HARFORD
COMMUNITY COLLEGE

April 16, 2019

James D. Fielder, PhD
Maryland Higher Education Commission
6 N. Liberty Street, 10th Floor
Baltimore, MD 21201

RE: New Program Approval Request – Additive Manufacturing area of concentration in Engineering Technology, A.A.S.

Dear Dr. Fielder:

Harford Community College is proposing Additive Manufacturing (AM) as a new area of concentration within the existing Engineering Technology, A.A.S. degree program. The AM curriculum supports training in additive manufacturing, which is a growing industry in Harford County and the surrounding areas. The addition of the AM area of concentration, is supported by the NSF ATE grant, known as RAMP, that was awarded to Harford Community College in September 2017.

The AM area of concentration aligns with the College's mission to provide accessible, innovative, learner-centered educational opportunities and to promote graduation, transfer, individual goal attainment and career and workforce development. The program is also driven by "learner-centered educational opportunities" that will enhance "individual goal attainment."

Payment in the amount of $250 for MHEC approval has been included in the new program proposal arriving via U.S. mail. A copy of the payment is included in this electronic correspondence. Please contact Alison Amato at aamato@harford.edu or 443-412-2384 with any questions.

Sincerely,

Karen Hays

Karen Hays, PhD
Interim Vice President for Academic Affairs

Office Use Only: PP#

MHEC
Creating a state of achievement

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Harford Community College

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ◉ New Area of Concentration
- ○ New Degree Level Approval
- ○ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ○ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ○ Offer Program at Regional Higher Education Center

Payment Submitted: ◉ Yes ○ No

Payment Type: ○ R*STARS ◉ Check

Date Submitted: 02/08/2019

Department Proposing Program	Integrated Business and Applied Technology (IBAT)
Degree Level and Degree Type	Associate of Applied Sciences (A.A.S.)
Title of Proposed Program	Additive Manufacturing - area of concentration in Engineering Technology
Total Number of Credits	60
Suggested Codes	HEGIS: 5301.01 CIP: 15.0613
Program Modality	◉ On-campus ○ Distance Education (*fully online*) ○ Both
Program Resources	◉ Using Existing Resources ○ Requiring New Resources
Projected Implementation Date	◉ Fall ○ Spring ○ Summer Year: 2019
Provide Link to Most Recent Academic Catalog	URL: http://ww2.harford.edu/Catalog/
Preferred Contact for this Proposal	Name: Alison Amato Title: Coordinator for Curriculum and Program Development Phone: (443) 412-2384 Email: aamato@harford.edu
President/Chief Executive	Type Name: Dianna G. Phillips, Ph.D. Signature: Dianna G Phillips, PhD Date: 2.25.2019 Date of Approval/Endorsement by Governing Board: Richard D. Vail 4/9/2019

Revised 6/13/18

Academic Program Proposals (MHEC) from Degree-Granting Institutions Authorized to Operate in Maryland

Additive Manufacturing Area of Concentration in Engineering Technology, A.A.S.

Contents

A. Centrality to institutional mission statement and planning priorities

1. Program description

Harford Community College is proposing Additive Manufacturing (AM) as a new area of concentration within the existing Engineering Technology, A.A.S. degree program. The AM curriculum supports training in additive manufacturing, which is a growing industry in Harford County and the surrounding areas. The addition of the AM area of concentration, is supported by the NSF ATE grant, known as RAMP, that was awarded to Harford Community College in September 2017.

The AM area of concentration consists of 37 credits of core curriculum that emphasizes applications, problem solving, critical thinking, and communication skills. Within the 37 credits of core curriculum, students are completing 15 credits of coursework specific to additive manufacturing.

This program prepares students for employment in additive manufacturing and a variety of other industries that use technicians or technology specialists to support engineering staff. The program fosters training in a variety of comprehensive skill sets, including but not limited to, calculations and data systems, computer skills, knowledge of additive manufacturing tools, basic laboratory skills, and systems and test methodologies. Upon graduation, students will be able to use these skills to, organize, and carry out engineering technology projects. Graduates of this program will demonstrate knowledge of CADD, electronics, hydraulics, pneumatics, blueprint reading, 3D printing and mechanics.

Harford Community College's mission reads, "Harford Community College provides accessible, innovative, learner-centered educational opportunities. As an open-access institution, the College promotes graduation, transfer, individual goal attainment, and career and workforce development. The College fosters lifelong learning, global awareness, and social and cultural enrichment." The development of AM as a new area of concentration is driven by "learner-centered educational opportunities" that will enhance "individual goal attainment" by providing students with concentration options. Furthermore, the structure of the program emphasizes the development of career pathways for additive manufacturing and engineering technicians in the rural region of northeast Maryland, which supports the College's mission to promote "career and workforce development."

2. Program in relation to strategic plan and institutional priority

The development of the AM curriculum supports Goal 2, Strategy 1 of HCC's Strategic Plan, which prioritizes the expansion of educational programs and workforce development training to meet the needs of the community. Data shows that there is a strong workforce demand for individuals skilled in engineering technologies and advanced manufacturing, including additive manufacturing.

The curriculum of the AM area of concentration was designed to align with industry demands. The College hosted a modified DACUM with additive manufacturing industry subject matter experts. Experts identified core industry competencies and proposed curriculum was designed with those experts to

align with the competencies identified. This approach to curriculum design and program modification supports Strategy 2 of Goal 1 of HCC's Strategic plan to, "develop new programs and enhance existing programs to reduce time to degree, increase student success, and promote goal completion." The alignment of the AM concentration with industry competencies not only enhances the curriculum, but also promotes goal completion by providing graduates with industry-ready skills and experience.

3. Program funding for the first 5 years

HCC has receive a National Science Foundation grant, entitled Regional Additive Manufacturing at Harford Community College. Forty-nine Thousand Two Hundred dollars ($49,200) of the grant funding will be used to purchase the necessary laboratory equipment (3D printer kits) for the additive manufacturing concentration. As the Engineering Technology A.A.S. degree program already exists at HCC, the college intends to continue its operating budget for full-time and part-time faculty, faculty professional development, and laboratory maintenance. Sufficient funds are already included in the adjunct budget to cover teaching the five additional courses in the proposed AM concentration. As program enrollment grows, related additional tuition and fee revenue will be allocated to the program

4. Institutional commitment

Dianna G. Phillips, Ph.D., president of Harford Community College, vigorously supports aligning academic programs to meet state and local workforce needs. HCC is committed to providing administrative, financial, and technical support for the proposed program.

The existing Engineering Technology A.A.S. degree program has 36 students. There is a dedicated laboratory for this program which contains 3-D printing equipment for additive manufacturing instruction and electronics equipment and parts. There is another laboratory that houses trainers, such as hydraulic and pneumatics trainers, although that room is used for other programs as well. These labs are not at capacity. The College will leverage this existing laboratory capacity to support the new AM concentration. Furthermore, the college employs an Engineering Technologies Coordinator who is a subject matter expert in additive manufacturing and engineering technologies. The coordinator has composed an industry advisory board with which he has worked to complete a modified DACUM and develop the additive manufacturing courses that comprise the proposed new concentration. The coordinator's industry expertise and curriculum experience enables him to teach both additive manufacturing and engineering technologies and also to ensure that the curriculum remains current and linked to industry standards.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

The addition of an AM as an area of concentration within Engineering Technology addresses several goals of the 2017-2021 Maryland State Plan for Postsecondary Education. Goal 2 (Success), Strategy 6, seeks to "[i]mprove the student experience by providing better options and services that are designed to facilitate prompt completion of degree requirements," recommends the creation of "focused pathways" that "demonstrate the fastest way to get to an associate degree by taking specific courses in a specific sequence." The proposed AM area of concentration employs this framework to create a workforce pathway leading to a family-sustaining career. As detailed in Section A(2), above, the proposed program was co-created with industry subject matter experts and the sequence is designed to quickly prepare graduates for immediate entry into the workforce.

Goal 2 (Success), Strategy 7, seeks to "enhance career advising and planning services and integrate them explicitly into academic advising and planning" recommends opportunities for students to "explore a specific industry relevant to their academic program." These recommendations are supported by the growing body of evidence that attainment is predicated upon a structured pathway whereby clear routes to completion are achieved through an alignment of general education and discipline-specific coursework[9]. Whereas traditional programs delay discipline-specific and experiential courses for the third and fourth semesters, the proposed program requires students to complete at discipline-specific courses each semester.

Goal 3 (Innovation), Strategy 8 seeks to "develop new partnerships between colleges and businesses to support workforce development and improve workforce readiness." The curriculum for AM was co-created with industry experts who participated in a modified DACUM and identified core industry competencies around which the curriculum has been developed. Via the NSF grant, the college was able to pay the subject matter experts to collaborate with HCC faculty to develop a curriculum to align with the industry competencies. As such, students will be workforce-ready upon graduation.

Goal 3 (Innovation), Strategy 9, "Strengthen and sustain development and collaboration in addressing teaching and learning challenges" encourages the incorporation of Open Education Resources (OER) into programs to offset the cost of college. Via the National Science Foundation grant, the content of each of the five additive manufacturing courses in the proposed concentration is created as OER. Therefore, students will not have textbook expenses associated with these courses. As encouraged by the NSF grant, such OER is scalable and replicable at other institutions.

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

Data illustrates a significant demand for well-educated and highly-skilled additive manufacturing workers in Harford County and in the State of Maryland. In 2015 Maryland's 3,680 manufacturing businesses generated $20.2 billion in gross state product and employed more than 109,000 persons. The state supports numerous 21st century manufacturing industries including defense electronics, aeronautics, systems engineering, medical diagnostics, specialty chemicals, software and aircraft engines. Sixty percent of these manufacturers are advanced, producing a profound multiplier effect on Maryland's economy. High-technology manufacturers in Maryland generate almost two additional jobs for each new manufacturing job created.

Nevertheless, the State of Maryland, like the rest of the United States, has witnessed a dramatic change in the manufacturing industry. The largest manufacturing industry sector in Maryland is computer and electronic products, a sector that did not even exist forty years ago. These changes are largely driven by technology. Modern factories have more machines and fewer workers, and traditional manufacturing methods of yesterday are being tested by cutting edge technologies on super-automated factory floors.

An emerging process of an advanced manufacturing technology that is disrupting the traditional industry is additive manufacturing, or as it is sometimes more commonly called 3-D printing. Additive manufacturing is the process of creating a 3-D object from a digital file, by layering materials in sequential layers, using a 3-D printer. Whereas traditional manufacturing is a "subtractive" process, which starts with a block of material and removes what is not needed, additive manufacturing creates precise layers and can be more efficient, flexible, and less wasteful. 3-D printing is influencing many industries including automotive, aviation and medical, with applications ranging from medical devices and prosthetics, to automotive and aerospace parts. According to the Bureau of Labor Statistics the US digital manufacturing industry is anticipated to grow by 7.55% from 2015 to 2019.

Additive Manufacturing at Aberdeen Proving Ground

Considerable innovation and research in the rapidly developing world of 3-D printing has been conducted at Harford County's largest employer, Aberdeen Proving Ground (APG). Considered by military leaders as a "megabase," APG has recently attracted more than 120 defense contractor firms into Harford County and is a driving force for science and technology in the region.

The Combat Capabilities Development Chemical Biological Center (CCDCBC), formerly known as the U.S. Army Edgewood Chemical Biological Center at APG, encompasses some of the most advanced additive manufacturing capabilities in the nation and has been using additive manufacturing technology for longer than 25 years. The CCDCBC lab is worth $1.8 billion in infrastructure and specialized equipment with about 1,400 personnel. Pioneering uses for 3-D printing technology at CCDCBC include developing protective equipment for soldiers. Although the lab primarily creates projects for the military, CCDCBC also contracts with businesses and corporations to create models and prototypes.

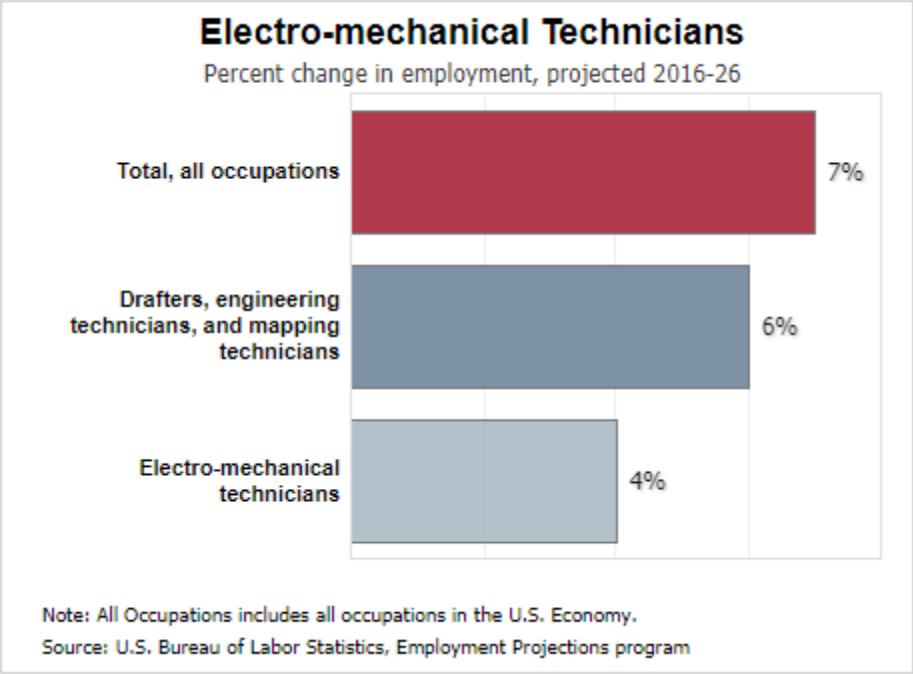
To leverage the additive manufacturing technology of APG, and spur the growth of manufacturing businesses and jobs in the region, the State of Maryland created the Regional Additive Manufacturing Partnership of Maryland (RAMP MD), in Harford County in 2014. This is a consortium of more than 150 private businesses, educational institutions, governmental agencies, and representatives of APG. Cooperative agreements between RAMP MD and CCDCBC have allocated "between $50 million and $75 million in resources, including engineers, personnel, blueprints, technology, knowledge, machines and equipment toward projects and initiatives" developed by RAMP MD. RAMP MD goals include:

- Provide business access to additive manufacturing facilities, equipment, and expertise
- Build the required infrastructure to support the manufacturing base, and
- Educate a supporting workforce

Manufacturing in the Susquehanna Workforce Region

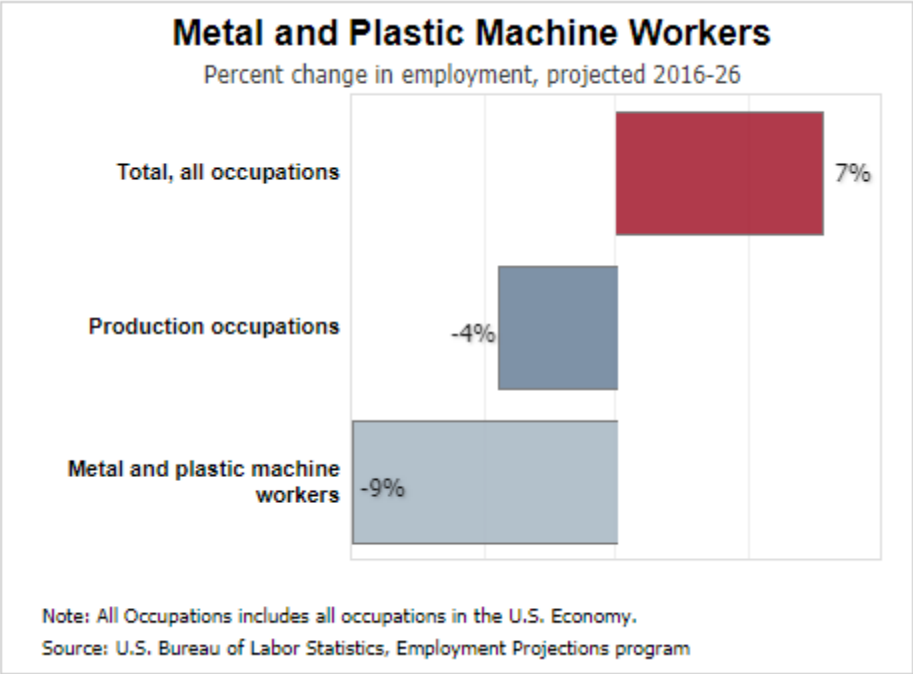
Within the Susquehanna Workforce Region, approximately 7.4%, or almost 9,000 persons, work in the manufacturing industry. Major manufacturing employers in the region include: W.L. Gore & Associates (Medical products/R&D); ATK (Propellants, rocket motors); Terumo Medical Products and Terumo Cardiovascular Systems (Medical products/R&D). New companies in Harford, including Maines Paper & Food Service and Malloy Aeronautics, have created more than $160 million in investment and 650 new jobs. Growth is strong in manufacturing, with 459 jobs being added to the Susquehanna Workforce Region between 2011 and 2015, which averages 90 new jobs annually. According to the Maryland Labor Market Index (July 2015), Occupational Projections – 2012-2022, growth occupations in the Susquehanna region in manufacturing include: industrial engineering technicians (16%), mechanical engineers (18%), computer-controlled machine tool operators - metal and plastic (52%) and medical appliance technicians (12%).

Despite the growth in manufacturing and technology in the Susquehanna Workforce Region, many of the jobs in demand are highly technical in nature and are being left unfilled. Within the region, in July 2016, there were 755 openings in computer and mathematical occupations with only 482 seekers; in the architecture and engineering occupations there were 721 openings with only 584 seekers. Interviews with local manufacturers reveal the need for highly skilled labor. Shawn Drinan, Corporate Hiring Manager at SURVICE [sic] Engineering Company, a services and technology solutions company in support of National Defense and the U.S. Warfighter, reports that finding local talent is a challenge. Mr. Drinan states, "While the manufacturing industry is trending growth, the qualified engineering and manufacturing labor workforce is declining. Operations, engineering, robotics, automation, quality assurance, safety and general labor job functions continue to be in demand. We anticipate hiring 25-50 people in the next five years, depending on contracts and growth, but local talent can be hard to find, especially for skilled workers." Technicians with 21st century skillsets, who can leverage innovative additive manufacturing technologies within the changing needs of the manufacturing industry, are critical to the manufacturing workforce in Maryland.



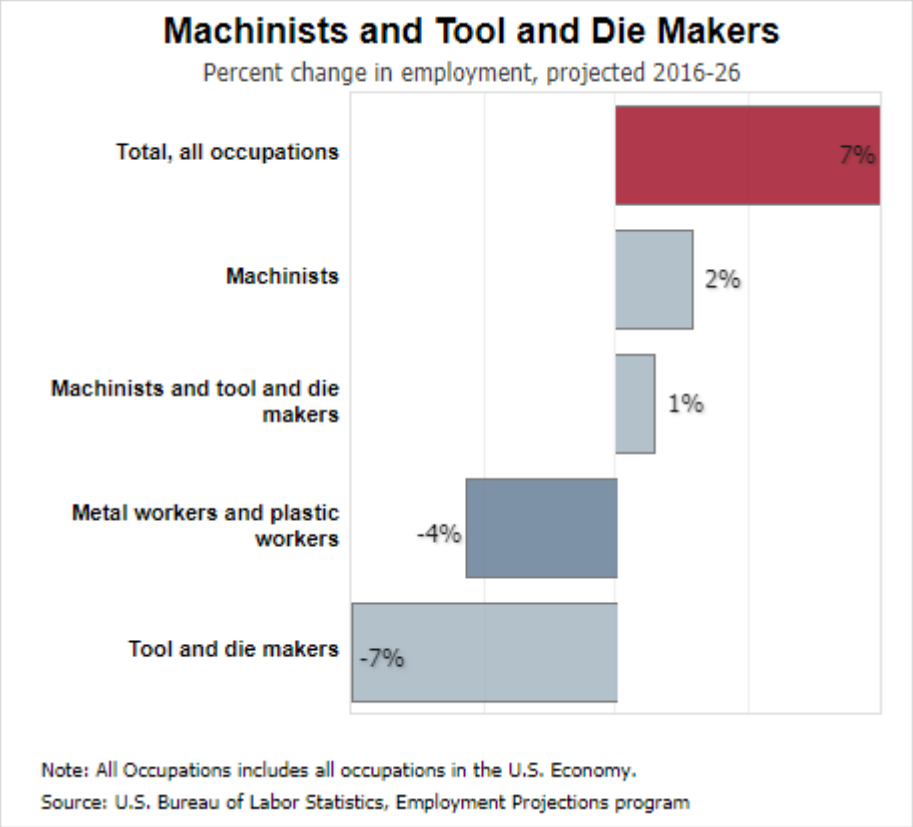
Electro-mechanical Technicians	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2016	2026		
United States[1]	13,800	14,300	+4%	500
Maryland	241	258	+7.05	17
Pennsylvania	590	560	-5.1%	

[1] Bureau of Labor Statistics Occupational Outlook Handbook.



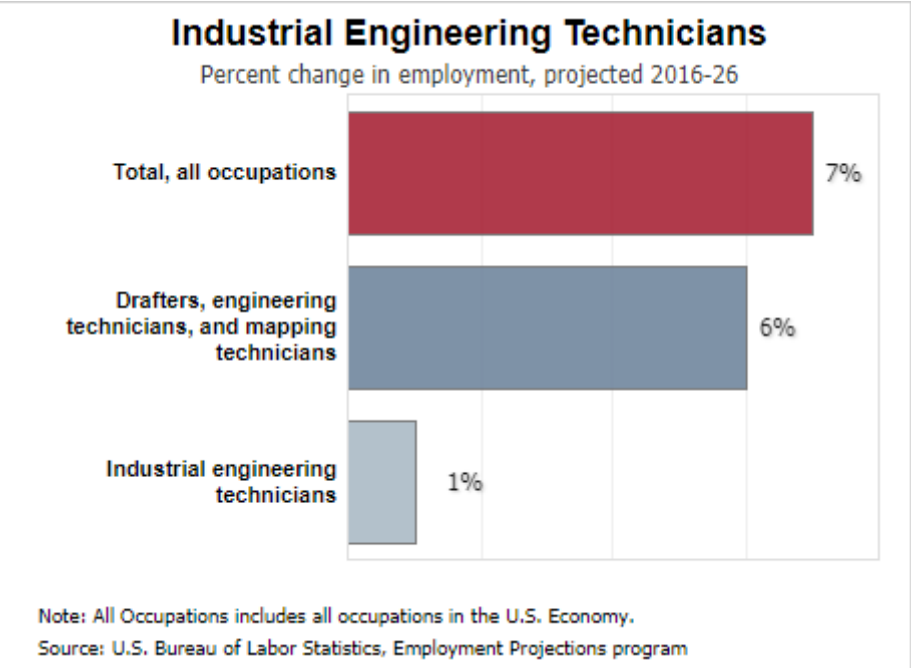
Metal and Plastic Machine Workers Computer numerically controlled machine tool programmers	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2016	2026		
United States[2]	25,100	29,200	16	4100
Maryland	172	174	1.16%	2
Pennsylvania	930	1120	+20.4%	19

[2] Bureau of Labor Statistics Occupational Outlook Handbook.



Machinists	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2016	2026		
United States[3]	396,200	404,100	2	7900
Maryland	2,827	2872	+1.69%	45
Pennsylvania	19,830	22,230	+12.1%	240

[3] Bureau of Labor Statistics Occupational Outlook Handbook.



Industrial Engineering Technicians	Employment		Percent Change	Projected Annual Job Openings due to Growth
	2016	2026		
United States[4]	63,900	64,300	+1%	400
Maryland	653	683	+4.59%	30
Pennsylvania	1850	1870	+1.1%	2

D. Reasonableness of Program Duplication

1. Similar programs

While other colleges in Maryland have baccalaureate programs related to engineering, manufacturing and materials, the proposed AM area of concentration is unique to community colleges in Maryland because it focuses on the skills of an additive manufacturing technician. The curriculum, which has been

[4] Bureau of Labor Statistics Occupational Outlook Handbook.

constructed via a National Science Foundation grant and in collaborations with industry experts, will employ open educational resources and be available to other colleges for replication.

Institution	**Program Name**	**Credential**	**Key Differences**
Howard Community College	Additive Manufacturing	Certificate	This program is greater than 40 miles away from HCC. It is a certificate and not a degree program and has a component of entrepreneurship.
Hagerstown Community College	Advanced Manufacturing Systems; Industrial Technology; Mechanical Engineering Technology	Associate of Applied Science; Certificate; Associate of Applied Science	This program is well outside HCC's service area. While there are similarities with the proposed program, Hagerstown's focus is on mechanical engineering.
Community College of Baltimore County	1) Design, Fabrication, and Advanced Manufacturing; 2)Engineering Technology (Civil Engineering Technology Option); 3)Engineering Technology (Electrical/Electronic Engineering Technology); 4)Engineering Technology (Mechanical Engineering Technology)	Associate of Applied Science (all)	1) This program is different from HCC's in that CCBC's program is focused on floor shop work; 2) This program is different from HCC's in that CCBC's program is focused on civil engineering; 3) This program is different from HCC's in that CCBC's program is focused on electrical; 4) This program is different from HCC's in that CCBC's program is focused on mechanical.
College of Southern Maryland	Engineering Technology (Drafting Concentration); Engineering Technology (Robotics Concentration)	Associate of Applied Science	CSM's program is greater than 90 miles away and is well outside of HCC's service area. CSM offers three concentrations, focused on electronics, robotics and mechanical engineering but not on additive manufacturing

Prince George's Community College	Engineering Technology	Associate of Applied Science	PG's program is greater than 60 miles away and is focused on electrical engineering and not additive manufacturing.
Wor-Wic Community College	Manufacturing Engineering Technology	Associate of Applied Sciences; Certificate	Worwic's program is well outside of HCC's service area and does not focus on additive manufacturing, as does HCC's proposed program.

The following baccalaureate and graduate programs have been identified and present opportunities for articulated pathways toward bachelors and graduate degrees:

Engineering Technology and Additive Manufacturing

- University of Maryland, CP – Graduate degree and certificate in Additive Manufacturing
- University of Maryland Eastern Shore – Engineering Technology, B.S. with electrical/electronics focus
- UMBC – Integrated Product Development and Manufacturing, Post-baccalaureate certificate

2. Program justification

This new area of concentration in AM will provide students the opportunity to prepare for highly-skilled careers at Aberdeen Proving Ground and manufacturing employers throughout the Susquehanna Region. By providing an additional area of concentration within the career-entry Engineering Technology, A.A.S. degree program, HCC will be able to develop and sustain a pipeline of skilled technicians to industry partners around the county and beyond.

The AM program aligns the program competencies with industry nomenclature and enables students to better identify the appropriate academic pathway needed to prepare for jobs in advanced manufacturing industries, including high-demand jobs in public and private sector local workforce. Furthermore, the courses within additive manufacturing concentration have been designed to facilitate dual enrollment opportunities for students in the Harford County Public School system. All modifications have been developed intentionally and based on several important factors, including: 1) Expanding engineering technology career and technical education (CTE) options for rural HCPS high school students; 2) Increasing student engagement in STEM and advancing postsecondary opportunities for high school students; and 3) Creating a pathway to college as well as the workforce.

E. Relevance to High-demand Program at Historically Black Institutions (HBIs)

1. Potential program impact on high demand programs at HBIs

As noted above, this new program concentration may provide an additional articulation pathway opportunity with University of Maryland Eastern Shore's Engineering Technology baccalaureate program and may further enrich transfer under HCC's current agreement with Morgan State University's Engineering program.

F. Relevance to the Identity of Historically Black Institutions (HBIs)

1. Potential program impact on identities and missions of HBIs

HCC is not aware of any impacts on the identities and missions of Maryland's HBIs.

G. Adequacy of Curriculum Design, Program Modality, and Related Learning Outcomes (as outlined in COMAR 13B.02.03.10)

1. Program establishment and faculty involved

The AM area of concentration within the Engineering Technology, A.A.S. was co-created by HCC faculty and industry subject-matter experts. All modifications were developed in accordance with the College's Curriculum Manual and included assessment of data to support enrollment, consultation with other divisions, and analysis of course transferability to the College's top transfer institutions. The approval process involved Integrated Business and Applied Technology division faculty discussions, the curriculum workgroup, the Vice President of Academic Affairs, the President of the College, and the Board of Trustees.

2. Educational objectives and learning outcomes

The educational objectives of the AM curriculum are to provide a foundation for diverse employment opportunities in industries where innovative technologies are used to improve products and/or processes. Students who complete the program will have developed the skills and experience to

perform as technicians or technology specialists to support engineering staff.

The learning outcomes (LOs) of the AM curriculum align with the five program learning outcomes (LOs) of the existing Engineering Technology program. Upon successful completion of this program of study students will be able to:

1. Apply appropriate communications skills to work independently and collaboratively within an organization to promote the goals and objectives of the work unit.
2. Recognize how to facilitate successful completion of technical projects.
3. Demonstrate competency in using technical tools, technology, methods, and processes.
4. Recognize professional and ethical behavior.
5. Apply problem solving skills to technical problems.

The following crosswalk demonstrates how course outcomes have been mapped to the program learning outcomes.

Program Goals:	1	2	3	4	5
Courses Specific to the Additive Manufacturing Area of Concentration					
ENGT 106: Introduction to Additive Manufacturing	☒	☐	☒	☐	☒
ENGT 110: 3D Printing for Additive Manufacturing	☒	☒	☒	☒	☒
ENGT 115: Optimizing Print Files	☒	☒	☒	☐	☒
ENGT 225: Quality Control Metrology for Additive Manufacturing	☒	☒	☒	☒	☒
ENGT 230: Additive Manufacturing Capstone	☒	☒	☒	☒	☒
Remaining Courses in the Curriculum					
ENGT 108: Introduction to Electronics	☒	☐	☒	☐	☒
ENGT 105: Electrical Control Systems	☒	☐	☐	☐	☒
ENGT 223: Principles of Mechanics	☐	☐	☒	☐	☒
CIS 115: Fundamentals of Programming	☒	☐	☒	☐	☒
CADD 101: Introduction to CADD	☐	☒	☒	☐	☒
CIS 102: Introduction to Information Sciences	☐	☒	☒	☐	☐
ENGR 203: Engineering Materials	☒	☐	☒	☐	☒

ENG 101: English Composition	☒	☐	☒	☐	☐
ENG 209: Technical Writing	☒	☐	☒	☐	☐
MATH 103: Trigonometry	☒	☐	☒	☐	☒
Biological/Physical Lab Science elective	☒	☒	☐	☐	☒
Philosophy elective (Arts/Humanities)	☒	☐	☐	☒	☐
CMST 105: Interpersonal Communication	☒	☐	☒	☒	☒
Behavior/Social Science elective	☒	☐	☐	☒	☐

3. Program assessment in terms of student achievement and documentation

Assessment of student program learning outcomes will be performed throughout the core courses, including engineering technology (ENGT), computer aided design and drafting (CADD) and engineering (ENGR), as well as others. Formative, summative and authentic assessments will be used. Outcomes are collected and documented using a learning management system-integrated software solution. The learning management system-integrated software solution allows for documentation of individual course learning outcomes as well as program goal achievement. All course learning outcomes are assessed every four years per HCC's recommendations.

4. List of courses

Core Courses Required for the Additive Manufacturing area of concentration in Engineering Technology, A.A.S.

CADD 101: Introduction to CADD | 3 credits
The content of the basic course includes learning CADD commands and working with the user-interface. File maintenance and plotting are used to create two-dimensional design models in a CADD environment using AutoCAD software. Course includes 30 lecture hours and 30 lab hours per semester. Course fee.

Upon satisfactory completion of this course, the student will be able to:

- Create and edit basic CADD drawings.
- Develop competence using AutoCAD to make and execute the decisions necessary for solving problems in drafting.
- Plot CADD drawings.

CIS 102: Introduction to Information Sciences | 3 credits | GI
This is a survey course of the characteristics, functions and applications of computers. It includes the concepts and principles of problem solving and computer programming. Emphasis is placed on microcomputers and application software packages, such as word processors, spreadsheets, and graphics. Course fee.

Upon satisfactory completion of this course, the student will be able to:

- Identify the major developments in computer hardware and software.
- Describe the characteristics, functions and limitations of processors, storage media and peripherals.
- Describe the difference between developing computer programs and using software packages.
- Analyze the reasons for using computer languages and software packages given their characteristics and limitations.
- Discuss the complexity of global communication and the effect of computers in the international community.
- Evaluate computer systems that satisfy given constraints.
- Access, use, and exit word processing, spreadsheet, presentation graphics, database and operating system software, and produce a report, a spreadsheet, and a graphic presentation.

CIS 115: Fundamentals of Programming | 3 credits
This course is designed to develop problem-solving skills in relation to designing computer programs. The student examines and uses program development techniques by developing hierarchy charts, flowcharts and pseudocode to solve common programming problems. This course is a co-requisite for programming languages classes. It is strongly recommended that students complete CIS 115 prior to taking a programming language.

Upon satisfactory completion of this course, the student will be able to:

- Describe and practice the problem-solving process.
- Explain information processing concepts including data storage and file processing.
- Identify different kinds of program logic, including reports with headings, control breaks, reports with totals, data validation and tables.
- Analyze and solve program logic problems by using sequence, branching, and looping structures.
- Design small & medium scale program solutions for real-life applications by creating hierarchy charts, flowcharts, and pseudocode.
- Identify techniques for developing programs in an object-oriented environment.
- Discuss current issues in programming.

ENGT 108: Introduction to Electronics | 4 credits
This course provides a broad introduction to electronics. It focuses on DC and AC circuit fundamentals, including electrical components, voltage, current, resistance, Ohm's Law, energy and power, series circuits, parallel circuits, series-parallel circuits, capacitors, inductors, and transformers, RC, RL, RLC circuits and the application of circuit theorems in AC analysis. Prerequisites: Qualifying score on the math assessment, or MATH 026. Course fee.

Upon satisfactory completion of this course, the student will be able to:

- Recognize common electrical components and measuring instruments.

- Define and calculate voltage, current and resistance.
- Explain and apply Ohm's Law and Kirchhoff's Laws.
- Describe and analyze series circuits, parallel circuits, series-parallel circuits and ladder networks.
- Identify and describe a sinusoidal waveform and measure its characteristics.
- Describe the basic structure and characteristics of capacitors, inductors, and transformers.
- Analyze RC, RL, and RLC circuits.
- Apply circuit theorems in AC analysis.

ENGT 223: Principles of Mechanics | 3 credits
This course is designed for students in the Engineering Technology Program. The course focuses on establishing a hands-on background in the basic principles of mechanics as applied to an industrial setting. A broad range of tools and techniques are presented which introduce students to industry standard procedures and equipment. Topics include hand tools, fasteners, basic fundamentals of mechanics, lubrication, bearings, seals, gaskets and packing, belt drives, chain drives, gears, couplings, clutches and brakes, and rigging. Prerequisites: ENGT 101 and MATH 103.

Upon satisfactory completion of this course, the student will be able to:
- Demonstrate mastery of essential industrial mechanics tools.
- Use various mechanical devices, including fasteners, seals, gaskets, belts, gears, and couplings.
- Identify safe practices in the use of mechanical devices.
- Demonstrate problem-solving skills using the basic principles of mechanics.
- Explore possible career paths for engineering technicians working in various fields.

ENGR 203: Engineering Materials | 3 credits
This course is an introduction to a broad spectrum of engineering materials used in various industries. Emphasis is on the types, properties, production, and application of the materials. The topics include selection of materials, availability, elastic moduli, yield strength and ductility, hardness, fracture, toughness, fatigue, corrosion, deformation, and a CADD design project to incorporate various engineering materials. Usually offered in spring semester.

Upon satisfactory completion of this course, the student will be able to:

- Identify a variety of engineering materials.
- Understand the physical properties of each material such as strength, toughness, ductility, hardness, and fracture.
- Recognize the effect of production on the physical properties of the materials.
- Understand the application of the engineering materials in various industries.
- Understand the physical properties, availability, and price requirements in selection.

ENGT 105: Electrical Control Systems | 3 credits
This course covers the basic concepts needed to understand the operation and programming techniques common to most Programmable Logic Controllers (PLC). An overview of Programmable Logic Controllers and the different number systems are covered. Topics include various number systems, programming fundamentals, timers, counters, sensors and their wiring, input/output modules and wiring, arithmetic instructions, and an overview of plant floor communications. Prerequisite: ENGT 108. Course fee.

Upon satisfactory completion of this course, the student will be able to:

- Describe the operation of Programmable Logic Controllers.
- Identify a variety of control systems and describe the purpose and application of each.
- Identify various number systems and explain the benefits of these systems.
- Write programs for Programmable Logic Controllers.
- Diagram the distribution of power from utility source through point of use.
- Describe the purpose and application of various input/output modules.
- Interpret electrical drawings and schematics.

ENG 209: Technical Writing | 3 credits

This course emphasizes types of technically oriented, practical report writing skills necessary to develop progress reports, proposals and recommendation reports. Through individual assignments, students learn the techniques of definition, description of a mechanism and a process, clarification, analysis and interpretation. Prerequisites: minimum of C grade in ENG 101.

Upon satisfactory completion of this course, the student will be able to:

- Use the techniques of technical writing in preparing larger writing.
- Prepare effective major reports in occupational writing.
- Perform effective oral presentations of written work.

Courses Required for the Additive Manufacturing area of concentration

ENGT 106: Introduction to Additive Manufacturing | 3 credits

This course will explore 3D printing and its role in Additive manufacturing, global product development, and innovation. Students will have the opportunity to use 3D printers. Through the use of 3D printers, students will practice the techniques of 3D printing. The objective of this course is for the students to learn the fundamental skills and terminology of 3D printing.

Upon satisfactory completion of this course, the student will be able to:

- Explain current and emerging 3D printing technology and the role within additive manufacturing (Program Goal: 1 and 4).
- Produce 3D printed parts that satisfy specifications (Program Goal: 2, 3, and 5).
- Demonstrate use of various printing host software (Program Goal: 3).
- Assemble and identify various subassemblies of a 3D printer (Program Goal: 3 and 5).
- Recognize and use terminology appropriately (Program Goal: 1 and 3).
- Perform basic 3D modelling techniques (Program Goal: 3 and 5).
- Identify and troubleshoot faulty prints (Program Goal: 3 and 5).

ENGT 110: 3D Printing for Additive Manufacturing | 3 credits

This course expands the application of 3D Printing techniques learned in ENGT 106. The different printing processes are explored. Failed prints will be analyzed. Basic 3D Scanning and enhancement of scanned files are introduced. Open source modeling software and meshing software are explored. Rapid Prototyping and Additive Manufacturing concepts used in the production process are explained. Simple

jig and fixtures are modeled and printed. PBCL is used to examine prototyping issues. Prerequisite: ENGT 106 or ENGT 103. A student cannot receive credit for both ENGT 104 and ENGT 106.

Upon satisfactory completion of this course, the student will be able to

- Discuss the ethical implications of the technology (Program Goal: 4)
- Demonstrate optimal printing techniques (Program Goal: 3)
- Apply various finishing techniques (Program Goals: 3 and 5)
- Analyze the results of calibration prints (Program Goals: 3 and 5)
- Generate a 3D file by scanning an object (Program Goals: 3 and 5)
- Construct a printable 3D water-tight file using meshing techniques on a scanned file (Program Goals: 3 and 5)
- Construct printable 3D files of jigs and fixtures (Program Goals: 3 and 5)
- Explain how design for manufacturing can be applied to 3D printing and rapid prototyping (Program Goals: 3 and 5)

ENGT 115: Optimizing Print Files | 3 credits

This course will explore various techniques and software applications used to modified or optimize 3D print files. Students will have the opportunity examine and modify G-code for FFF 3D printers. Learn fundamental techniques of examining files 3D model in order to repair and optimizing files using open source software used 3D printing. Students will have the opportunity to evaluate modification by using 3D printers. Prerequisite: ENGT 110.

Upon satisfactory completion of this course, the student will be able to:

- Recognize common printing faults in FFF printed
- Apply corrective techniques to improve 3D prints
- Recognize and explain faults in other 3D printing processes
- Identify possible faults in 3D model files
- Determine optimal orientation of print model
- Recognize the need of supports
- Determine optimal supports placement and configuration
- Apply appropriate adhesion techniques

ENGT 225: Quality Control and Metrology for Additive Manufacturing | 3 credits

This course is designed to explain the challenges encountered when measuring additively manufactured parts. Methods and technologies for measuring, evaluating and validating additive manufactured parts are explored to convey best measurement practices.

Upon successfully completing this course, Students will be able to:

1. Demonstrate basic measuring methods and practices (Program Goals: 1, 3, 5)
2. Explain introductory metrology concepts (Program Goals: 1, 3, 5)
3. Explain the challenges in measuring and qualifying an additive manufacturing part (Program Goals: 1, 3, 5)

ENGT 230: Additive Manufacturing Capstone | 3 credits
Students apply the knowledge, skills, and attitudes acquired throughout the additive manufacturing concentration to a real-world workplace situation. Using the PBCL (Problem Based Case Learning) framework, students, under the guidance of industry mentors and HCC faculty, address problems encountered in industry and work to an effective solution throughout the semester. Working within teams and effective communication skill will also be developed.

Pre-requisitions: ENGT 106, ENGT 110, and ENGT 115, Co-requisite 225.

Upon satisfactory completion of this course, the student will be able to:

1. Apply project team skills to troubleshoot a complex problem (Program Goals: 1, 2, 3, 4, 5)
2. Develop and present project solutions to evaluation panel (Program Goals: 1, 2, 3, 4, 5)
3. Demonstrate the ability to work in teams to meet project goals (Program Goals: 1, 2, 3, 4, 5)

5. General education requirements

HCC students must complete a minimum of 60 credits of college-level work to be eligible for the Associate of Applied Science (A.A.S.) degree. In accordance with COMAR 13B.06.01.03, of the 60 credits, at least 18 credits must fulfill HCC's General Education requirements, including at least one, three to four semester-hour course from each of the five areas listed below. The remainder of the required general education credits may be selected from any of the approved general education categories. The distribution of the 18 General Education credits must meet the following specifications at HCC:

- 3 credits of Behavioral/ Social Sciences (GB)
- 3 credits of English Composition (GE)
- 3 credits of Arts/ Humanities (GH)
- 4 credits of Biological/ Physical Laboratory Science (GL/ GS)
- 3 to 4 credits of Mathematics (GM)
- 2 or more credits of General Education Electives (GB, GH, GM, GS, GI)

The Additive Manufacturing area of concentration includes 19 credits of General Education as follows:

General Education Area	**Course**	**Credits**
Behavioral/ Social Sciences	Behavioral/ Social Sciences Elective (GB)	3
English Composition	ENG 101: English Composition (GE)	3
Arts/ Humanities	PHIL Elective (GH)	3
Biological/ Physical Laboratory Science	Biological/ Physical Laboratory Science Elective (GL)	4
Mathematics	MATH 103: Trigonometry (GM)	3
General Education Electives	CMST 105: Interpersonal Communication (GI)(D)	3
Total General Education Credits Required for Completion:		**19**

6. Specialized accreditation or graduate certificate requirements

There are no specialized accreditation or graduate certificate requirements for this program.

7. Scope of written contracts with other institutions

There are no contracts with other institutions associated with this program.

8. Assurance and evidence to illustrate student needs

Following a 2017 comprehensive review of business processes, HCC has begun implementation of projects designed to enhance the student experience. Improvements to workflow will provide students with clear, complete, and timely information. For example, the adoption of catalog and curriculum software that integrates with both the current Enterprise Resource Planning (ERP) solution and the degree-auditing and tracking tool will provide students with transparent, real time information regarding curriculum, course and degree requirements.

HCC regards faculty interactions with the student body as paramount to academic success. All full time faculty maintain at least five reasonably distributed office hours per week when the faculty member's courses are in session. Office hours are posted in the syllabus, on office doors and in the learning management system. Additionally, the Coordinator of Engineering Technology works closely with students to assist in advising and career placement.

Assumptions about technology competence and skills and technical equipment requirements are stated in the College's course catalog, as well as course descriptions and degree requirements.

All HCC courses are required to use the LMS to provide links to academic support services, financial aid resources, and college policies regarding tuition costs and payment regardless of instructional delivery mode.

The Office of Communications is committed to providing transparent and accurate advertising, recruiting, and admissions materials through ongoing processes. When a new degree program is approved, it will be advertised in is several ways. A headline banner will be put on the official HCC website and listed under the degree programs offered at HCC. An article will be written about the new program and a news release will be put in the local papers, included in the weekly newsletter distributed campus-wide, as well as the *Harford Highlights,* a newsletter accessible to community members. Other advertising includes social media communications as well as brochures given out at open houses both at HCC and local high schools.

9. Assurance and evidence regarding program advertising

Harford Community College's Office of Communications generates promotional materials for academic programs that are used in advertising, recruiting, and admission. Office of Communications staff work closely with staff in Academic Affairs and Student Affairs & Institutional Effectiveness to ensure the accuracy of promotional materials. An annual review process of program brochures has been established to coincide with the release of each academic catalog, as well as a line of communication for any programmatic changes that may occur outside of the annual review cycle.

H. Adequacy of Articulation

1. Articulation with partner institutions (if applicable)

As an Associate of Applied Sciences degree, neither Engineering Technology nor Additive Manufacturing is designed as a transfer degree. However, the Coordinator and the College's Advising, Career and Transfer Services work with students to identify potential for transfer programs in this field of study.

HCC graduates have successfully continued their education at University of Maryland Eastern Shore where they have majored in the Engineering Technology, B.S. program. The College remains open to working with partner institutions to negotiate additional articulation pathways.

I. Adequacy of Faculty Resources

1. Quality of program faculty

Harford Community College employs highly qualified faculty in all disciplines. Additionally, through the Center for Excellence in Teaching and Learning (CETL), the College offers comprehensive professional development and training for all who are engaged in the teaching and learning process at HCC. CETL is intentionally designed to be a hub both digitally and physically for innovation, collaboration, and learning transformation through a variety of events and resources in order to:

- Create faculty teaching and learning communities of practice;
- Celebrate innovation in instruction and scholarship;
- Offer on-going basic and advanced learning management system training;
- Provide resources, facilities and technology to foster experimentation; and
- Offer opportunities for faculty to gain additional knowledge and hone skills related to technology and pedagogy.

Specifically, for this proposed program, grant funding has been used for additional faculty professional development in additive manufacturing to elevate their expertise in the discipline. Furthermore, the

college provide faculty $1,500 annually for professional development which enables program faculty to remain professionally current in this high-technology area.

The lead instructor for this program is David Antol who holds a Master of Science in Engineering and worked for over 20 years as an engineer in related industry. He also serves as the program coordinator. He teaches or will teach the following courses within the program. Additional faculty engaged in this program have also been identified.

David Antol
Coordinator for Applied Technology Programs
Master of Science in Engineering
ENGT 103, ENGT 105, ENGT 106, ENGT 108, ENGT 110, ENGT 115, ENGT 230 and CIS 115.

Jerome Brown
Assistant Professor
Master of Science in Computer Science
CIS 115

Thomas Almuttil
Engineering Technology Adjunct Faculty
Doctor of Philosophy, Mechanical Engineering
ENGT 223 ENGT 107

Matthew Lapinsky, P.E.
Engineering Technology Adjunct Faculty
Bachelor of Science, Mining Engineering
ENGT 101

Hugh Richardson
Engineering Technology Adjunct Faculty
Bachelor of Science, Engineering Technology
ENGT 105 and ENGT 108

J. Adequacy of Library Resources

The HCC Library is a 25,734 square foot facility located centrally on campus. It is open seven days per week for student access. The library's website provides 24-hour free access to the catalog, databases, subject guides, tutorials and other resources. Borrowing privileges are available for all students, as well as county residents 18 years or older. The library focuses its collection on a mixture of print, electronic, and video resources to meet the informational and curricular needs of the HCC community. Students have access to full-text journal, magazine and newspaper articles through the College's subscription databases. Streaming video collections are available through two databases, Films on Demand and

Alexander Street Press. Students have access to unlimited resources through the Inter-Library Loan Service, which can deliver titles from almost any academic library in the country.

K. Adequacy of Physical Facilities, Infrastructure and Instructional Equipment (as outlined in COMAR 13B.02.03.13)

1. Assurance regarding physical facilities, infrastructure, and equipment

No new facilities are required for this program. Physical resources at HCC offer sufficient space and learning technology to support education. The 352-acre campus has a physical plant of 21 buildings including a performing arts center, an observatory, a 3,000-seat arena and athletic center and six classroom buildings.

Students enrolled in the program have access to the HCC Learning Center for tutoring services in math, science, writing, study skills and test taking skills. Additionally, the Test and Assessment Center, Academic Advising and Transfer Services, and Career Services are all resources of the college that may be utilized episodically for individual or groups of students.

Computing and Technology Services (CTS) at HCC provide technology support for desktop, laptop and tablet devices provided by the college, classroom computers and instructional technology such as SMART Boards, LCD projectors, and DVDs. Wireless access is available throughout the HCC campus. Open-access computer labs located in the library offers a wide selection of computer software and applications for student use, including multimedia production and digital editing capabilities. A resource help desk, staffed by eLearning personnel, is located in this area specifically for student help with online resources.

There are presently two dedicated laboratories for this program, one which contains 3-D printing equipment for additive manufacturing instruction and the other that contains electronics equipment and parts for electronics classes. There is another laboratory that supports this program which also houses trainers, such as hydraulic and pneumatics trainers. This additional laboratory is not solely dedicated to the program as it is versatile and used for other programs as well. These labs are not at capacity. The college will leverage this existing laboratory capacity to support the new additive manufacturing concentration.

2. Assurance regarding distance education access in terms of institutional electronic mailing system and learning management system

All faculty and credit-earning students are provided with an institutional e-mail account that integrates with the learning management system. Open-access, comprehensive student support for the learning management system is provided in module format and includes “how to” video and print tutorials, an eLearning Help Desk, links to student services, and tips for success in an online learning environment.

Faculty are assigned an eLearning point-of-contact for technical support, a learning management system "trouble-shoot" guide, and access to Help Desk dedicated line.

Supportive statement by the President

It is the position of Dianna G. Phillips, Ph.D., President of Harford Community College, that existing library resources, physical facilities, infrastructure and instructional equipment will more than adequately support the CHP program.

L. Adequacy of Financial Resources with Documentation

1. Complete Table 1 and rationale

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	$0	$0	$0	$0	$0
2. Tuition/Fee Revenue (c + g below)					
a. Number of F/T Students	46*	55	60	65	70
b. Annual Tuition/Fee Rate[5]	*$4170*	*$4170*	*$4170*	*$4170*	*$4170*
c. Total F/T Revenue (a x b)	$191,820	$229,350	$250,200	$271,050	$291,900
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	$129	$129	$129	$129	$129
f. Annual Credit Hour Rate	$0	$0	$0	$0	$0
g. Total P/T Revenue (d x e x f)	$0	$0	$0	$0	$0
3. Grants, Contracts & Other External Sources	$39,595	$0	$0	$0	$0

[5] $129/credit x 30 credits=$3870 + average of $300 in course fees

* As this proposal seeks to modify an existing program by creating a new area of concentration the projected enrollments are for both concentrations within the degree, including the Engineering Technology concentration that already exists and has active enrollments of 36 students.

4. Other Sources Consolidated Service Fee	$0	$0	$0	$0	$0
TOTAL (Add 1 – 4)	$231,415	$229,350	$250,200	$271,050	$291,900

2. Complete Table 2

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)	$51,278	$52,304	$53,350	$108,833	$111,010
a. # FTE	1**	1	1	2	2
b. Total Salary	$46,501	$47,431	$48,380	$98,694	$100,668
c. Total Benefits	$4777	$4873	$4970	$10139	$10,342
2. Admin. Staff (b + c below)	$0	$0	$0	$0	$0
a. # FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
3. Support Staff (b + c below)	$0	$0	$0	$0	$0
a. # FTE	0	0	0	0	0
b. Total Salary	$0	$0	$0	$0	$0
c. Total Benefits	$0	$0	$0	$0	$0
4. Equipment					
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$0	$0	$0	$0	$0
7. Other Expenses	$13,000	$13,000	$15,000	$18,000	$20,000

TOTAL (Add 1 – 7)	$64,278	$65,304	$68,350	$126,833	$131,010

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15)

1. Course evaluation procedures

Faculty are evaluated annually by the division dean using the following core components: instruction observations, syllabus, final examinations, assessment instruments or strategies used to evaluate course objectives and academic outcomes, data reports and written critiques of student surveys of instruction, participation records of college assignments, professional development activities, and college and community service activities.

HCC has a systematic plan for evaluation of all degree programs and courses that will be applied to the AM area of concentration in Engineering Technology. The College supports the review of curriculum as a significant component of an overall educational effectiveness plan. Program reviews lead to program and course improvements that are based on sustained information gathering and analysis and provide insight for needed resources and ensure superior educational programs that meet student and community needs. Program reviews assess how well the program has achieved its objectives and suggests potential approaches to enhance this effort and address and fulfill accreditation requirements as prescribed by Middle States.

2. Institutional assessment of program effectiveness

The program evaluation process includes faculty and staff within and outside of the program, students, advisory board members, representatives from resource areas in the college, and other communities of interest. This clearly defined program review process provides a consistent framework for evaluating a program's educational effectiveness and includes the use of a comprehensive data management system to systematically collect and report student learning outcome assessments and collaboration with the Office of Institutional Research, Planning, and Effectiveness for data regarding student retention and completion, faculty and student satisfaction, and program cost-effectiveness. All programs and their options/tracks, including A.A.S. (career), certificate, A.A. /A.S./A.F.A. (transfer) degree programs, and programs such as General Education, Information Literacy and Distance Learning are evaluated every three to five years on a planned cycle.

N. Consistency with the State's Minority Student Achievement Goals (as outlines in COMAR 13B.02.03.05)

1. Minority student needs

HCC has a history of promoting diversity and creating an environment that is open and inclusive for students, visitors, and employees. HCC embraces differences, respects intellectual and academic freedom, promotes critical discourse, and encourages socio-cultural and global awareness.

HCC has developed strategies to address the eradication of the attainment gap including implementation of the My College Success Network (MCSN) and Soar2Success (S2S). Established in July 2014, these programs are a network of services, events, staff and faculty geared toward empowering and supporting African American students.

In 2018, HCC joined Achieving the Dream (ATD), a network dedicated to improving student success, with a particular focus on academic goal attainment, personal growth, and economic opportunity for low-income students and students of color.

O. Relationship to Low Productivity Programs Identified by the Commission

This proposed program is not directly related to an identified low productivity program.

P. Adequacy of Distance Education Programs (as outlined in COMAR 13B.02.03.22)

1. Affirmation of institutional distance education eligibility

HCC is an approved institution of the National Council for State Authorization Reciprocity Agreement (NC-SARA). As a NC-SARA institution, HCC is approved to offer distance learning courses to students who reside in other NC-SARA approved states. At this point in time, HCC is unable to admit students from California, as California is not a participating member of NC-SARA.

2. Assurance regarding C-RAC guidelines

HCC does comply with C-RAC guidelines for the Evaluation of Distance Education. The College's eLearning Department and the Distance Learning Committee (DLC) ensure online learning offered by

HCC aligns with the College's mission to provide accessible, innovative, and learner-centered education as a means to promote individual goal attainment, as well as career and workforce development. Both the DLC and eLearning have worked together to develop a formal Quality Matters review for courses as well as an internal review process for all new and existing online classes at HCC to ensure a high quality and rigorous educational experience for all online students.

Blackboard is used as the College's learning management system (LMS). All full and part-time faculty are provided Blackboard course sites for each of their courses and are required to complete Blackboard basic training or demonstrate competency through a "Blackboard Veterans" quiz developed internally. In addition to the required training, course syllabi, contact information, and college closing information must be included on all course sites. To further facilitate student success in online learning environments, the DLC developed and implemented common nomenclatures for online course menus to standardize terminology used in courses across campus. An "Online Readiness Check" was also developed as a tool to assess the readiness of students interested in enrolling in online courses.

eLearning also provides professional development training that focuses on enhancing online instruction for all faculty throughout the year. Workshops and training sessions range in level and content in order to adequately provide faculty with relevant information and experiences, as well as facilitate continual growth in online instruction.

Appendix A: Harford Community College Catalog Page

Associate of Applied Sciences Degree

Area of Concentration in Engineering Technology

Additive Manufacturing

Award: Associate of Applied Sciences Degree

No. of Credits required: 60

Program Description

This program prepares students for employment in advanced manufacturing, including additive manufacturing (3D printing), and a variety of other industries that use technicians or technology specialists to support engineering staff. A strong emphasis is placed on applications, problem solving, critical thinking, and communication skills. Upon graduation, students will be able to use these skills to, organize, and carry out engineering technology projects. Graduates of this program will demonstrate knowledge of CADD, electronics, hydraulics, pneumatics, blueprint reading, and mechanics. Engineering and science courses are important parts of this program.

Program Goals

Upon successful completion of this program of study students will be able to:

1. Apply appropriate communications skills to work independently and collaboratively within an organization to promote the goals and objectives of the work unit.
2. Recognize how to facilitate successful completion of technical projects.
3. Demonstrate competency in using technical tools, technology, methods, and processes
4. Recognize professional and ethical behavior.
5. Apply problem solving skills to technical problems.

1st Semester

Course	Gen. Ed.	Credit
CADD 101: Introduction to CADD		3
CIS 102: Introduction to Information Sciences	GI	3
CMST 105: Interpersonal Communication	GI, D	3
ENGT 106: Introduction to Additive Manufacturing		3
CIS 115: Fundamentals of Programming		3
Semester total		15

2nd Semester

Course	Gen. Ed.	Credit
ENGT 110: 3D Priniting for Additive Manufacturing		3
ENGT 108: Introduction to Electronics		4
ENGR 203: Engineering Materials		3
ENG 101: English Composition	GE	3
MATH 103: Trigonometry	GM	3
Semester total		16

3rd Semester

Course	Gen. Ed.	Credit
ENGT 115: Optimizing Print Files		3
ENGT 223: Principles of Mechanics		3
ENGT 105: Electrical Control Systems		3
Biological/Physical Lab Science Elective	GL	4
PHIL Elective	GH	3
Semester total		16

4th Semester

Course	Gen. Ed.	Credit
ENG 209: Technical Writing		3
ENGT 225: Quality Control and Metrology for Additive Manufacturing		3
ENGT 230: Additive Manufacturing Capstone		3
Physical Education Elective		1
Behavioral/Social Science Elective	GB	3
Semester total		13

Appendix B: Best Practices for HCC Online Courses

Faculty Presence

Faculty should have an active presence that encourages student involvement in the online course environment. Courses that adhere to this practice will typically include several of the following:

- Expectations of availability and turn-around time are clear
- There is evidence that instructors will regularly engage with students in various course activities.
- Faculty intends to provide frequent and substantial feedback
- A personable faculty introduction is included
- A welcome is clearly visible upon first logging into the course

Start-Up Information & Navigation

Course navigation guidance, including start-up information, is readily available. The course is well organized and easy to navigate. Courses that adhere to this practice will typically include several of the following:

- A location, clearly evident upon logging into the course, labeled “start here,” includes information the student should view prior to starting the course selected by the instructor such as welcome letter, syllabus, instructor information, student expectations/tips for success, etc.
- The syllabus is complete and easy to access
- Navigation is clear, simple, and user friendly
- The course schedule is summarized in one location
- Organization and sequencing of the course content is logical and clear
- Required instructional materials are easily located
- Links to other parts of the course and external sources are accurate and up to date
- FAQs or help for technological issues are available

Content

Instructional rigor is equal to that of a face-to-face course. It is delivered to address different learning styles and reinforced through various tools. Courses that adhere to this practice will typically include several of the following:

- Instructional content should include more than one of the following: readings, online lectures, videos, simulations, case studies, games, discussion forums, study guides, practice problems, pretests, homework, etc.
- Activities promoting a sense of engagement and community are included, such as scavenger hunt, ice breakers, collaborative exercises, discussion boards, etc.
- The pace of the course is appropriate to the course content and level
- Clear information and instructions are provided regarding the access of required course materials
- Appropriate media supports course content and adds interest
- Any materials which are not required are clearly marked as optional
- Written material is professional and uses language appropriate to the course topic and level
- Copyright ownership is followed and clearly documented
- All course components are visually and functionally consistent with each other

Active Learning

The course provides a variety of opportunities for interaction that support active learning. Courses that adhere to this practice will typically include several of the following:

- The course includes activities which provide opportunities for students to interact with the teacher, with each other, and with the content
- Activities are included which do not have a single right answer
- Challenging tasks are presented
- Sample cases and assignments are used as a template
- Expectations for student participation in the course activities are clear
- Activities and assessments encourage students to apply, analyze and evaluate course content
- Students are encouraged to create new understandings as demonstrated on course assessments
- Students have input to the learning environment, for example, due dates, assessment formats, course content, etc.

Assessment

Various forms of assessment occur throughout the course, in accordance with the HCC attendance policy, and measures student achievement of Student Learning Objectives and/or competencies. Courses that adhere to this practice will typically include several of the following:

- Forms of assessment should include more than one of the following: quizzes, papers, discussions, self-checks, projects, tests & exams, presentations, case studies, labs, skill assessments, etc.
- Assessments clearly align with Student Learning Objectives
- Instructions, student expectations, and grading standards are clearly stated, this may include the provision of sample assignments
- The course grading policy and grading calculations are stated clearly
- The gradebook is visible to students and there are clear instructions on how students can access their grades and feedback, preferably using the Blackboard Grade Center
- The gradebook is current

Accessibility

Course design reflects a commitment to accessibility and usability throughout the course. Courses that adhere to this practice should include the following:

- Course content is in compliance with the Americans with Disabilities Act
- The course design facilitates readability (e.g., color, font, use of white space, length, background, etc.)
- Necessary technology is easily obtainable
- Course media is easy to view and operate
- Technology used in the course supports achievement of the Student Learning Objectives
- Hardware and software requirements are clearly stated and students are given information about downloading necessary software
- Information directing students to methods of accessing institutional support services; including technology, accessibility, and academic support is included