulics Basic Pneumatics	Mechanical Drive Systems Components & Calculations Belts, Chains, & Lubrication Maintenance & Installation of components	Sensors I PLC Technology 1	Introduction to Robotics	Introduction to Industry 4.0 Add to Intro Class				

#1 Curriculum: I4.0 Thread + Occupation-Based Learning Outcomes

1. Demonstrate the ability to program advanced industrial automation components and systems

3. Implement and troubleshoot industrial networked devices 5. Utilize simulation, digital twin, and AR/VR in industrial situations.

2. Apply sensors and automatic identification technologies to make automated systems more capable.

4. Apply industrial technologies to make automated systems safer and more adaptable. 6. Design and implement automated systems that apply to real world situations and challenges.

Course Example: CBE + I4.0 + Credentials

Course Name	Potential Embedded Credential(s)	Program Outcome	ARM Skills and Competencies
Industrial Robotics II	 2D iRVision Operations and Programming FCR-T1 FANUC Certified Robot Technician-1* FCR-T2 FANUC Certified Robot Technician-2* 	Demonstrate the ability to program advanced industrial automation systems	 Advanced Robotics (From Level 3 of Matrix) Critical Thinking Problem Solving



Continuous Industry Feedback – Work and Learn, Advisory, Stakeholders



= Consistent Training Results in I4.0 Repeatable Replicable Agile

"This system was developed to bring alignment between Industry and Education to directly tie into the FANUC CERT program, foundational skills in robotics, vision, and integrated solutions." - Paul Aiello, Director of Education, FANUC America

#3. Equipment, Faculty Expertise, and Resource Network





#4. Flexible Delivery with Integrated Work-Based Learning

Work and Learn: Industry Experience & Program Feedback

Delivery of courses and WBL experience ideal for working age adults/upskilling current workforce

TRAIN OH PROGRAM GOALS



HANDS-ON EXPERIENCE ON-THE-JOB TRAINING HIGH DEMAND INDUSTRIES

TRAIN OH is an employment program that allows students to attend school full-time, two days a week and work at a sponsoring company three days a week.

#5. Industry Designed and Validated



Ohio Manufacturing Workforce Partnership Partners in Training Ohio's Manufacturing Workforce



hioHigherEd



State Objectives and to each other

Current Ecosystem

- ✓ Braided Resources, Goals, and Funding
- ✓ Continuous Industry Engagement through ISP's
- Established mutually beneficial relationships between leading I4.0 equipment manufacturers who are also key technical training developers and educators



SUMMARY:

Bachelor of Applied Science in Smart Industrial Automation Systems Engineering Technology



"While there are numerous schools across the State of Ohio, and around the nation, teaching robotics and PLCs, **LCCC provides the opportunity and learning around connected and integrated systems**. Today's manufacturing is smart & connected... LCCC will provide students and incumbent workers the ability to further their learnings beyond siloed technology, but rather fully integrated or connected systems. This teaching aligns directly with today's industry, as well as the future careers developing in automation."



Feedback, Questions

As we finalize the development of this program, we need your feedback.

"Bachelor of Applied Science in Smart Industrial Automation Systems Engineering Technology"

THANK YOU!



Open Forum:

Lorain County Community College's Bachelor of Applied Science in Smart Industrial Automation

CHAT – COMMENTS AND QUESTIONS

From Tim Zarkovacki (InTec Consultants LLC) (Industry):

Can you discuss your plans for continuing education for the existing workforce and graduated alumni?

From Sara Elizabeth Siegler (Sara Elizabeth Siegler, LLC - SES)(Industry)

Is there a pharmaceutical/cell-based gene therapy manufacturing track available within your curriculum? If not, are there plans to include such a track in the future?

From Jim Vosmik (Everett Industries, LLC)(Industry)

Any work/tracks in digital twin, control simulation and similar areas?

From CAE Faculty/General 15 (Kent State University)(Higher Education)

This is a great program. Can you offer more details that faculty from other institutions could participate or collaborate with LCC in this I4.0 training?

From Sara Elizabeth Siegler (Sara Elizabeth Siegler, LLC – SES)(Industry) for more information please email me at sara@saraelizabethsiegler.mygbiz.com

From Joanne M Belovich (Cleveland State University)(Higher Education)

are all students in the program guaranteed to be provided these internship experiences? will courses be offered remotely? will courses be offered on standard 15-week semester and credit hour system?

From Oliver Theiss (Andonix)(Industry)

Is there any opportunity for emerging technology - early stage companies to donate their technology to the curriculum?

From Lori Baukus (Lorain County Community College) information on 14.0 - contact Lori Baukus <u>lbaukus@lorainccc.edu</u>

From Lisa Lufkin (Saint-Gobain Crystals)(Industry)

What is the targeted geography/distance from LCCC for the partner manufacturing organizations, as well as the desire for students graduating from the programs?

From Mike Yost (Clean Energy Smart Manufacturing Institute)(Economic Development) ARM's sister institute, CESMII - the Smart Mfg Institute - is developing baseline definitions and language for consistency in education. Is there an opportunity to collaborate with them on this curriculum to drive consistency with other national education programs?

From Mark Lamoncha (Humtown Products)(Industry)

I would like to speak to what we as manufacturers can do to influence an expanded learning environment.

From Jim Vosmik (Everett Industries, LLC)(Industry)

sorry, I joined late...is there a track for already BA/BS students to participated in just the I4.0 curriculum vs the general requirements?

From Ed Yenni (LogiSync)(Industry)

Great work LCCC Team. You may want to also consider adding some additional courses on common IIoT communication protocols.

From Jim Vosmik (Everett Industries, LLC)(Industry) as to the protocols, is Profinet/Profisafe covered?

From Chris Littman (Case Western Reserve University)(Higher Education) Thank you very much! This was very informative.

From Michael Cook (Rockwell Automation)(Industry)

As a local Ohio manufacturer and supplier we are very humbled and delighted at this approach and program

<u>From Sara Elizabeth Siegler (Sara Elizabeth Siegler, LLC – SES)(Industry)</u> Thank you!

<u>From Cher Hendricks (The University of Akron)(Higher Education)</u> Thanks for the great information from your colleagues at The University of Akron.

From PATRICK RETKO (Parker Hannifin)(Industry)

thank you great program. looking forward to partnering with the team on this.

From Mark Lamoncha (Humtown Products)(Industry)

Very well done Thank you this is our future

Appendix B: Industry Partnership

Letters of Support
 Work-Based Learning Form
 Employer Survey



7420 Industrial Parkway Dr. Lorain, OH 44053

> 440-960-6911 800-852-7825 AbsoluteMachine.com

October 28, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Absolute Machine Tools, Inc., I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as augmenting our Automation Applications Engineering toolbox with the skills needed to create the manufacturing cells of today and the future.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led 14.0 pilots. These pilots will be in partnership with statewide manufacturers and 14.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Absolute Machine Tools affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Absolute Machine Tools accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely,

David A. Zunis, CMfgT. Director, Service & Application Engineering David A. Zunis, CMfgT. Digitally signed by David A. Zunis, CMfgT. Date: 2020.10.28 08:18:09 -04'00'



300 Creekside Dr. Oberlin, OH 44074

> 440-774-2981 440-775-2104 AgriNomix.com

November 3, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of AgriNomix LLC, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as Industrial Controls *Field Service Technician, Industrial Electrical Controls Design Engineer, and Industrial Controls focused Manufacturing Engineer.*

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, AgriNomix LLC affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help AgriNomix LLC accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely, Joseph Smith VP Manufacturing

Joseph Sonth


MOVING METALS IN INNOVATIVE WAYS

January 21, 2020

Marcia J. Ballinger, PhD Lorain County Community College 1005 North Abbe Rd. Elyria, OH 44035

Dear Dr. Ballinger:

On behalf of A.J. Rose Manufacturing Co., I am writing in support of the proposal for Lorain County Community College (LCCC) to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science.

Lorain County Community College is well positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of working with the industry to support the successful adoption and integration of new technology. The proposed degree builds on the College's current excellence in providing advanced manufacturing education to provide individuals with skills to support the design, modeling, analysis and control of predominantly computer-based automated systems or processes. The discipline requires knowledge of elements of electrical engineering, mechanical engineering, software programming, networking, security, and human factors engineering.

It closes a gap for education that currently is available to individuals in Ohio by providing an affordable pathway for automation technicians to advance to positions where they design, integrate, manage and supervise these functions. Critically, the degree that LCCC is proposing is structured as an earn and learn model; the hands-on training that this entails, delivered in close partnerships with industry, makes it a truly unique proposal that directly meets industry need for individuals who have both theoretical knowledge as well as practical, hands-on experience. In support of the proposed program, our company will pursue opportunities to host students in work-based learning opportunities, while providing feedback to the representatives of the college for tailoring the degree to meet ongoing workforce needs.

Lorain County Community College is well positioned to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science, building on its current academic expertise, significant partnerships with industry and unique facilities. Its innovative approach will create a high value, affordable option for students who will be prepared to drive the next generation of Ohio's advanced manufacturing sector. We see great value in this initiative and fully support the College's proposal to the Ohio Department of Higher Education.

Sincerely

Molly Lucas Human Resources Manager

CORPORATE HEADQUARTERS AVON PLANT 38000 CHESTER ROAD AVON, OHIO 44011 440/934-7700 WWW.AJROSE.COM

CLEVELAND PLANT 3115 WEST 38th STREET CLEVELAND, OHIO 44109 440/934-7700



4590 Beidler Road Willoughby, OH 44094

(440) 946-1770 office (440) 946-1789 fax www.bowdenmfg.com

December 23, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Bowden Manufacturing, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as CNC Machinist, Wire EDM Production Specialist, Operations Support and Quality Control Engineer.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Bowden affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Bowden accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely,

Andy McCartney

C. Andrew McCartney President



Eaton Corporation 1000 Eaton Boulevard Cleveland, OH 44122 440 523-4481 www.Eaton.com

December 10, 2020

Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Eaton Corporation, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as supply chain specialists, production managers, logistics analysts, continuous improvement/lean, and control automation.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Eaton Corporation affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Eaton Corporation accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely,

Mahr

Michael Regelski SVP, CTO, Electrical Sector



October 26, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Jergens Inc, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as machine tool monitoring analyst, business analyst, engineering technician.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Jergens affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Jergens accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

> Jergens Way-15700 South Waterloo Road-Cleveland, Ohio 44110-3898 USA Phone (216) 486-5540- Fax (216) 481-6193 Website: www.jergensinc.com

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely, Kurt Schron Sr. Finance Analyst



22221 Saint Clair Ave. Cleveland, OH 44117

216-481-8100 www.LincolnElectric.com

January 2, 2021 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Lincoln Electric, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as Field Applications Technicians, Field Service Technicians, Automation Sales Specialists, and Automation Assembly Technicians.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Lincoln Electric affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Lincoln Electric accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely, Matthew Young Operations Manager

Matthe M



6001 Euclid Avenue 440-268-3141 https://mcpc.com

January 2, 2021 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of MCPc, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce in our Secure Technology Logistics and Secure Technology Asset Disposition facilities.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, MCPc affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help MCPc accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely,

Peter Cavrell

Peter Cavrell VP Marketing & Sales Operations



January 15, 2020

Marcia J. Ballinger, PhD Lorain County Community College 1005 North Abbe Rd. Elyria, OH 44035

Dear Dr. Ballinger:

On behalf of MAGNET, I am writing in support of the proposal for Lorain County Community College (LCCC) to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science.

The mission of MAGNET: The Manufacturing Advocacy and Growth Network is to grow and strengthen Northeast Ohio manufacturing. As a critical piece of our educational infrastructure, and central source for manufacturing talent, Lorain County Community College has been a valued partner with MAGNET as we work to meet the technology and talent needs of small and medium sized manufacturing enterprises in our region. The challenge of filling increasingly high-tech manufacturing occupations is particularly acute for these companies, with 72 percent of Northeast Ohio manufacturers intending to grow their workforce in 2020, but just 35 percent report they have the talent they need. The concurrent impact of an aging workforce and the rapid pace of new technology adoption within the fourth industrial revolution (Industry 4.0) are exacerbating this problem, and holding our region back. Future growth may be constrained by the significant disparity between the number of available manufacturing jobs and the number of qualified applicants to fill those jobs.

Lorain County Community College is well positioned to offer the proposed Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science, building on its current academic expertise, significant partnerships with industry and unique facilities. Its innovative approach will make a lucrative career available to more Ohioan's by creating a high value, affordable option for students who will be prepared to drive the next generation of Ohio's advanced manufacturing sector.

MAGNET sees great value in this initiative and fully supports Lorain County Community College's proposal to the Ohio Department of Higher Education.

Etnan Karp ' CEO & President Chairman of the Board JANE M. NEAL Senior Vice President, AMG Vanadium LLC



President ERIC L. BURKLAND

January 22, 2020

Marcia J. Ballinger, PhD Lorain County Community College 1005 North Abbe Rd. Elyria, OH 44035

Dear Dr. Ballinger:

On behalf of The Ohio Manufacturers' Association (OMA), I am writing in support of the proposal for Lorain County Community College (LCCC) to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science.

The mission of the OMA is to protect and grow Ohio manufacturing. Lorain County Community College has been a valued partner with OMA as we've launched an Ohio manufacturing workforce strategy, and in our work to facilitate an Automation and Robotics Workgroup.

LCCC's application meets the needs of Ohio's manufacturing sector, and will provide an important, costeffective path to high paying jobs for Ohioans. Manufacturing is the leading private sector employer in Ohio and the state is expected to see continued sector growth over the next ten years. The challenge of filling these increasingly high-tech manufacturing occupations is driven by the concurrent impact of an aging workforce and the rapid pace of new technology adoption within the fourth industrial revolution (Industry 4.0). Future growth may be constrained by the significant disparity between the number of available manufacturing jobs and the number of qualified applicants to fill those jobs.

Lorain County Community College is well positioned to offer the proposed Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science, building on its current academic expertise, significant partnerships with industry and unique facilities. Its innovative approach will make a lucrative career available to more Ohioan's by creating a high value, affordable option for students who will be prepared to drive the next generation of Ohio's advanced manufacturing sector. OMA sees great value in this initiative and fully supports Lorain County Community College's proposal to the Ohio Department of Higher Education.

Regards,

Eric L. Burkland



Parker Hannifin Corporation Parker Technology Center 1390 E. Highland Rd. Macedonia, OH 44056 Office 216 896 3000

December 8, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Parker Hannifin, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as manufacturing engineers with robotics, integration, and connectivity knowledge.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Parker Hannifin affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Parker Hannifin accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely. WIL.

Michael A. Laurich Filtration Group Leader, Digital Product and Factory Technologies



January 15, 2020

Marcia J. Ballinger, PhD Lorain County Community College 1005 North Abbe Rd. Elyria, OH 44035

Dear Dr. Ballinger:

On behalf of Recognition Robotics, Inc. I am writing in support of the proposal for Lorain County Community College (LCCC) to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science.

Lorain County Community College is well positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of working with the industry to support the successful adoption and integration of new technology. The proposed degree builds on the College's current excellence in providing advanced manufacturing education to provide individuals with skills to support the design, modeling, analysis and control of predominantly computer-based automated systems or processes. The discipline requires knowledge of elements of electrical engineering, mechanical engineering, robotics, software programming, networking, security, and human factors engineering.

It closes a gap for education that currently is available to individuals in Ohio by providing an affordable pathways for automation technicians to advance to positions where they design, integrate, manage and supervise these functions. Critically, the degree that LCCC is proposing is structured as an earn and learn model; the hands-on training that this entails, delivered in close partnerships with industry, makes it a truly unique proposal that directly meets industry need for individuals who have both theoretical knowledge as well as practical, hands-on experience. In support of the proposed program, our company will pursue opportunities to host students in work-based learning opportunities, while providing feedback to the representatives of the college for tailoring the degree to meet ongoing workforce needs.

Lorain County Community College is well positioned to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science, building on its current academic expertise, significant partnerships with industry and unique facilities. Its innovative approach will create a high value, affordable option for students who will be prepared to drive the next generation of Ohio's advanced manufacturing sector. We see great value in this initiative and fully support the College's proposal to the Ohio Department of Higher Education.

Simon Melikian, PhD President/CEO



January 23, 2020

Marcia J. Ballinger, PhD Lorain County Community College 1005 North Abbe Rd. Elyria, OH 44035

Dear Dr. Ballinger:

On behalf of Team NEO, I am writing in support of the proposal for Lorain County Community College (LCCC) to offer a Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science.

Team NEO is a business development organization focused on accelerating economic growth and job creation throughout the 18 counties of Northeast Ohio. Lorain County Community College is a valued partner as we work to meet the technology and talent needs of companies driving our region's innovation tech economy. We have seen firsthand LCCC's successes in responding to business needs by building a sustainable and robust talent pipeline and developing unique facilities and expertise to support new technology adoption and related processes. The challenge of filling increasingly high-tech manufacturing occupations is particularly acute for these companies and is driven by the concurrent impact of an aging workforce and the rapid pace of technological change.

As an active member of Team NEO's Innovation Clusters, including additive manufacturing, SMART manufacturing and the industrial internet of things, LCCC has listened and learned from our industry members and is proposing a degree that is directly aligned to the critical talent needs we hear from cluster members. An analysis by our research team indicates that the degree is aligned to over 4,700 job postings in 2019, from over 500 employers.

Lorain County Community College is well positioned to offer the proposed Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science, building on its current academic expertise, significant partnerships with industry and unique facilities. Its innovative approach will make a lucrative career available to more Ohioan's by creating a high value, affordable option for students who will be prepared to drive the next generation of Ohio's advanced manufacturing sector. Team NEO sees great value in this initiative and fully supports Lorain County Community College's proposal to the Ohio Department of Higher Education.

Sincerely,

Bill Koehler CEO



Team Northeast Ohio I 1111 Superior Ave. I Suite 1600 I Cleveland. Ohio 44114 I 216 363 5400 I teamneo oro



10036 Aurora-Hudson Rd. Streetsboro, OH 44241

> 440-248-3025 440-248-3882 www.tth.com

December 11, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of The Technology House, Ltd, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as Mechatronics Engineer, *Programmers for Robotics and Information Technology*.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, The Technology House affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help The Technology House accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

Sincerely,

Chip/Ge CEO



33490 Pin Oak Parkway Avon Lake, Ohio 44012 Toll free (866) 933-8850 Fax (440) 933-7839 www.thogus.com

December 8, 2020 Dr. Marcia Ballinger Lorain County Community College 1005 Abbe Rd North Elyria, OH 44035

On behalf of Thogus Products Company, I am happy to write in support of the proposal for Lorain County Community College to offer an Applied Bachelor's Degree in SMART Manufacturing.

Lorain County Community College is well-positioned to develop an advanced bachelor's degree which furthers the skills, knowledge, and experience of those working in SMART Industry 4.0 Advanced Manufacturing, which is critical to the adoption and expansion of automation and robotics in our local and state communities. For our company, this proposed degree path is anticipated to help us upskill our workforce and/or fill critical needs such as automation engineering.

The work LCCC has participated in with ARM (Advanced Robotics for Manufacturing national institute) and the Ohio Manufacturing Association's Automation and Robotics Task Force to define and validate the core critical competencies and employability skills needed in these areas is an excellent framework on which to build this degree. This, combined with hands-on labs, embedded micro-credentials, and work-based learning, is a modern approach to education meeting the speed and articulated needs of industry in advanced manufacturing. In addition, Lorain County Community College students will have the unique opportunity to participate in industry led I4.0 pilots. These pilots will be in partnership with statewide manufacturers and I4.0 technology partners, and will address real-time needs in Ohio's statewide workforce, including companies like ours.

In support of this critical program, Thogus affirms that this degree will help us fill anticipated talent needs (either for upskilling or new hires), and commits to pursuing opportunities to interview students, take advantage of new training assets, and provide ongoing feedback to the representatives of the college for tailoring the degree to meet our workforce needs. As we strive to maintain our competitiveness, we understand that robotics technicians, specialists, and integrators can help Thogus accomplish its goals. With quality training courses focused on equipment operation, engineering, and design issues associated with a dynamic manufacturing environment, Lorain County Community College can help address an unmet need in the advanced manufacturing workforce pipeline.

This project is well-aligned with the skills needs of our business and we look forward to seeing its success as a benefit to the region and to the state of Ohio. We are hopeful that the reviewers will find this proposal favorable and we look forward to working with you to make it an extraordinary success.

- Sincerely,
- MKH
- Matthew K. Hlavin
- CEO



TRAIN OH*

*Training & Recruitment -- Accelerated Innovation Network, Ohio

Employer Opportunity Form TRAIN OH Program at LCCC

EMPLOYER BENEFITS

- Form partnerships with LCCC and other education partners to help create a continuous pipeline of skilled employees.
- Lower the time and cost to recruit and retain top talent.
- ✓ Support the creation of additional education experience and increase the skill levels of employees.
- Have the opportunity to hire students into full-time positions at the completion of the program.

EMPLOYER COMMITMENT/PARTICIPATION

Please identify how your company will be able to commit to the program by checking all that apply.

- Sponsor a student through their Associate Degree program, starting third semester (Student will work three days a week at a \$10 minimum per hour)
- Allow the use of your company logo in candidate recruitment and promotional materials
- _____ Participate on an industry advisory council at LCCC
- We are not ready to commit to the above, but would like to still participate in the design of the program
- We are not ready to commit, but would like to set up a meeting to discuss further.

COMPANY INFORMATION:

Title

Signature:	Date:
Print Name:	Email:

Company	Name:		



Consolidated Survey Results from 8 Companies who also provided Letters of Support

1. Which answer best describes your hiring needs in Smart Industrial Automated Systems Engineering Technology?	2. If your hiring needs are increasing, looking to the next five years, which best describes your hiring needs in this area?					
Growing: 7	Greater than 30%: 2					
Stable: 1	21-30% 1					
	11-20% 4					
	0-10% 1					
3. Please list job titles you have hired o	r plan to hire in this area (bolded titles					
are most frequently cited):						
 Electronic Engineers Electronic Technicians Robotic Engineers Robotic Technicians Industrial Maintenance Engineers and Technicians Information Technology Engineers Assembly Tech Project Manager Business Admin Assistant Marketing Representative 	 Product Manager Software/Hardware Engineer Al Scientist Field Installation Supervisor Industrial Controls Engineer Automation Engineer Automation Specialist Mechanical Engineer Electrical Engineer Automation Sales Engineer Robotics / Automation Field 					
 Application Engineer Field Sales 	 Service Lechnician Robot Programmers 					

Machinist

l. Do supp	5 out of 8 answered Yes 3 out of 8 answered Yes 3 out of 8 answered Yes a out of 8 answered Yes unless years of direct experience	5. Aft Scienc Syster to con open	er reviewing LCCC's Bachelor of Applied e - SMART Industrial Automated ns Engineering Technology, do you plan sider students from this program for positions? 8 out of 8 answered Yes
5. A [:] Engii key j	fter reviewing LCCC's Bachelor of Applied Scienc neering Technology, does this program fit the sk ob responsibilities? 8 out of 8 answered Yes	e - SMA ills and	ART Industrial Automated Systems competencies you are seeking in these

Responding Companies and Contacts:

David Zunis, Director, Service and Application	Absolute Machine Tools
Engineering	
Joe Smith, Vice President, Manufacturing	Agrinomix
Molly Lucas, Human Resources Manager	AJ Rose
Anthony Nighswander, Manager	APT Manufacturing
Matt Young, Operations Manager	Lincoln Electric
Larry Sansom, President	Thogus
Simon Melikian, President/CEO	Recognition Robotics
Vice President	IST OHIO

Appendix C: Institutional Capacity

- 1. Program Skills, Competencies, and Draft Curriculum Guide
- 2. LCCC/University Program Scorecard
- 3. List of Existing Equipment
- 4. List of Needed Equipment

Employability Pyramid



Level 3 – Integrator – Proposed Smart Industrial Automated Systems Engineering Technologies, Bachelor of Applied Science

Level 2 – Specialist - Associate of Applied Science in Automation Engineering Technologies – Systems Specialist Curriculum Code #6211

Level 1 – Technician - Maintenance Technician Short-Term Certificate Curriculum Code #6181

- Project management
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Critical thinking
 - Infused in many technical courses, I1 Critical thinking
- Planning
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Problem solving
 - TECN 111 Technical Problem Solving
 - Applied in most technical courses
- Time Management
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Adaptability
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
 - AETC 3xx Work Based Learning I
 - AETC 4xx Work Based Learning II
- Attention to detail
 - QLTY 122 BASIC QUALITY TOOLS AND APPLICATIONS
 - QLTY 224 LEAN MANAGEMENT PRINCIPLES & PRACTICES

- Technical learning ability
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
 - All technical courses
- Interpersonal
 - BADM 251 PRINCIPLES OF MANAGEMENT
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Communications
 - ENGL 161 COLLEGE COMPOSITION I
 - ENGL 164 COLLEGE COMPOSITION II WITH TECHNICAL TOPICS
 - Also infused in many technical courses, I2 Communications
- Technology aptitude
 - Advanced AETC courses
- Teaming
 - AETC 231 Flexible Manufacturing Systems
 - AETC 4xx Automation Capstone Projects and Special Topics
- Safety
 - SAFE 235 Machine Guarding Basics
 - Also covered in applicable technical courses

Critical Competencies as applies to

Smart Manufacturing

Degree





Level 3: Robotics Integrator

Advanced Product ID	НМІ	Advanced Robotics	Advanced PLC	Smart Maintenance	Cyber Security
Vision Technology II Near Field Communications RFID II Potential & Impact	Manufacturing Processes Programming Creating Visual Awareness Recipe Creation Data Acquisition	Collaborative Robots Augmented Reality IRA Safety Standards Integration of PLC's w/Robotics Virtual Commission	Sensors III OPCUA w/MES & PLC I/O Condition Monitoring Advanced Networking & Connectivity	Predictive Maintenance Data Analysis LEAN & Visual Awareness Top Floor- Shop Floor Communication	Data Corruption: Understanding Risks & Consequences Preventing Cyber Attacks
				Level 2:	Robotics Specialist
Product ID Fundamentals	Applied Fluid Power	Applied Mechanical Systems	Applied PLC	Applied Robotics	Applied Industry 4.0
Vision Technology 1 RFID 1 Bar Coding 1	Maintenance & Troubleshooting Energy Efficiency Vacuum Technology	Gear Drives Bearings & Gaskets, Seals Clutches & Brakes Ball Screws and Linear Bearings	Sensors II PLC Technology II Basic Networking CoDeSys	Programming & Editing Maintenance & PM Welding Material Handling Palletizing	Introduction to MES Introduction to HMI Introduction to Data Safety Introduction to 3D Modeling
				Level 1:	Robotics Technician
Electricity Fundamentals	Fluid Power Fundamentals	Mechanical Systems	PLC Fundamentals	Robotics Fundamentals	Industry 4.0 Fundamentals
Electricity AC Electricity DC	Basic Hydraulics Basic Pneumatics	Mechanical Drive Systems Components & Calculations Belts, Chains, & Lubrication Maintenance & Installation of components	Sensors I PLC Technology 1	Introduction to Robotics	Introduction to Industry 4.0



Reimagining Education in Advanced Manufacturing Overview of Program Expansion 2021-2023





Design Thinking and Program Differentiators

- Competency-based and credential focused = Ohio's Future
- Work and Learn
- Enhanced scheduling models
 - Maximize opportunity for traditional, new, and expanded student target audiences
- Integrated Systems/I4.0 Focus
- Industry-relevant labs and projects with more access to help
- Employer Design Advisory
- Level 2 and 3 Automation and Robotics Training
 - LCCC will be among the first to do this



Reimagining Education in Advanced Manufacturing



Smart Industrial Automated Systems Engineering Technology Engineering, Business & Information Technologies Division Bachelor's of Applied Science - Curriculum Code 9601

Smart Industrial Automated Systems Engineering Technology program prepares students is a multidisciplinary engineering field concerned with the design, modeling, analysis and control of predominantly computer-based automated systems or processes. The hands-on program prepares students to apply basic engineering principles and technical skills to implement and evaluate secure industrial networks, program advanced industrial automation systems, and design and integrated automated systems that apply to real world situations und challenges. The program also prepares students to apply additive manufacturing, rapid tooling, and simulation (virtual reality/augmented reality) to industrial situations and to integrate collaborative robots and human machine interfaces to make systems that are safer and more user friendly.

Course	Course Title	Semester Credits	Course	Course Title	Semester Credits
	First Year			Third Year	
Fall Semester			Fall Semester		
AETC 111	ROBOTICS'AUTOMATED MANUFACTURING	3	AETC 3XX	WORK BASED LEARNING AUTOMATION II	1
CADD 111	INTRO COMPUTER AIDED BRAFTING 7	2	AETC 3XX	PROGRAMMABLE LOOIC CONTROLLERS III	3
ELCT111	ELECTRICAL CIRCUITS I	3	CADD 213	INTRODUCTION TO SOLIDWORKS 1, 5	3
MTHM 121	TECHNICAL MATHEMATICS 2	4	CAMM 111	INTRO TO CNC	2
SDEV 101	COLLEGE 101 0	1	BOT 129	PROGRAMMING ESSENTIALS	5
TECN 111	TECHNICAL PROBLEM SOLVING	3			
		16	7. ()		14
Spring Semester			Spring Semester		
AFTC 121	PROGRAMMABLE LOGIC CONTROLLERS	3	AETC 3XX	INDUSTRIAL ROBOTICS II	3
27VOL 161	COLLEGE COMPOSITION I	3	CAMM 232	CAD-CAM ORAPHICS	3
MTHM 122	TECHNICAL MATHEMATICS II 2	3	HOT 130	HOT SENSORS	4
TECN 121	PLUID POWER 1	3	MTHM 168	STATISTICS 1	3
TECN 133	MECHANICAL SYSTEMS	3	TECN 211	FLUID FOWER CONTROL SYSTEMS	2
		15			1.5
	Second Year			Forth Year	
Fall Semester			Fall Sensester		
AETC 2NN	WORK BASED LEARNING AUTOMATION I	1	AETC 4XX	WORK BASED LEARNING AUTOMATION III	1
AETC 211	WORKCELL INTERFACING *	3	AETC 4XX	ADVANCED AUTOMATION III	3
AETC 223	PROGRAMMABLE LOGIC CONTROLLERS II	3	CMNW 145	NETWORK INSTALLATION/DIAGNOSTICS	4
PHYC 150	GENERAL PHYSICS I*	4	DFAB 211	ADDITVE MANUFACTURING AND 3D SCANNING	3
TECN 131	MANUFACTURING PROCESSES 1	3	SAFE 235	MACHINE OUARDINO BASICS	2
Arts and Bun	tamities Elective	3	Social Science	e Elective	3
		17			16
Spring Semester	-	-	Spring Semester		102
AETC 231	FLEAIBLE MANUFACTURING SYSTEMS	3	AETC 4XX	AUTOMATION CAPSTONE PROJECTS/SPECIAL T	4
AETC 241	INSTRUMENTATION AND CONTROL *	3	BADM 251	PRINCIPLES OF MANAGEMENT	3
ELCT 211	ELECTRICAL POWER AND DEVICES "	4	QUTY 122	BASIC QUALITY TOOLS AND APPLICATIONS I	3
ENGL 164	COLLEGE COMPOSITION II TECH TOPICS *	3	BOT 140	BOT PRIVACY, SECURITY, AND CLOUD SERVIC	*
Social Science	as Elective		Arts and Hun	- anities Electron	3
		16			17
	Total Semester Credit Hours	126			
Notes		1201		Established January 2020	
1 Indicates that	this course requires a prerequisite.			Effective XXXX	

hours.

¹ Indicates that this course has a prerequisite or may be taken concurrently.

4 This course offers an opportunity for experiential learning.

¹ Indicates that this course is at a 300 level at other universities.

Program Scorecard

Institution	Degree	Key Differences	% of Overl ap	Gen Ed	Industrial network installation, diagnostics and security	Industrial Internet of Things (IIOT)	Computer Numerical Control (CNC) programming and CAD/CAM	Required Work- Based Learning	Distance from LCCC
KENT STATE.	Bachelor of Science degree in Mechatronics Engineering Technology	Emphasis on Advanced modeling, system response, closed loop control and system software for mechatronic systems.	40%					3 Credit Hours	56 miles; 1 hr. 10 min
The. University of Akron	Bachelor of Science in Automated Manufacturing Engineering Technology	Focuses on manufacturing planning, evaluation and management	50%					Optional	54 Miles; 1 hour
BGSU _® Bowling Green State University	Bachelors of Science in Technology – Degree in Mechatronics Engineering Technology	Focuses on the software to hardware interface, not the manufacturing of the hardware	40%					12 Credit Hours???	100 Miles 1 hr. 40 min

State of the Art Labs

The Campana Center for Ideation and Invention

- \$5M project supported by the Small Campus Grants Initiative (received 8/2014)
- Significantly expand digital design/prototyping space in the Nord Advanced Technologies Center







LCCC's Digital Manufacturing Line





Supporting Industry 4.0

Campana Center offers local businesses access to equipment designed to enhance their companies without a large-scale investment.

- Campana Center for Equipment
- > Digital Manufacturing Line
- Industry 3D Printing Lab

LCCC's Digital Manufacturing Line: Shared Resource for Industry and Education





Engineering Business Information Technologies Campana Center Equipment List

Campana Center Equipment	Location	Description
Laser Cutters/Engravers and New	Fab Lab	
Epilog Mini 18 Laser	Fab Lab	20-watt CO2 Legend Elite Series computer controlled laser engraver/cutter provides an 18" x 12" (457 x 305 mm) work area.
Epilog Helix 2 Laser	Fab Lab	40-Watt CO2 Legend Elite Series computer controlled laser engraver/cutter provides 24" x 18" (610 x 457 mm) work area and a 8.5" (216 mm) z-stroke.
Epilog Rotary Attachment	Fab Lab	Rotary axis that allows cylindrical objects to be lasered inside of the Mini 18 or Helix 24.
Vinyl Cutters	Fab Lab	
Roland CAMM-1 Servo GX-24		Precisely cut vinyl decals, conductive copper film, adhesive backed epoxy film, or laminate film. Loadable material width is 50 to 700 mm (2 to 27-1/2 in) Maximum cutting area is width of 584 mm (22-15/16 in) and length of 24998 mm (984-1/8 in).
Precision CNC Milling Machine	Fab Lab	
Roland Modela MDX-15		Precision (micron resolution) milling machine includes a contact scanner attachment. Max operation area: 152.4 mm (X) x 101.6 mm (Y) x 60.5 mm (Z).
Large CNC Milling Machine	Fab Lab	
Shopbot PRSstandard		Large (4'x8') numerically-controlled milling machine with variable frequency drive (VFD) spindle – 96" x 48" x 6" nominal cutting area. Must use during designated times when assistance is available unless certified.
Forest Scientific HS CNC Router		With closed loop hybrid servo technology, variable frequency drive (VFD) spindle, and vacuum hold-down table – 48" x 96" x 10.5" nominal cutting area. Intended for experienced users; must use during designated times when assistance is available
Vertical CNC Machining	Digital Man	ufacturing Lab
Haas VF-1 CNC 3-axis Vertical Machining Center		XYZ range: 20" x 16" x 20" (508 mm x 406 mm x 508 mm). 20HP (15KW) 7,500 RPM spindle. Dual drive (Y-Delta), 20-tool carousel toolchanger, 1000 IPM (25.4M/Min) rapids, rigid tapping, 55 gallon flood coolant system.
3D Printers	Fab Lab	
MakerGear M2 Dual Extruder		FFF (Fused Filament Fabrication) print technology, build dimensions: 200 mm (8") x 250 mm (10") x 200 mm (8"), heated borosilicate glass print bed, 0.35 mm brass nozzles.
3D Scanners	3D Lab	
NextEngine 3D Scanner HD (with turn table)		Uses Multistripe laser triangulation (MLT) technology with twin 5.0 megapixel CMOS image sensors. Field size: 5.1" x 3.8" (Macro) and 13.5" x 10.1" (Wide). Dimensional accuracy +/- 100 micron (Macro) and +/- 300 micron (Wide).
3D Browprinter	3D Lab	
Dimension SST 1200es		3D browprinter based upon FDM technology. Uses ABSPlus model material and soluble support material. Maximum build size of 254 x 254 x 305 mm (10 x 10 x 12 inches). Layer Thickness .254 mm (.010 in.) or .33 mm. (.013 in.)

Engineering Business Information Techologies Campana Center Equipment List

Campana Center Equipment	Location	Description
3D Handheld Scanners	3D Lab	
Creaform GoScan3D		For handmade model digitizing, reverse engineering, 3D-scan-to-CAD, packaging design, quality inspection, etc. Light source: white light (LED). Part size recommended: 1 ft. – 10ft (0.3 m – 3 m). Scanning area: 15" x 15" (380 mm x 380 mm). Dynamic referencing allows part to be moved to a different orientation during scanning. Software: VXelements.
KnockOut KS1 3D scanner	3D Lab	
Waterjet Cutter	Digital Man	ufacturing Lab
MAXIEM 1515 JetMachining® Center by OMAX		Three axis cutting head. Diamond MAXJET 5i nozzle 0.15". MAXIEM variable frequency drive M4050V pump for high and low pressure operations – 40 HP for up to 50,000 PSI (3,450 bar). Cutting travel area of 5'2" x 5'2" (1,575 mm x 1,575 mm). Z- axis travel of 12" (305 mm). slat bed maximum support material load: 300 lbs. / square foot (1,465 kg / square meter). Intelli-MAX® software. Options include water-level control system, variable speed solids removal system (VS-SRS), 100 lb. abrasive feed system, and collision sensing terrain follower.
Workstations	Fab Lab	
Windows Computers		Some computers also have Ubuntu. Have software for 2D design, 3D design, CAD/CAM, electronic schematic and circuit design, micro-controller programming, 3D slicing and printing, etc.
iMac Computers		These are equipped with Adobe Creative Suite
Electronics Workbench	Fab Lab	
Soldering station	Fab Lab	
Circuit board rework tools	Fab Lab	
Programming tools for low-cost high- speed embedded processors	Fab Lab	
Variable DC power supply		
Digital multi-meter, oscilloscope, etc.		
Other Equipment		
24" Acrylic bender	Messy Fab	
Vacuum former	Messy Fab	
8.5" x 11" laminator	Messy Fab	
Scroll saw	Messy Fab	
Ridgid oscillating Edge Belt / Spindle Sander	Messy Fab	
Drill press	Messy Fab	
Molding and casting supplies	Messy Fab	
Composites supplies	Messy Fab	

Engineering Business Information Technologies Campana Center Equipment List

Campana Center Equipment	Location	Description
Multi-site group video conferencing	Messy Fab	
system	11000,140	
Fab Cab	Fab Lab	
	1	
Digital Manufacturing Line	Digital Manu	Ifacturing Lab
		Has a 35kg payload (77lbs.), 1813mm reach (5.9ft) from center of robot to tool mounting plate. Equipped with the Latest
M20IA-35m FANUC Robot	CIM Lab	robot technology, DCS (Dual Check Safety), Intelligent interference check, vision for robot navigation, quick change tooling, and
		other advanced options
		8 meter (25ft) linear rail, that one FANUC M20iA-35m robot is mounted to. It allows the robot to increase its work envelope by three
Gudel TMF-2 RTU(robot tansfer unit)	CIM Lab	times that of a standard robot. It is fully integrated with the robot for seamless programming and operation
		The CNC milling center is equipped with a 14 tool turret for storing up to 14 tools for automatic tool change. Performs rigid
EANUC PoboDrill a-D14MiB5 CNC	CTM Lab	tapping and tool changes in under a sec. Also has a trunnion axis for added capability (4th axis). This machine will allow us to
TANGE Robobini d DIAMBS ene	CIFIEdd	pocket, drill, surface, and tap blocks of materials to machine parts to a desired design. It is also fully integrated with the tending
		robot for seamless setup and programming.
		The welding cell contains a FANUC ARC Mate 50iC 5L robot. It can preform GMAW welding (Gas Metal Arc Welding). It has
Lincoln Eletric Welding Coll	CTMLab	the ability to weld hot rolled, cold rolled, mild steel, possibly stainless steel and proccess material from 1/16 inch to 3/8 inch. The cell
Lincoln Electric weiding Cell		is equipped with two stations that can be configured for different applications and jobs. (different fixtures, welding, parameters).
		The conveyors provides the ability to complete sequential manufacturing processes within the line. It also provides places for raw stock
Dorner Conveyors	CIMLab	to be brought into line and also for finished parts to exit. The conveyors utilize Allen Bradley PowerFlex 527 VFDs, these VFDs use CIP
		safety and communicate over the network to control speed, direction, start/stopetc.
		Contains the computer based equipment that controls the Digital Manufacturing Line. The cabinets contain Allen Bradley
Industrial Control Cabinets	CIMLab	5069-L320ERMS2 and L310ERMS2 safety PLCs. It also is equipped with Allen Bradlet 5510 HMIs (Human Machine Interface). HMI
		allow users to view status and control the operation of the line. While the PLC is executing the ladder logic program that runs the
	I	i Digital Line.
Industrial 3D Printers		
		The Connex 3 has the widest range of material properties available to it for its class of 3D printers. This 3D printer uses
Stratasys Objet 260 Connex3	3D Lab	and many other material properties
		Industrial 3D printer that utilizes ABS_PC-ABS and PLA plastics. It prints the parts using EDM (Eused Deposition Modeling)
Stratasys F370	3D Lab	and the parts are rigid. The printer can also use support material to print more complex parts
		Selective laser sintering (SLS) technology, uses a laser to precisely fuse nylon powder. The printer makes lightweight, robust
Sintratec	3D Lab	parts.
Mark Forend Mark Tura	201-5	3D Print strong, stiff, and durable parts made of nylon carbon fiber thermoplastic embedded with continuous strands of
магк гогдеа магк і юо	3D Lab	fiberglass, carbon fiber, or Kevlar.
		This industrial 3D additive printer creates good looking, durable, and functional prototypes that can be snapped, screwed
Dimension SST 1200es	3D Lab	and pieced together. Useful for concept and marketing models, functional test parts, tools, patterns, molds, jigs and fixtures up to 12"
		x 12" x 10". Utilizes SST - soluble support and BST - breakaway support.

Priority	Quote #	Equipment Name	Vendor	Description	Qty. for ARCTOS	Qty. for BAS	Qty. Needed after ARCTOS Procurement		Ca	ost/Item	Total Cost after ARCTOS Procurement
			All prices ar	e not final, they will be more accurate as we	e keep defining the	e equipment					
1				Equipment from IST						_	
	Quote: 3495	FANUC Collaborative Robot CRX-10iA/L	IST	Co-Bot for 4 year	2	3	1	3	\$	44,000.00	\$ 44,000.00
	Quote: 3495	Mobile Cart for CRX with Schunk EG Gripper	IST	Cart for Co-Bot	2	3	1	3	\$	7,940.00	\$ 7,940.00
	Quote: 3496	Machine Tending Education Cell Simulator (MTEC-SIM)	IST		0	0	0	0	\$	65,380.00	\$-
	Quote: 3497	Connected Smart Manufacturing (CSM™) with FANUC MTEC Sim	IST		0	0	0	0	\$	452,056.00	\$-
	Quote: 3498	Connected Smart Manufacturing (CSM™) with FANUC Robodrill	IST		0	0	0	0	\$	538,206.00	\$-
	Quote: 3499	FANUC ENCLOSED - SR-3IA SCARA CERT CART with 2D iRVision	IST		2	3	1	3	\$	31,500.00	\$ 31,500.00
	Quote: 3500	FANUC FENCELESS ER-4IA CERT CART with 2D iRVision	IST		2	1	0	2	\$	42,800.00	\$-
	Quote: 3501	SWIVELLINK VARIABLE SPEED CONVEYOR	IST		2	3	1	3	\$	6,840.00	\$ 6,840.00
	Quote: 3504	AB-ROCKWELL AUTOMATION FERRIS WHEEL WORKSTATION (LEVEL 1)	IST		3	0	0	3	\$	16,250.00	\$-
	Quote: 3502	PLC HMI Trainer (apt)	IST		2	3	1	3	\$	10,960.00	\$ 10,960.00
	Quote: 3504	AB-ROCKWELL CONTROLLOGIX WORKSTATION (LEVEL 2)	IST		3	3	0	3	\$	26,250.00	\$-
	Quote: 3503	M-10iD/12 with 2D iRVision	IST	e old M6i robots in CIM lab, to enable use of ne	0	3	3	3	\$	40,300.00	\$ 120,900.00
										Total:	\$ 222,140.00
1				LCCC built Trainers						-	
		PLC Trainers	LCCC	LCCC Design and Built	13	13	0		\$	5,000.00	\$ -
		Adv. Automation/IIOT Trainer (network trainer)	LCCC	Used for sensors, networked devices	0	25	25		\$	4,500.00	\$ 112,500.00
		More WorkCell trainers?					0		\$	4,500.00	\$-
		HMI Trainer	LCCC	LCCC Design and Built	0	13	13		\$	2,000.00	\$ 26,000.00
		Motion Trainers	LCCC	LCCC Design and Built	0	7	7		\$	10,000.00	\$ 70,000.00
										Total:	\$ 208,500.00
1				Computers						_	
		Computers for students and teacher	Dell		0	13	13		\$	2,500.00	\$ 32,500.00
		Laptops	Dell		0	13	13		\$	2,500.00	\$ 32,500.00
		server	Dell	Industry 4.0 data collection and storage		1	1		\$	3,500.00	\$ 3,500.00
		server	Dell	For hosting software, that will let students have remote access (Roboguide, PLC,etc.)		1	1		\$	3,500.00	\$ 3,500.00
										Total:	\$ 72,000.00

Priority	Quote #	Equipment Name	Vendor	Description	Qty. for ARCTOS	Qty. for BAS	Qty. Needed after ARCTOS Procurement		Cost/Item		Total Cost after ARCTOS Procurement	
1 Software												
		software	various	Software, eLearning, textbooks, advanced software, weld proetc		1	1		\$	1,700.00	\$	1,700.00
		MES, Plant simulation and design, FANUC ZDT, Cloudetc.	various	Industry 4.0 software		1	1		\$	15,000.00	\$	15,000.00
										Total:	\$	16,700.00
1	L			Equipment to support degree (2 a	nd 4 year)							
		Remote I/O devices	Rexel, Adcon	Turk, Allen Bradleyetc	0	26	26		\$	700.00	\$	18,200.00
		VR/ augmented reality for automation lab				1	1		\$	25,000.00	\$	25,000.00
		Safety devices	Adcon	Various types of devices - estop, palm switch light curtain gate interlock, rfid gate interlock, locking gate (passive vs active)		1	1		\$	75,000.00	\$	75,000.00
		HMI for I/O control Cert Cart	Adcon and Rexel			2	2		\$	2,000.00	\$	4,000.00
		Need PLC cabinet for 1 Cert Cart	Automation Direct			1	1		\$	500.00	\$	500.00
		Conveyors		Build or buy pre made		4	4		\$	1,500.00	\$	6,000.00
		IPendant	IST	o finish our current set and more for second clas	13	18	5		\$	5,200.00	\$	26,000.00
	[Devices to control - candy machine, log splitter, garage door, elevator, etc.	ATC	utilize FESTO Mech Lab or build our own	13	26	13		\$	2,000.00	\$	26,000.00
		Instrumentation and control trainers	ATC	update AETC 241		3	3		\$	50,000.00	\$	150,000.00
		Instrumentation and control system	ATC	update AETC 242		1	1		\$	205,000.00	\$	205,000.00
		area scanners	Adcon	laser area scanners (like ones on cert carts)		5	5		\$	850.00	\$	4,250.00
		I/O link power supplies	NEFF			5	5		\$	350.00	\$	1,750.00
		Pill and battery sorting projects for cert carts	IST		1	1	0		\$	15,000.00	\$	-
										Total:	\$	541,700.00
2	2			Lab supplies								
		lab equipment	Various	Tools, wires, Tool box, air hoses, fitting, power strips, hardware (fasteners), air tub, fittings,etc.		1	1		\$	15,000.00	\$	15,000.00
		80/20 components	F	or building tooling, fixture, capstone projectse	tc.	1	1		\$	15,000.00	\$	15,000.00
		saw for cutting 80/20		For use in lab,		1	1		\$	5,000.00	\$	5,000.00
		Heavy duty metal break		For us in lab when fabricating		1	1		\$	5,000.00	\$	5,000.00
		non rotating and rotating cylinders	NEFF	52 cylinders 2 / student and projects		1	1		\$	15,000.00	\$	15,000.00
		solenoids	NEFF, Automation Direct	for cylinders above		52	52		\$	50.00	\$	2,600.00
										Total:	\$	57,600.00

Priority	Quote #	Equipment Name	Vendor	Description	Qty. for ARCTOS	Qty. for BAS	Qty. Needed after ARCTOS Procurement		Cost/Item		Total Cost after ARCTOS Procurement	
1 Improvements to M6i Robots (old robots in cim lab) Enable us to teach New tech, increase capacity (2 year and 4 year)												
		Conveyors	Adcon,Neff, EMI			3	3		\$	1,500.00	\$	4,500.00
		EOAT	ATI/EMI	Quick change and EOAT, Tool stands		1	1		\$	27,000.00	\$	27,000.00
		Tables for robots	Neff	Extruded aluminum custom build		3	3		\$	1,200.00	\$	3,600.00
		Ethernet Solenoids banks	Neff			3	3		\$	7,000.00	\$	21,000.00
		sensors, stack lights,etc.	Adcon			1	1		\$	5,000.00	\$	5,000.00
		robot installation	IST/AMS			1	1		\$	10,000.00	\$	10,000.00
		cabinet stands (for R30iB-plus)	AMS			3	3		\$	700.00	\$	2,100.00
		tooling	Neff/EMI	Air cylinders, clamps, fittings, hosesetc.		1	1		\$	7,500.00	\$	7,500.00
										Total:	\$	80,700.00
1				Sensors								
		I/O link sensors	Adcon			1	1		\$	40,000.00	\$	40,000.00
		Smart sensors	Adcon			1	1		\$	50,000.00	\$	50,000.00
		RFID/NFC	Adcon			1	1		\$	25,000.00	\$	25,000.00
		Barcode	Adcon			1	1		\$	25,000.00	\$	25,000.00
		I/O Link Air pressure sensors	Adcon/Neff			5	5		\$	700.00	\$	3,500.00
		I/O Link Electrical power sensors	Adcon/Neff			5	5		\$	700.00	\$	3,500.00
		I/O link outputs	Adcon			1	1		\$	30,000.00	\$	30,000.00
		managed switches	Rexel			9	9		\$	2,000.00	\$	18,000.00
		Cables and sensors accessories (splitters)	Adcon/REXEL/Autom ation Direct			1	1		\$	15,000.00	\$	15,000.00
										Total:	\$	210,000.00
1				Vision Systems								
		Vision systems	Cognex		0	17	17		\$	10,477.50	\$	178,117.50
										Total:	\$	178,117.50

Priority	Quote #	Equipment Name	Vendor	Description	Qty. for ARCTOS	Qty. for BAS	Qty. Needed after ARCTOS Procurement		C	ost/Item	Total Cost a ARCTOS Procureme	after S ent
2 Processes/Equipment for Digital Line that was proposed during original development												
		Nut runners	ASG	Used for assembly applications		1	1		\$	25,000.00	\$ 25,0	000.00
		Fixture clamps for tables and line		For holding parts on existing fixture tables		6	6		\$	690.00	\$ 4,1	140.00
		Clamps for welding table		For E-cell to hold parts while welding		4	4		\$	690.00	\$ 2,7	760.00
		Tooling for deburr and finishing tool		To finish implementing		1	1		\$	1,000.00	\$ 1,0	000.00
		Shields for deburring tool		To finish implementing		5	5		\$	350.00	\$ 1,7	750.00
		table mount accessories for deburring tool		To finish implementing		1	1		\$	1,500.00	\$ 1,5	500.00
		CNC Equipment		RFID tool holders, load sensors,etcTakes the CNC to the next level		1	1		\$	27,000.00	\$ 27,0	000.00
										Total:	\$ 63,1	150.00
2/3				Items needed to run system, and adapt	to new projects					-		
		CNC supplies		Tooling, tool holders, vise jaws,		1	1		\$	7,500.00	\$ 7,5	500.00
		Tool trees for quick change tooling				1	1		\$	7,500.00	\$ 7,5	500.00
		End of arm tooling and accessories		Grippers, supplies, Vacuumetc.		1	1		\$	20,000.00	\$ 20,0	000.00
		Materials for digital mfg. line and robots to run		metal stock, sheet metal,etc.		1	1		\$	15,000.00	\$ 15,0	000.00
		Materials for trainers and machines (consumables, metal stocketc.)				1	1		\$	10,000.00	\$ 10,0	000.00
				Upgrade/ add on for existing equ	inmont					Total:	\$ 60,0	000.00
3		fiber laser upgrade for witek	Vutek	Witek laser	ipinent	1	1		¢	50,000,00	\$ 50 (000.00
			vytek	Vytexidder		-	±		Ş	Total:	\$ 50,0	000.00
			Р	rocesses/Equipment for Digital Line based u	upon Industry nee	ds					÷,	
1		graco G-flex 1500 flexible parts feeder (or similar)		Graco		1	1		\$	25,000.00	\$ 25,0	,000.00
		laser marking system				TBD				TBD		
3		Pericles riveting				TBD				TBD		
3		Stud welding		Stanley		TBD				TBD		
3		Dispensing Equipment		Nordson		TBD				TBD		
3		AGV (MIR)	ATC			TBD				TBD		
										Total:	\$ 150,0	000.00
									Gra	nd Total:	\$ 1,910,60 [°]	7.50
Smart Industrial Automated Systems Engineering Technology, Bachelor of Applied Science

Note: Some software, costs associated with credentials and course expenses have not been determine yet. This is a Draft of fees and expenses for the 4 year program

Program Year	Lab Fees	Course Fees	Optional Cert. Fees	Approx. total:	Lab fees cover:	Course fees cover:	Optional Certification fees cover:
Year 3	\$ 70.00	\$ 350.00	\$ 60.00	\$480.00	Consumables such as wires, raw materials and parts that are used while running the automated systems for training	FANUC eLearning: Vision and Collaborative Robot and Rockwell eLearning	NOCTI FANUC Robot Technician (FCR-T1 & FCR-T2) Certification
Year 4	\$ 130.00	\$ 100.00	\$ 30.00	\$260.00	Consumables such as wires, raw materials and parts that are used for running the automated systems and for use with capstone projects	E-Learning -TBD	NOCTI FCSM-T1 FANUC / Rockwell CSM System Integrator*: TBD
	Total for 2 yrs		\$740.00				