CAPITOL
Technology University

Bradford L. Sims, PhD
President

November 14, 2018

Dr. James D. Fielder, Jr.
Secretary of Maryland Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201

Dear Dr. Fielder,

Capitol Technology University is requesting approval to offer a **Doctor of Philosophy (Ph.D.) in Manufacturing**. The degree curriculum will be taught using a significant number of existing faculty at our university and will be supplemented by new courses supporting the Ph.D. in Manufacturing.

The mission of Capitol Technology University is to provide practical education in engineering, computer science, information technology, and business that prepares individuals for professional careers and affords the opportunity to thrive in a dynamic world. A central focus of the university's mission is to advance practical working knowledge in areas of interest to students and prospective employers within the context of Capitol's degree programs. The university believes that a Ph.D. in Manufacturing is consistent with this mission.

The revolutionization of manufacturing is occurring every day now along multiple paths. However, the common element in all the paths is technology and the ability to lead and manage the related changes in a company. The seismic changes occurring in manufacturing will create new opportunities for companies to achieve great success while others will inevitably fail – even if the past has been highly profitable. The keys to success involve coupling the latest technology, speed, customization, agility on every production line, and new business models. This program is in response to those changes; the Ph.D. in Manufacturing degree is for current professionals in the field who desire to elevate their skills to the highest level and contribute to the body of knowledge in manufacturing.

To respond to needs of the Manufacturing industry, we respectfully submit for approval a Doctor of Philosophy (Ph.D.) in Manufacturing. The required proposal is attached as well as the letter from me as university president confirming the adequacy of the university's library to serve the needs of the students in this degree.

Respectfully,

Bradford L. Sims, PhD

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Technology University

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President

November 14, 2018

Dr. James D. Fielder, Jr.
Secretary of Maryland Higher Education
Maryland Higher Education Commission
6 N. Liberty Street
Baltimore, MD 21201

Dear Dr. Fielder,

This letter is in response to the need for confirmation of the adequacy of the library of Capitol Technology University to support the proposed Doctor of Philosophy (Ph.D.) in Manufacturing. As president of the university, I confirm that the library resources, including support staff, are more than adequate to support the Ph.D. in Manufacturing. In addition, the university is dedicated to, and has budgeted for, continuous improvement of its library resources.

Respectfully,

Bradford L. Sims, PhD

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MHEC
Creating a state of achievement

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

Institution Submitting Proposal	Capitol Technology University

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

Department Proposing Program	Department of Doctoral Programs	
Degree Level and Degree Type	Doctor of Philosophy (Ph.D)	
Title of Proposed Program	Ph.D. in Manufacturing	
Total Number of Credits	60	
Suggested Codes	HEGIS: 5312	CIP: 14
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: https://www.captechu.edu/current-students/academic-resources	
Preferred Contact for this Proposal	Name: Professor Soren Ashmall	
	Title: Director, Assessment & Accreditation	
	Phone: (571) 332-4344	
	Email: spashmall@captechu.edu	
President/Chief Executive	Type Name: Dr. Bradford Sims	
	Signature: B M S	Date: 11-14-18
Approval/Endorsement by Governing Board	Type Name: Dr. Bradford Sims	
	Signature: B M S	Date: 11-14-18

Revised 5/15/18

PROPOSAL FOR:

__X__NEW INSTRUCTIONAL PROGRAM

_____ SUBSTANTIAL EXPANSION/MAJOR MODIFICATION

_____ COOPERATIVE DEGREE PROGRAM

__X__WITHIN EXISTING RESOURCES or____REQUIRING NEW RESOURCES

CAPITOL TECHNOLOGY UNIVERSITY

1927

Institution Submitting Proposal

Fall 2019
Projected Implementation Date

Doctor of Philosophy (Ph.D.)
Award to be Offered

Doctor of Philosophy in Manufacturing
Title of Proposed Program

5312
Suggested HEGIS Code

14.3601
Suggested CIP Code

Doctoral Programs
Department of Proposed Program

Dr. Ian McAndrew
Dean, Doctoral Programs

Dr. Helen Barker
VP Academic Affairs,

hgbarker@captechu.edu
Contact E-Mail Address

240-965-2510
Contact Phone Number

11-14-18
Signature and Date

President/Chief Executive Approval

11-14-18
Date

Date Endorsed/Approved by Governing Board

Proposed Doctor of Philosophy in Manufacturing
Department of Doctoral Programs
Capitol Technology University
Laurel, Maryland

A. Centrality to Institutional Mission and Planning Priorities:

1. **Provide a description of the program, including each area of concentration (if applicable), and how it relates to the institution's approved mission.**

Doctor of Philosophy in Manufacturing Program Description:

The Doctor of Philosophy (Ph.D.) in Manufacturing provides students with the opportunity to conduct extensive and sustained original research at the highest level in the field of Manufacturing. The Ph.D. in Manufacturing is a unique interdisciplinary program designed to meet the demands for the highest skilled professionals to become the leaders who will be involved in the advancement, expansion and support of manufacturing on a large or small commercial scale. The design of manufacturing for increased revenue, lowers costs, time to market, and higher quality is more demanding now in a competitive global environment and with the introduction of mechatronics and robotics engineering. One manufacturing model will not fit all production lines. The Ph.D. in Manufacturing is for current professionals in the field who desire to elevate their skills to the highest level and contribute to the body of knowledge in Manufacturing.

The Ph.D. in Manufacturing addresses one of the greatest skill challenges of the 21st century – how to dramatically improve manufacturing processes, systems, and techniques of the last generation of manufacturing leaders, engineers, planners, and scientists. The University is in a unique position to provide students with an avenue to pursue a deep proficiency in this area using an interdisciplinary methodology, courses offered, and the skill set of the faculty. Graduates will contribute significantly to the Manufacturing field through the creation of new knowledge and ideas that are currently lacking as the whole sector expands and uses technology to rapidly evolve. The Ph.D. in Manufacturing program is designed as a doctorate by research where students will quickly become able to engage in research and publishing without the need to navigate the limitations inherent in traditional coursework models. This degree is for current professionals in the field who desire to elevate their skills to the highest level and contribute to the body of knowledge in Manufacturing.

Advanced computers have increased the speed of the design process for all items. However, the manufacturing development times have reduced only slightly in the past two decades. The field is now at a critical juncture where it requires the highest skilled professionals to tackle the issue and make manufacturing in the state and nation truly competitive in a competitive global economy.

Production experts estimate the recall of one item on a car, due to manufacturing errors, can seriously diminish or wipe out the profit for that car line for the entire year. A new terminal advanced degree is now required to infuse the highest level of expertise and leadership into every area associated with Manufacturing.

The Ph.D. in Manufacturing program is designed for students with an appropriate master's degree and experience. During the program, students will conduct original research in an approved area of Manufacturing. Successful completion of the program culminates in the award of the Doctor of Philosophy (Ph.D.) in manufacturing degree.

There are two options for completion of the Ph.D. in Aviation program. Under the thesis option, the student will produce, present, and defend a doctoral dissertation after receiving the required approvals from the student's Committee and the Ph.D. Review Board. Under the publication option, the student will produce, present, and defend their original doctoral research after receiving the required approvals from the student's Committee and the Ph.D. Review Board. The student must also publish three works of original research in a scholarly peer-reviewed journal(s). One of the three published works may be in a peer reviewed conference proceeding.

Relationship to Institutional Approved Mission:

The Ph.D. in Manufacturing is consistent with the University mission to educate individuals for professional opportunities in engineering, computer science, information technology, and business. The University provides relevant learning experiences that lead to success in the evolving global community. Fundamental to the degrees in the Department of Doctoral Programs are opportunities to pursue cutting-edge knowledge in technological applications, techniques, and procedures. The Ph.D. in Manufacturing is consistent with that philosophy. This same philosophy is supported by existing degree programs and learning opportunities. The University has a Doctor of Science (D.Sc.) in Cybersecurity, Ph.D. in Business Analytics and Decision Science, Ph.D. in Technology, and Ph.D. in Unmanned Systems Applications. The Ph.D. in Manufacturing degree is an integral part of the Strategic Plan for FY 2017-2021 and succeeding years. Funding to support the new degree has been included in the institutional and departmental budgets for FY 2019-2020 and forecasted budgets going forward.

The Ph.D. in Manufacturing degree will be offered online using the Canvas Learning Management System and Adobe Connect. The result is the convenience required by the 21st Century learner and provides the interaction with faculty and fellow students that is critical to the high-level learning experience. The curriculum provides the doctoral student the necessary learning tools that the University believes critical to success in the modern Manufacturing sector. The degree is also consistent with the interdisciplinary nature of the University.

2. **Explain how the proposed program supports the institution's strategic goals and provide evidence that affirms it is an institutional priority.**

Capitol Technology University operates on four strategic goals:

1. **Expand Educational Offerings, Increase Program Completion:** *Capitol Technology University is an institution that offers career-relevant curricula with quality learning outcomes. The strategy includes continuing to expand educational offerings, increasing program completion, and raising learner qualifications and outcomes.*

2. **Increase Enrollment and Institutional Awareness:** *Capitol will accelerate its goal pursuit to become more globally renowned and locally active through student, faculty and staff activities. Enrollment will grow to 650 undergraduates, 350 masters' students*

and 250 doctoral candidates.

3. **Improve the Utilization of University Resources and Institutional Effectiveness While Expanding Revenue**: *Capitol will likely continue to be 80% financially dependent on student tuition and fees. We plan to enhance our resources by expanding the range and amount of funding from other streams and aligning costs with strategic initiatives.*

4. **Increase the Number and Scope of Partnerships**: *Capitol's service to our constituents and sources of financial viability both depend upon participation with continuing and new partner corporations, agencies, and schools.*

The Ph.D. in Manufacturing program supports all the University's four strategic goals. The proposed degree builds upon the already successful graduate areas of study, including the Doctor of Science in Cybersecurity, Doctor of Philosophy in Business Analytics and Decision Sciences, Doctor of Philosophy in Technology, Doctor of Philosophy in Unmanned Systems Applications, Master of Business Administration, Master of Science in Cyber Analytics, Master of Science in Electrical Engineering, Master of Science in Internet Engineering, Master of Science in Cyber and Information Security, Master of Science in Computer Science, Master of Science in Information Systems Management, Technical Master of Business Administration in Cybersecurity, Technical Master of Business Administration Business Analytics and Data Science. The University's terminal degree programs are structured to prepare students to provide the critical expert leadership as well as technical and business skills necessary at the highest level to meet the needs of a modern technology and information-dependent society. The University's programs have been preparing professionals for rapid advances in information and technology, intense global competition, and increasingly complex technological environments for decades. The Ph.D. in Manufacturing will allow students to increase their knowledge to the extreme technological limits of Manufacturing and contribute to the body of knowledge in the field.

The new Ph.D. in Manufacturing is fully supported by the University's Vision 2025 and Strategic Plan 2017-2021. Funding to support the degree has been included in forecasted budgets going forward.

The University has active partnerships (e.g., Leidos, Patton Electronics, Lockheed Martin, Northrup Grumman, Cyber Security Forum Initiative, IRS, and NCS) in the private and public arenas. The Ph.D. in Manufacturing degree will provide new opportunities for partnerships as well as expanded research. The increase in partnerships and placement of our graduates in our partner institutions will serve to expand the University's enrollment and reputation. While additional enrollment will increase financial resources, additional partnerships and grants in the Manufacturing field will help diversify and increase the University's financial resources.

3. **Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation. (Additional related information is required in section L.)**

Capitol Technology University has reallocated funds during Year 1 for support of the program and course development, online support, office materials, travel, professional development, and initial marketing. There is no substantial impact on the institution because of the reallocation of

these funds. The reallocated funds will be recovered after the first year. The program is expected to be self-sustaining after Year 1.

4. **Provide a description of the institution's a commitment to:**

   a. **Ongoing administrative, financial, and technical support of the proposed program**

      The proposed degree is an integral part of the University's Strategic Plan for FY 2017-2025 and forward. Funding for the administrative, financial, and technical support of the new degree has been included in the institutional and departmental budgets for FY 2019-2020 as well as the forecasted budgets going forward.

   b. **Continuation of the program for a period of time sufficient to allow enrolled students to complete the program.**

      Capitol Technology University is fully committed to continuing the Ph.D. in Manufacturing degree program for a period of time sufficient to allow enrolled students to complete the program.

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

1. **Demonstrate demand and need for the program in terms of meeting present and future needs of the region and the State in general based on one or more of the following:**

   a. **The need for advancement and evolution of knowledge.**

      The State of Maryland has a rich history in Manufacturing that began during the early days of our country. The Baltimore shipyards were the center of industry in the state in the early 1800s. Shipbuilding and nautical iron parts led the state's burgeoning manufacturing sector. By the middle of the century, weather instruments and fertilizers helped expand the diversity of goods produced. In the 1900s, manufacturing grew again with the addition of metal refineries. The expansion has continued in the 21st Century with publishing, food, machinery, chemicals, automobiles, automotive parts, steel, solar panels, and the latest flu vaccines leading the way.

      (Source: http://www.bayindustrialgroup.com/2013/12/the-importance-of-marylands-manufacturing-industry/)

      The future success of manufacturing in the State of Maryland lies in its ability to remain highly competitive within the nation and the global economy. The survivors of the impending wave of change in manufacturing will be those industries and production lines that can lead and manage change with the introduction of advanced robotics and mechatronics. Maryland can remain a leader in Manufacturing by leading the nation in educating Manufacturing professionals to the highest level in the field. The University's Ph.D. in Manufacturing program will be produce those leaders with the technological expertise needed by the Manufacturing industry.

b. Societal needs, including expanding educational opportunities and choices for minorities and educationally disadvantaged students at institutions of higher education.

Capitol Technology University is a diverse multiethnic and multiracial institution with a long history of serving minority populations. The University has a 51% minority student population with 7% undisclosed. The Black/African American population is 34%. The university has military/veteran population of 22%. The University also has a 22% female population – a significant percentage given its status as a technology institution. If approved, the proposed Ph.D. in Manufacturing will expand the field of opportunities for minorities and disadvantaged students.

c. The need to strengthen and expand the capacity of historically black institutions to provide high quality and unique educational programs.

While Capitol Technology University is not a historically black institution, the university is a diverse multiethnic and multiracial institution with a long history of serving minority populations. The University has a 51% minority student population with 7% undisclosed. The Black/African American population is 34%. The University has military/veteran population of 22%. The university also has a 22% female population – a significant percentage given its status as a technology institution. If approved, the proposed Ph.D. in Manufacturing will expand the field of opportunities for minorities and disadvantaged students.

2. Provide evidence that the perceived need is consistent with the Maryland State Plan for Postsecondary Education.

The 2017-2021 Maryland State Plan for Postsecondary Education articulates three goals for postsecondary education:

1. Access
2. Success
3. Innovation

<u>Goal 1: Access</u>

"Ensure equitable access to affordable and quality postsecondary education for all Maryland residents."

Capitol Technology University is committed to ensuring equitable access to affordable postsecondary education for all Maryland residents. The University meets its commitment in this arena through its diverse campus environment, admissions policies, and academic rigor.

The Capitol Technology University community is committed to creating and maintaining a mutually respectful environment that recognizes and celebrates diversity among all students, faculty, and staff. The University values human differences as an asset and works to sustain a culture that reflects the interests, contributions, and perspectives of members of diverse groups. The University delivers educational programming to meet the needs of diverse audiences. We also seek to instill those values, understanding, and skills to encourage leadership and service in a global multicultural society.

The University's commitment to diversity is reflected in its student body. Capitol Technology University has a 51% minority student population with 7% undisclosed. The Black/African American population is 34%. The university has military/veteran population of 22%. The university also has a 17% female population – a significant percentage given its status as a technology university.

Achievement gaps: the University provides leveling courses in support of individuals attempting a career change to a field of study not necessarily consistent with their current skills. There are situations where additional graduate and/or undergraduate courses best serve student needs in subject areas. The university makes those courses available.

The University engages in diversity training for its institutional population, including students. Diversity and inclusiveness are built in to the curriculum allowing graduates to operate effectively in a global environment. The University supports multiple diversity enhancing actions, including team projects and grants across degrees. This has proven effective at supporting multiple aspects of diversity.

Capitol Technology University does not discriminate on the basis of race, color, national origin, sex, age, sexual orientation, or handicap in admission, employment, programs, or activities.

Through its academic programs, Capitol Technology University seeks to prepare all of its graduates to demonstrate four primary characteristics:

- **Employability:** The ability to enter and advance in technical and managerial careers, appropriate to their level and area of study, immediately upon graduation.
- **Communications:** Mastery of traditional and technological techniques of communicating ideas effectively and persuasively using aviation language and that for the wider audience.
- **Preparation of the Mind:** The broad intellectual grounding in technical and general subjects required to embrace future technical and managerial opportunities with success.
- **Professionalism:** Commitment to life-long learning, ethical practice and participation in professions and communities.

The proposed Ph.D. in Manufacturing program and University Financial Aid will be available to all Maryland residents who qualify academically for admission. The University has successfully managed supporting Financial Aid for doctorate students since its first doctoral courses started.

The Ph.D. in Manufacturing program, with its academic rigor, will produce the highest qualified Aviation professionals for this advancing field of study and employment. The university has a proven record of rigorous high-quality education. The University is fully accredited by three accrediting organizations. In addition to regional accreditation from the Middle States Commission on Higher Education (MSCHE), the university also has specialized accreditation from the International Accreditation Council of Business Education (IACBE) and Accreditation Board for Engineering and Technology (ABET). The Ph.D. in Manufacturing program is consistent with the MSCHE criteria for regional accreditation of the delivery of high quality higher education as well as the specialized IACBE accreditation requirements.

Goal 2: Success

"Promote and implement practices and policies that will ensure student success."

The courses for the Ph.D. in Manufacturing will be offered online. The online modality provides learning opportunities for students unable or unwilling to attend an on-campus institution of higher education. The University provides a tuition structure that is competitive with its competitors. The University tuition structure does not differentiate between in-state and out-of-state students. Student services are designed to provide advising, tutoring, virtual job fair attendance, and other activities supporting student completion and employment for both on-ground and online students.

Students receive information through admissions regarding the cost to attend the University. The information is also publicly available on the University website. Admissions and financial aid identify potential grants, scholarships, and state plans for each student to reduce potential student debt. The net cost versus gross costs are identified clearly for the student. Students receive advising from financial aid prior to enrolling in classes for the first time. Admissions, student services and the Dean of Doctoral Programs advise students of the need for academic readiness as well as the degree requirements. A specific success pathway is developed for each student.

The University's tuition increases have not exceeded 3%. The University also has a tuition lock, which means full-time tuition is locked at the rate applied at time of enrollment. The tuition remains at this rate if the student remains enrolled full-time without a break in attendance.

The University has in place services and learning tools to guide students to successful degree completion. Programs such as Early Alert provide the University's faculty and staff opportunities for early student intervention on the pathway to graduation. This applies to all students regardless of the mode of course delivery or degree program. Capitol Technology University is also a transfer friendly institution and participates in multiple programs for government and military credit transfer. Capitol Technology University participates in the Articulation System for Maryland Colleges and Universities (ARTSYS) and has multiple transfer agreements with local institutions at all degree levels.

The University has in place services, tutoring, and other tools to help ensure student graduation and successful job placement. The University hosts a career (job) fair twice a year. The University has an online career center available to all students covering such topics as career exploration, resume writing, job search techniques, social media management, mock interviews, and assistance interpreting job descriptions, offers, and employment packages.

The University also works with its advisory boards, alumni, partners, and faculty to help ensure the degrees offered at the University are compatible with long-term career opportunities in support of the state's knowledge-based economy.

Goal 3: Innovation

"Foster innovation in all aspects of Maryland higher education to improve access and student success."

Capitol Technology University's past, present, and future is inextricably intertwined with innovation. The University has a long tradition of serving as a platform for the use of new and transformative approaches to delivering higher education. New technology and cutting-edge techniques are blended with proven strategies with the goal of enabling student success in the classroom as well as in a successful career after graduation. As a small institution, Capitol Technology University has the agility to rapidly integrate new technologies into the curriculum to better prepare students for the work environment. The University designs curriculum in alliance with its accreditation and regulating organizations/agencies.

The University also employs online virtual simulations in a game-like environment to teach practical hands-on application of knowledge at all levels; for Manufacturing, this will include the four main production categories (i.e., casting and molding, machining, joining, and shearing and forming), additive manufacturing, advanced robotics, and advanced mechatronics engineering. The University is engaged with a partner creating high-level virtual reality environments for specific courses in the degree. This use of current technology occurs in parallel with traditional proven learning strategies. These elements of the University online learning environment are purposeful and intended to improve the learning environment for both the student and faculty member. In addition, these elements are intentionally designed to increase engagement, improve outcomes, and improve retention and graduation rates. The University believes that innovation is the key to successful student and faculty engagement.

Example: The University engages its students in 'fusion' projects, which allows students to contribute their skills in interdisciplinary projects such as those in our Astronautical Engineering and Cyber Labs. In those labs, students become designers, builders, and project managers (e.g., to send a CubeSAT on a NASA rocket) and data analysts (e.g., to analyze rainforest data for NASA). We are recruiting partners for this proposed degree in Aviation for which real projects will provide students potential research and integrative learning opportunities.

The University supports transfer of a limited number of graduate level courses appropriate to the degree. The university has some agreements with articulation partners for the transfer of graduate work (e.g., National Defense University).

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

1. **Describe potential industry or industries, employment opportunities, and expected level of entry (*ex: mid-level management*) for graduates of the proposed program.**

Opportunities exist at the highest levels in all sub-sectors of manufacturing, including production, machine tools, robotics, distribution, quality, and specialized areas. Manufacturing is the company profit center where revenue is generated. With the introduction of advanced technology, a Ph.D. in Manufacturing is needed now more than ever before. There are currently 3,696 jobs

listed on indeed.com where a Ph.D. in Manufacturing is required or desired.

(Source: https://www.indeed.com/q-PhD-Manufacturing-jobs.html)

Manufacturing experts predict this number will grow exponentially in the coming years as companies within each sub-sector face competitors that have revolutionized their production lines.

(Source: http://www.jobs2careers.com/results.php?q=Manufacturing+engineer&l=MD)

Graduates with the Ph.D. in Manufacturing will be expected to fill executive and senior-level management positions in manufacturing and production companies with titles such as:

- Chief Executive Officer
- Chief Operations Officer
- Chief Manufacturing Officer
- Chief Scientific Officer
- Technical Vice President
- Managing Director, Manufacturing Research Center
- Managing Director, Manufacturing & Design
- Transformational Manufacturing Executive
- Senior Vice President, Manufacturing
- Senior Vice President, Manufacturing Operations
- General Manager
- Operations Manager
- Chief Staff Scientist

Ph.D. in Manufacturing graduates will possess the highest level of expertise in the Manufacturing field, serve as subject matter experts, and possess the ability as top leaders to transform their sector of Manufacturing.

2. Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program.

The revolutionization of manufacturing is occurring every day now along multiple paths. However, the common element in all the paths is technology and the ability to lead and manage the related changes in a company.

> The changing economics of production and distribution, along with shifts in consumer demand and the emergence of "smart" products, are pushing manufacturers to explore radically new ways of creating and capturing value.
>
> Manufacturing is no longer simply about making physical products. Changes in consumer demand, the nature of products, the economics of production, and the economics of the supply chain have led to a fundamental shift in the way companies do business. Customers demand personalization and customization as the line between consumer and creator continues to blur. Added sensors and connectivity turn "dumb" products into "smart" ones, while products increasingly become platforms—and even move into the realm of services.

As technology continues to advance exponentially, barriers to entry, commercialization, and learning are eroding. New market entrants with access to new tools can operate at much smaller scale, enabling them to create offerings once the sole province of major incumbents. While large-scale production will always dominate some segments of the value chain, innovative manufacturing models—distributed small-scale local manufacturing, loosely coupled manufacturing ecosystems, and agile manufacturing—are arising to take advantage of these new opportunities.

Meanwhile, the boundary separating product makers from product sellers is increasingly permeable. Manufacturers are feeling the pressure—and gaining the ability—to increase both speed to market and customer engagement. And numerous factors are leading manufacturers to build to order rather than building to stock. In this environment, intermediaries that create value by holding inventory are becoming less and less necessary.

Together, these shifts have made it more difficult to create value in traditional ways. At the same time, as products become less objects of value in their own right and more the means for accessing information and experiences, creating and capturing value has moved from delivering physical objects to enabling that access.

These trends can affect different manufacturing sectors at different rates. To determine the speed and intensity of the coming shifts in a particular sector, companies should consider factors including the extent of regulation, product size and complexity, and the sector's level of digitization…

Agile manufacturing

For larger manufacturers, renewed interest in agile manufacturing is helping them remain competitive while staying responsive to increasingly fickle and unpredictable market signals. The key to this increased agility: a digital infrastructure that provides access to near-real-time point of sale (POS) data, rather than lagging monthly or quarterly sales reports.

The more accurate such forecasts are, the more sense it can make to choose highly efficient large production runs. However, when introducing a new product with less certainty of market acceptance, or making upgrades or changes to a product design, manufacturers may instead choose to focus on producing "minimal viable batch quantities," matching agile manufacturing practices with agility in the supply chain. Overseas production and freight shipping will force minimum manufacturing quantities to compensate for long lead times from production to customer. For smaller items, the cost of air freight and short fulfillment cycles may trump the cost of holding inventory, cost of capital, and obsolescence.

Taking all these factors into account, contract manufacturer PCH International demonstrates the benefits of agile manufacturing. In-house tracking technology allows the company to track each order from click to delivery in a single system, "managing to an order of one." PCH can also customize individual orders at the final assembly level. For Neil Young's high-end music device, the Pono Player, the buyer can choose a product color, select the signature of a favorite artist to be engraved on the casing, and

have his or her choice of music preloaded. Beyond using technology to support agility, the company has reengineered its manufacturing lines to be modular—and so easy to update that the minimum viable batch quantity equals the number of products produced on one manufacturing line during a single shift.

Faster speed to commercialization

While small manufacturers such as Pebble embrace a measured pace of development informed by community engagement, larger players are more likely to distinguish themselves through speed. And with ever more rapid shifts in consumer demand, speed to market is increasingly important. "Fast fashion" sellers such as TopShop, for example, credit their success in large part to optimizing manufacturing and the value chain to address changes in consumer tastes and demands.

With the success of such models, manufacturers have inevitably followed suit, working to compress time from idea to market. One major draw of manufacturing consumer electronics in Shenzhen [China] is "Shenzhen sudu" (Shenzhen speed), which allows sellers to capture market value almost as fast as it can be identified. For the Solowheel [a self-balancing electric unicycle], this resulted in development of dozens of lower-priced substitutes only weeks after the initial product was released. Today, such rapid speed to commercialization is poised to become the rule rather than the exception.

(Source: https://www2.deloitte.com/insights/us/en/industry/manufacturing/future-of-manufacturing-industry.html)

The seismic changes occurring in Manufacturing will create new opportunities for companies to achieve great success while others will inevitably fail – even if the past has been highly profitable. The keys to success involve coupling the latest technology, speed, customization, agility on every production line, and new business models.

The manufacturing landscape is undergoing a massive collective shift. Consumer demands, the nature of products, and the economics of production and distribution are all evolving. Boundaries are blurring between manufacturing and technology on one hand and manufacturing and retail on the other. While more value is being created, manufacturers are under increasing pressure. In this environment, capturing value requires fundamentally rethinking business models—remapping a company's strategic positioning based on internal capabilities, external shifts, and emerging influence points.

Several large incumbents are making moves in these directions. GE Aviation moved from selling jet engines to selling power by the hour, as a utility company would. And savvy startups are developing business models in alignment with the new manufacturing landscape. Xiaomi started with a direct-sales model that prioritized consumer relationships, then eventually expanded to include traditional retail channels. The company knew that the influence point was closeness to the consumer; owning that space allowed it to develop good terms with retailers.

The manufacturing landscape is facing dramatic changes. Creating and capturing value in this new environment will require understanding the factors driving change in specific manufacturing sectors, focusing on activities that convey a structural advantage,

leveraging the skills and capabilities of third parties, fundamentally rethinking business models, and identifying influence points.

(Source: https://www2.deloitte.com/insights/us/en/industry/manufacturing/future-of-manufacturing-industry.html)

Maryland is a center of manufacturing and has led the way in advanced manufacturing and technology. (Source: https://open.maryland.gov/industries/advanced-manufacturing/) Currently, there are over 2,700 manufacturing companies in the state. Given the state's current position and the massive changes underway in the manufacturing field, the University believes Maryland should seize the opportunity to be at forefront of educating the next generations of leaders in Manufacturing. The Ph.D. in Manufacturing program is designed to support Maryland in making this happen.

3. **Discuss and provide evidence of market surveys that clearly provide quantifiable and reliable data on the educational and training needs and the anticipated number of vacancies expected over the next 5 years.**

A 2018 Deloitte study shows the future needs in the manufacturing field and the requirements for a higher skill sets as well as leaders who have the highest abilities and can manage radical change.

> The manufacturing workforce has been absorbing new technology for more than two centuries. Today, the industry finds itself in the midst of the Fourth Industrial Revolution, which is poised to transform work at an unprecedented pace through exponential technologies such as artificial intelligence, advanced robotics and cognitive automation, advanced analytics, and the Internet of Things (IoT). And, contrary to some predictions, technology is likely to create more jobs than it destroys—as it has done historically. This is evident in the tight manufacturing labor market conditions prevailing both globally as well as in the United States.
>
> Additionally, the Fourth Industrial Revolution is creating a mismatch between available workers and the skills necessary for open jobs. In fact, Deloitte and The Manufacturing Institute anticipate the shortfall in US manufacturing during the next decade to reach the highest levels ever recorded, higher than the earlier estimates of 2 million unfilled jobs during 2015–2025. Part of the challenge the industry faces is understanding how today's jobs and associated skills are morphing into new jobs and career pathways that continue to evolve along with advanced technology.
>
> To help manufacturing leaders and workers visualize the possibilities of the future, we've developed a series of personas that describe what jobs could look like in 2025. We have chosen to describe these 2025 jobs from the vantage point of the workers themselves, exploring how their work has changed, what kinds of skills and career pathways they have, the types of digital tools that assist them in their work, and what a normal day on the job looks like.
>
> Bringing these future jobs to life can help business leaders, workers, educators, and policymakers shape their vision and spark conversations around what needs to change to

make this happen. These future personas represent our ongoing research on skills gaps and the future of work in manufacturing, and reflect several important themes:

Putting humans in the loop. As Deloitte's 2018 Global Human Capital Trends report explains, leading organizations are working hard to put humans in the loop—rethinking work architecture, retraining people, and rearranging the organization to leverage technology to transform business. The broader aim is not just to eliminate routine tasks and cut costs, but to create value for customers and meaningful work for people.

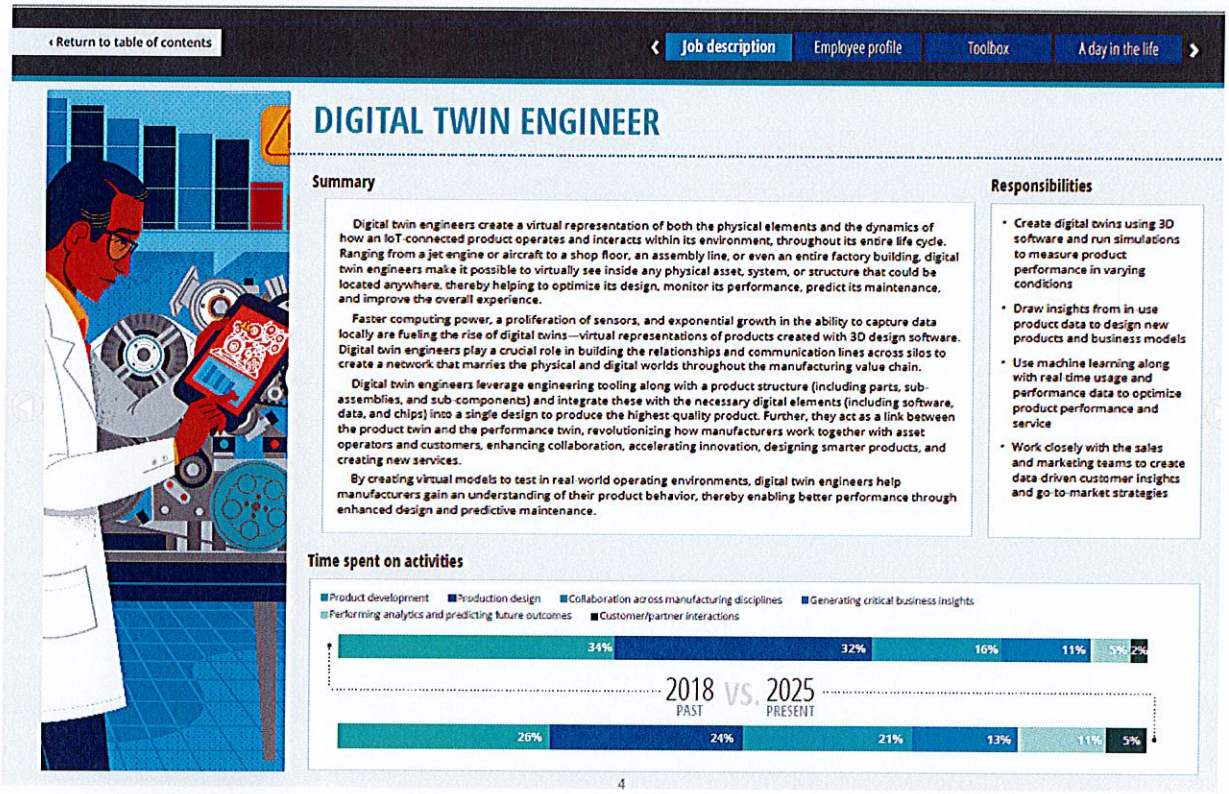
Expanding digital and "soft" skills. The rise of automation in the workplace has brought with it an interesting corollary for skills needed in human workers. As technology replaces many of the manual or repetitive tasks many jobs entail, it frees up space for skills that are uniquely human, often called "soft" skills. A recent World Economic Forum study found that the top 10 skills for the next decade include essential human skills such as critical thinking, creativity, and people management. Companies need workers that can exhibit these skills as well as the digital skills necessary to work alongside automation.

Leveraging the digital toolbox. Along with the move toward automation, robotics, and artificial intelligence, manufacturing workers are increasingly relying on digital tools to effectively complete their work. As the 2018 Global Human Capital Trends study shows, tools such as collaboration platforms, work-based social media, and instant messaging can increasingly support the communication necessary for higher productivity. We have created a "digital toolbox" for each of the personas to exemplify the types of tools a future worker can leverage to perform their daily work.

As digital transformation and the Fourth Industrial Revolution continue to redefine manufacturing jobs of the future, leaders and workers alike need to embrace a work environment that is expected to blend advanced technology and digital skills with uniquely human skills, to yield the highest level of productivity. Understanding how work might change can help the industry as a whole prepare for a future that promises to be transformative.

(Source: https://www2.deloitte.com/insights/us/en/industry/manufacturing/future-of-work-manufacturing-jobs-in-digital-era.html)

According to Deloitte, the highest-level leaders will be leading "personas" like the following "Digital Twin Engineer" and must have even more advanced skills:



The Fourth Industrial Revolution is changing the face of manufacturing at an accelerating pace. As a result, a new type of leadership is required – one that has been educated at the highest level and will help the industry change as it rapidly incorporates new technologies every year. The Ph.D. in Manufacturing will help place the State of Maryland at the forefront of the manufacturing revolution by producing graduates who trained at the highest level.

4. Data showing the current and projected supply of prospective graduates.

There are no Ph.D. or applied doctoral programs in Manufacturing in Maryland. There are also very few Ph.D. in Manufacturing programs in the nation. As a result, there is no current or projected supply of prospective graduates with a Ph.D. in Manufacturing. If approved, the Ph.D. in Manufacturing will send its graduates to the highest leadership positions in private industry, academia, and government with the ability to chart the course of their organization and its success in the future. The program graduates will be in the position to earn the maximum amount of income in Manufacturing and fill the requirement for its senior leaders to possess groundbreaking knowledge in the field.

D. Reasonableness of Program Duplication

1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

There are no Ph.D. or applied doctoral programs in Manufacturing in Maryland. There are also very few Ph.D. in Manufacturing programs in the nation. As a result, there is no current or

projected supply of prospective graduates with a Ph.D. in Manufacturing. If approved, the Ph.D. in Manufacturing will send its graduates to the highest leadership positions in private industry, academia, and government with the ability to chart the course of their organization and its success in the future. The program graduates will be in the position to earn the maximum amount of income in Manufacturing and fill the requirement for its senior leaders to possess groundbreaking knowledge in the field. Capitol Technology University's proposed Ph.D. in Manufacturing will be delivered online.

2. **Provide justification for the proposed program.**

   The Ph.D. in Manufacturing program is strongly aligned with the University's strategic priorities and is supported by adequate resources. The new Ph.D. in Manufacturing degree will strengthen and expand upon existing technology, management, and applied engineering degree programs at the University. In addition, the Ph.D. in Manufacturing program will be an option for all students as the field integrates well with the market needs of the University's other technical programs. The degree will present the opportunity for the most advanced study in a rapidly changing and technologically complex field that is experiencing the most profound change in its history. There is a thorough discussion of the need in Sections B and C of this document.

E. Relevance to high-demand programs at Historically Black Institutions (HBIs):

1. **Discuss the program's potential impact on the implementation or maintenance of high-demand programs at HBIs.**

   The University is not aware of any similar high-demand programs at the Maryland HBIs.

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

1. **Discuss the program's potential impact on the uniqueness and institutional identities and missions of HBIs.**

   The University is not aware of any impact on the uniqueness and institutional identities and missions of Maryland HBIs.

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

1. **Describe how the proposed program was established, and also describe the faculty who will oversee the program.**

   The University's New Programs Group established the proposed program through a rigorous review of unmet needs. The group includes selected representation from the faculty, University administrators, and Executive Council. The program will be overseen by a diverse faculty with backgrounds in Manufacturing Engineering, Cybersecurity, Computer Science, Mechanical Engineering, Environmental Science, Management, and Business. Please see Section I for a detailed list of the faculty's backgrounds.

2. **Describe educational objectives and learning outcomes appropriate to the rigor, breadth, and (modality) of the program.**

Educational Objectives:

a. Students will integrate and synthesize alternate, divergent, or contradictory perspectives or ideas fully within the field of Manufacturing.
b. Students will present scholarly work on Manufacturing via appropriate communication channels.
c. Students will apply advanced knowledge and competencies in Manufacturing.
d. Students will analyze existing theories to draw data-supported conclusions in Manufacturing.
e. Students will execute a plan to complete a significant piece of scholarly in Manufacturing.
f. Students will evaluate the safety, operational, social, economic, environmental, and ethical impact of actions within Manufacturing and demonstrate advanced knowledge and competency to integrate the results in the leadership decision-making process.
g. Students will plan and determine how to minimize Manufacturing's effects on pollution, noise, logistics, safety, environment, and local community.
h. Students will address the need for sustainability of operations to have limited impact on resources.

Learning Outcomes:

Upon graduation:

a. Graduates will evaluate the legal, social, economic, environmental, and ethical impact of actions within Manufacturing and demonstrate advanced knowledge and competency to integrate the results in the leadership decision-making process.
b. Graduates will demonstrate the highest mastery of traditional and technological techniques of communicating ideas effectively and persuasively.
c. Graduates will evaluate complex problems, synthesize divergent/alternative/contradictory perspectives and ideas fully, and develop advanced solutions to Manufacturing challenges.
d. Graduates will contribute to the body of knowledge in the study of Manufacturing.
e. Graduates will assess the impact Manufacturing has nationally and globally.
f. Graduates will analyze the effects of both expanding Manufacturing using the latest technological advances.
g. Graduates will plan Manufacturing systems that reflect the regional and national economics and safety requirements.
h. Graduates will contribute to improved quality of products and their use in society.
i. Graduates will develop plans that minimize pollution and waste.
j. Graduates will develop comprehensive plans to have optimize capacity with Just-in-Time and Resource Planning.

3. Explain how the institution will:

a) provide for assessment of student achievement of learning outcomes in the program

Capitol Technology University will assess student achievement of the learning outcomes per the regulations specified by two of the University's accreditation organizations: Middle States Commission on Higher Education (MSCHE) and International Accreditation Council for Business Education (IACBE).

Under MSCHE, the University will use Standard V, Educational Effectiveness Assessment, of the Standards for Accreditation and Requirements of Affiliation. Standard V requires:

> Assessment of student learning and achievement demonstrates that the institution's students have accomplished educational goals with their program of study, degree level, the institution's mission, and appropriate expectations for institutions of higher education.
>
> (Source: https://www.msche.org/?Nav1=About&Nav2=FAQ&Nav3=Question07)

Per the MSCHE's accreditation requirements, Capitol Technology University will measure Standard V by using the following criteria:

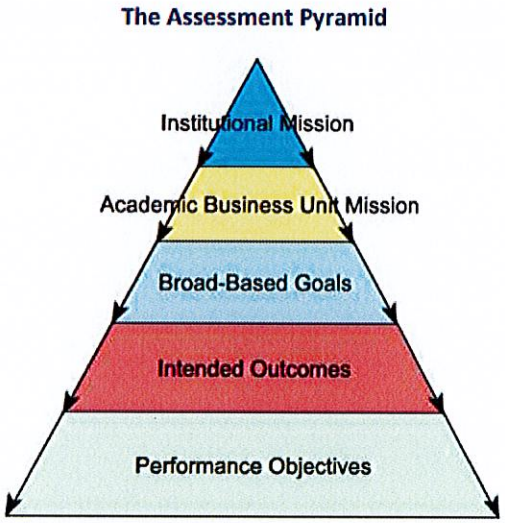
> An accredited institution possesses and demonstrates the following attributes or activities:
>
> 1. clearly stated educational goals at the institution and degree/program levels, which are interrelated with one another, with relevant educational experiences, and with the institution's mission;
>
> 2. organized and systematic assessments, conducted by faculty and/or appropriate professionals, evaluating the extent of student achievement of institutional and degree/program goals. Institutions should:
>
> a. define meaningful curricular goals with defensible standards for evaluating whether students are achieving those goals;
> b. articulate how they prepare students in a manner consistent with their mission for successful careers, meaningful lives, and, where appropriate, further education. They should collect and provide data on the extent to which they are meeting these goals;
> c. support and sustain assessment of student achievement and communicate the results of this assessment to stakeholders;
>
> 3. consideration and use of assessment results for the improvement of educational effectiveness. Consistent with the institution's mission, such uses include some combination of the following:
>
> a. assisting students in improving their learning;
> b. improving pedagogy and curriculum;
> c. reviewing and revising academic programs and support services;
> d. planning, conducting, and supporting a range of professional development activities;
> e. planning and budgeting for the provision of academic programs and services;
> f. informing appropriate constituents about the institution and its programs;
> g. improving key indicators of student success, such as retention, graduation, transfer, and placement rates;
> h. implementing other processes and procedures designed to improve educational programs and services;
>
> 4. if applicable, adequate and appropriate institutional review and approval of assessment services designed, delivered, or assessed by third-party providers; and

5. periodic assessment of the effectiveness of assessment processes utilized by the institution for the improvement of educational effectiveness.

(Source: https://www.msche.org/publications/RevisedStandardsFINAL.pdf)

Under IACBE, the University will also use IACBE's Assessment Pyramid to assess student achievement of the learning outcomes in the program:

The Assessment Pyramid below illustrates the general hierarchical relationships among mission, goals, outcomes, and objectives:



The Assessment Pyramid represents the flow from the institutional mission at the apex of the pyramid, which provides purpose and direction for the institution as a whole, followed by the mission of the academic business unit (and other academic units of the institution), and then down to the broad-based goals of the business unit, followed by intended outcomes, and then finally down to performance objectives associated with the intended outcomes at the base of the pyramid.

The widening and downward flow from the institutional mission in this hierarchical structure indicates that:

- The mission of the academic business unit flows from the institutional mission and should be consistent with and contribute to the institutional mission.
- The broad-based goals flow from the mission of the academic business unit with multiple goals associated with the business unit's mission and each goal relating to some aspect of the mission.
- Intended outcomes flow from the broad-based goals with multiple intended outcomes associated with each goal.
- Performance objectives flow from the intended outcomes with multiple objectives associated with each intended outcome.
- Consequently, evidence of accomplishment of desired results at a given level in the pyramid hierarchy would then constitute evidence of accomplishment of the desired results in the level above it.

Institutional and Academic Business Unit Mission

The institutional mission statement is a concise statement that defines the general purpose of the institution as a whole, provides direction for all of its activities and operations, and guides decision making for all of its academic and non-academic functional units. Similarly, the academic business unit mission statement provides direction for and guides decision making of the academic business unit. Furthermore, the mission of the business unit should be consistent and consonant with the institutional mission in the sense that each element of the business unit's mission should be associated with and contribute to some aspect of the institutional mission.

Broad-Based Goals vs. Intended Outcomes

Goals and intended outcomes are similar in that they describe desired results of the various activities of the business unit and establish the foundation for assessment. The difference between the two lies in the degree of specificity and measurability.
Goals are broad, clear, and general statements of what the academic business unit intends to accomplish in terms of student learning and operational effectiveness. They describe the general aims and aspirations of the business unit and provide the general framework for determining the more specific intended outcomes for the unit. In addition, they should be consistent with the academic business unit's mission in the sense that each broad-based goal should be associated with, contribute to, and mapped to some aspect of the unit's mission.

The main function of the goals is to provide a link between the academic business unit's broadly-stated mission and the more specific intended outcomes for the unit (as described in the discussion of the pyramidal structure above). The broad-based goals then become a blueprint for implementing the business unit's mission and for developing measurable intended outcomes relating to student learning and operational effectiveness. Goals are generally too broadly stated in order to be measurable in and of themselves. Therefore, intended outcomes need to be articulated in order to make the goals specific and to describe what the goals actually mean, i.e., in order to be able to determine the extent to which the goals have been met.

Intended outcomes are clear statements that describe in precise and measurable terms the specific, observable, and desired results pertaining to student learning and the operational effectiveness of the academic business unit. They flow from the academic business unit's broad-based goals and represent what students must specifically learn and what the academic business unit must achieve operationally in order to accomplish these goals. Consequently, each broad-based goal will usually have multiple intended outcomes associated with it. In addition, a particular intended outcome can support or contribute to the accomplishment of more than one goal.

Intended Outcomes vs. Performance Objectives

Once intended outcomes have been developed, the academic business unit must specify the ways in which it will measure the extent to which students and the business unit are achieving the intended outcomes. In other words, the specific instruments, tools, and metrics that will be used to assess the intended outcomes must be determined.
Whereas intended outcomes are expressed in terms of the specific knowledge, skills, and abilities that students are expected to acquire and in terms of the desired operational results of the academic business unit, performance objectives on the other hand are the

desired quantitative performance results (or performance targets) on the assessment instruments, tools, and metrics that are used to measure the intended outcomes. So, for example, if an academic business unit has defined an intended student learning outcome relating to the global dimensions of business and is measuring this outcome with a locally-developed examination (the assessment instrument), then a performance objective on this instrument for this outcome might be that 80% or more of the students will achieve a sub-score of at least 70% on the set of examination questions dealing with the international and global dimensions of business. Therefore, performance objectives are even more specific than intended outcomes in as much as they identify concrete quantitative targets for the assessment methods used to measure the achievement of the outcomes. Furthermore, each intended outcome should be capable of being measured by more than one assessment method, and would therefore have multiple performance objectives associated with it.

Summing Up

...As we move downward along the Assessment Pyramid, we progress from the broad and general to the narrow and specific. Intended outcomes and performance objectives provide the necessary degree of specificity and measurability required in order to determine the extent of student learning, operational effectiveness, and mission accomplishment.

(Source: http://iacbe.org/wp-content/uploads/2017/08/Outcomes-Assessment-Plan-Guidelines.pdf)

The following pages provide an example of how the IACBE Assessment Pyramid is implemented by the Capitol Technology University (using Capitol Technology University's current M.B.A. and M.S. in Information Systems Management programs). If approved, the Ph.D. in Manufacturing will use the same instruments with revisions tailored to the Ph.D. level.

OUTCOMES ASSESSMENT PLAN

Capitol Technology University

Department of Business and Information Sciences

Section I: Mission and Broad-Based Goals

MISSION STATEMENT

Mission of the Department of Business and Information Sciences:
Mission Statement: The mission of the School of Business and Information Sciences is to provide students a practical education in an environment supportive of academic excellence and high student achievement, preparing them to thrive in professional careers.

BROAD-BASED GOALS

Broad-Based Student Learning Goals:
1. **Employability:** Graduates will have an understanding of the difference between theory and practice and how to extract from theory and extend its application to real-world situations.
2. **Communications:** Graduates will be able to effectively communicate their ideas in both written and oral form (technical and non-technical) understanding that communication is a cooperative process in both the one-on-one and team environment.
3. **Preparation of the Mind:** Graduates will have a broad intellectual grounding in business and/or technology. Graduates will be able to analyze situations and successfully determine cause and effect. Graduates will know how to use contemporary research tools as well as more traditional methods to locate and analyze information and develop knowledge.
4. **Professionalism:** Graduates will have an understanding of their professional and ethical responsibilities. Graduates will have an understanding of the possible social, economic, cultural and environmental impact of their business and/or technical solutions in a global and social context. Graduates will recognize that lifelong learning is essential to the ongoing process of professional and personal development.

BROAD-BASED OPERATIONAL GOALS

Broad-Based Operational Goals:
1. The School of Business and Information Sciences will be successful in retaining its students based on the University's historical data. (see pg. 13)

2. The School of Business and Information Sciences will recruit, retain and develop qualified faculty committed to academic excellence.
3. The School of Business and Information Sciences will provide students a practical hands-on education.
4. The School of Business and Information Sciences will offer strong, comprehensive, and contemporary degree programs that successfully prepare students for academic and professional careers, graduate school and professional advancement.
5. The School of Business and Information Sciences will provide a supportive learning environment that fosters student success and contributes to excellence in business education.

Section II: Student Learning Assessment

STUDENT LEARNING ASSESSMENT: MASTER'S-LEVEL PROGRAMS

Student Learning Assessment for Master of Business Administration (MBA)
Program Intended Student Learning Outcomes (Program ISLOs)
1. Graduates will be able to identify organization problems and use information systems, technology, financial and accounting techniques, marketing research, and other decision-making tools to strategically analyze and solve business problems in a global environment. Broad-Based Student Learning Goals Associated with this Outcome: *1, 3* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *1, 2, 3*
2. Graduates will be able to employ quantitative techniques and methods and interpret the results in the analysis of real-world business situations. Broad-Based Student Learning Goals Associated with this Outcome: *3* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *3*
3. Graduates will be able to communicate effectively in multiple forms in a convincing and persuasive manner. Broad-Based Student Learning Goals Associated with this Outcome: *2* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *4*

4. Graduates will be able to collaborate effectively with a team of colleagues on diverse projects. Broad-Based Student Learning Goals Associated with this Outcome: *2, 3* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *5*	
5. Graduates will be able to deduce the ethical obligations and responsibilities of business in a leadership role. Broad-Based Student Learning Goals Associated with this Outcome: *4* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *6*	
6. Graduates will be able to differentiate and synthesize discipline-based knowledge as well as hypothesize the interrelationships of the specific areas of study. Broad-Based Student Learning Goals Associated with this Outcome: *1, 2, 3* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *2*	
7. Graduates will develop leadership skills and demonstrate the ability to become a change agent in a complex global economy. Broad-Based Student Learning Goals Associated with this Outcome: *1, 3* Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: *1, 2, 3,4*	
Assessment Instruments for Intended Student Learning Outcomes— Direct Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Direct Measures:**
1. Capstone Strategic Management (MBA 650) Case Study Program ISLOs Assessed by this Measure: *1, 2, 3, 4, 5, 6, 7*	At least 75% of the students will score 75% or higher. Rubric: See Appendix A, C, D In addition to the rubric each case study has solution against which all students are graded. This is case specific.
2. Capstone Senior Project (MBA 700) Program ISLOs Assessed by this Measure: *1, 2, 4, 5, 6*	At least 75% of graduating seniors will score 75% or higher. Rubric: See Appendix B, C, D
Assessment Instruments for Intended Student Learning Outcomes— Indirect Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Indirect Measures:**
1. Graduating Student Survey (Graduate) Program ISLOs Assessed by this Measure: 1, 2, 3 4, 5, 6, 7	On the exit survey instrument, at least 75% of graduating seniors in management will indicate that they were "successful" or "very successful" in achieving the intended learning outcomes for the major in business.

	Instrument: See Appendix E
2. End-of-course survey (contains overall course and curriculum questions) Program ISLOs Assessed by this Measure: *1, 2, 3, 4, 5, 6, 7*	At least 75% of the students agree or strongly agree that the overall quality of the course has met their expectations of quality and intended learning outcomes of the course. Instrument: See Appendix F

Section III: Operational Assessment

INTENDED OPERATIONAL OUTCOMES: SCHOOL OF BUSINESS AND INFORMATION SCIENCES

Intended Operational Outcomes for the School of Business and Information Sciences:
1. The School of Business and Information Sciences will be successful in placing its undergraduates in appropriate entry-level positions or in graduate school on an annual basis. Broad-Based Operational Goals Associated with this Outcome: *4*
2. Faculty members in the School of Business and Information Sciences will engage in appropriate professional development activities on an annual basis. Broad-Based Operational Goals Associated with this Outcome: *2*
3. The School of Business and Information Sciences will be successful in providing high-quality instruction to its students. Broad-Based Operational Goals Associated with this Outcome: *4*
4. The School of Business and Information Sciences will be successful in providing high-quality advising to its students. Broad-Based Operational Goals Associated with this Outcome: *5*
5. Students in the School of Business and Information Sciences will participate in relevant internships on an annual basis. Broad-Based Operational Goals Associated with this Outcome: *3, 4*
6. The School of Business and Information Sciences will provide a practical hands-on experience. Broad-Based Operational Goals Associated with this Outcome: *3*

7. The School of Business and Information Sciences will be successful in retaining its students on an annual basis. Broad-Based Operational Goals Associated with this Outcome: 1	
8. The School of Business and Information Sciences will be successful in contributing to the professional advancement of its MBA and MSISM graduates. Broad-Based Operational Goals Associated with this Outcome: *4*	
Assessment Measures/Methods for Intended Operational Outcomes:	**Performance Objectives (Targets/Criteria) for Operational Assessment Measures/Methods:**
1. *Report of the Office of Career Services and Graduate Student Support* Intended Operational Outcomes Assessed by this Measure: 1, 8	*The School of Business and Information Sciences will place 75% or more of its undergraduate students in degree related positions or in graduate school within nine months of graduation.*
2. *Graduating Student Survey* Intended Operational Outcomes Assessed by this Measure: 3	*At least 75 % of graduating students agreed or strongly agreed that the University provided high quality instruction.*
3. *Performance Review* Intended Operational Outcomes Assessed by this Measure: *2*	*At least 75% of full-time faculty will participate in professional development activities (webinars, publication, conferences, workshops) on an annual basis.* *At least 50% part-time faculty will participate in professional development activities (webinars, publication, conferences, workshops) on an annual basis.*
4. *Continuation Rates Report* Intended Operational Outcomes Assessed by this Measure: *7*	*At least 50% will graduate.*
5. *Course Survey—to include only those questions related to student satisfaction with course instruction and academic advising* Intended Operational Outcomes Assessed by this Measure: 3, 4, 6	*At least 75% of students will agree or strongly agree that they were provided high quality instruction in the course.* *At least 75% of students will agree or strongly agree that they were provided high quality advising.* *At least 75% will agree or strongly agree that they were provided hands on experiences.*
6. *Internship Report*	*At least 40% of the students will participate in internships.*

Intended Operational Outcomes Assessed by this Measure: 5	

b) document student achievement of learning outcomes in the program

The University will document student achievement of the learning outcomes in the Ph.D. in Manufacturing program in the same fashion as its current programs. The University will also publicly post the results of the assessment on its website per IACBE accreditation requirements.

The following pages are an example of the University's public disclosure of its assessment of the learning outcomes (for programs under IACBE):

Report of Student Learning and Achievement

Capitol Technology University
Department of Business and Information Sciences

For Academic Year: 2015-2016

Mission of the Department of Business and Information Sciences
The mission of the Department of Business and Information Sciences is to provide students a practical education in an environment supportive of academic excellence and high student achievement, preparing them to thrive in professional careers.

Student Learning Assessment for the Master of Business Administration (MBA)
Program Intended Student Learning Outcomes (Program ISLOs)
1. Graduates will be able to identify organization problems and use information systems, technology, financial and accounting techniques, marketing research, and other decision-making tools to strategically analyze, assess, and devise solutions to business problems in a global environment.
2. Graduates will be able to employ quantitative techniques and methods and interpret the results in the analysis of real-world business situations.
3. Graduates will be able to communicate effectively in multiple and present arguments in a convincing and persuasive manner.
4. Graduates will be able to collaborate effectively with a team of colleagues on diverse projects.
5. Graduates will be able to deduce the ethical obligations and responsibilities of a business in a leadership role.
6. Graduates will be able to differentiate and synthesize discipline-based knowledge as well as hypothesize the interrelationships of the specific areas of study.

7. Graduates will develop leadership skills and demonstrate the ability to become a change agent in a complex global economy	
Assessment Instruments for Intended Student Learning Outcomes—Direct Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Direct Measures:**
1. Capstone Strategic Management (MBA 650) Case Study Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7	At least 80% of the students will score 80% or higher on the case study evaluation rubric.
2. Capstone Project (MBA 700) Program ISLOs Assessed by this Measure: 1, 2, 4, 5, 6	At least 80% of graduating MBA students will score 80% or higher on the Capstone Project evaluation rubric.
Assessment Instruments for Intended Student Learning Outcomes—Indirect Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Indirect Measures:**
1. Graduating Student Survey (Graduate) Program ISLOs Assessed by this Measure: 1, 2, 3 4, 5, 6, 7	On the exit survey instrument, at least 75% of the MBA graduates will indicate that they were "successful" or "very successful" in achieving the intended learning outcomes for the major in business.
2. End-of-course survey (contains overall course and curriculum questions) Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7	At least 70% of the students agree or strongly agree that the overall quality of the course has met their expectations of quality and intended learning outcomes of the course.
Assessment Results: Master of Business Administration (MBA)	
Summary of Results from Implementing Direct Measures of Student Learning:	
1. <u>Capstone Strategic Management (MBA 650) Case Study</u>: Percentage of Students Achieving a Score of 80% or Higher on the Capstone Strategic Management Case Study:	

Capstone Strategic Management Case Study (Program ISLO 1, 2, 3, 4, 5, 6, 7): 100% of Total (Class average score: 90.8%)

2. Capstone Project (MBA 700):

Percentage of Students Achieving a Score of 80% or Higher on the Capstone Project:

Capstone Project (Program ISLO 1, 2, 3, 4, 5, 6, 7): 100% of Total (Class average score: 96.6%)

Summary of Results from Implementing Indirect Measures of Student Learning:

1. Graduating Student Survey (Graduate):

Not Assessed: the response rate was not statistically significant.

2. End-of-course Survey:
(contains overall course questions, curriculum questions, and percentage of students who "agree" and "strongly agree")

1.	The instructor was well prepared to present and discuss course material.	96.4%
2.	The instructor presented content in a systematic and organized fashion, relating parts to the whole.	97.5%
3.	The instructor used supplemental technology to present material (ex., audio visual aids, Canvas, www, etc.)	95.7%
4.	The instructor posed questions to students designed to promote critical thinking and analysis.	90.4%
5.	The instructor promoted free-flow of communication: instructor and student, and between students.	97.5%
6.	The instructor introduced divergent viewpoints in areas where different points of view exist.	92.5%
7.	The instructor clarified abstract and complex ideas, using examples within students	91.5%

8.	The instructor periodically evaluated students.	90.3%
9.	The instructor assigned homework which reinforces the lecture materials.	95%
10.	The instructor provided useful feedback on submitted materials.	91.4%
11.	The instructor was available outside of scheduled class hours.	92.8%
12.	Course objectives were clearly defined.	97.6%
13.	Dates for the submission of major materials were specified.	98.8%
14.	Guidelines and requirements for presentations and written assignments were clearly stated.	97.5%
15.	Clear, well-developed policies and procedures for evaluating student performance and grading were explained.	96.3%
16.	Expectations of students including, but not limited to attendance, make-up work, and honor code policies were clearly explained.	97.6%
17.	The course objectives were accomplished.	94.2%
18.	Exams and quizzes were designed to test the course outcomes (covered appropriate subject matter).	95.3%
19.	The required text(s) were valuable in contributing to my overall understanding of the course content.	89.6%
20.	The labs demonstrated and reinforced the course objectives.	92.5%

Summary of Achievement of Intended Student Learning Outcomes:

Intended Student Learning Outcomes	Learning Assessment Measures							
Program ISLOs	*Direct Measure 1*	*Direct Measure 2*	*Direct Measure 3*	*Direct Measure 4*	*Indirect Measure 1*	*Indirect Measure 2*	*Indirect Measure 3*	*Indirect Measure 4*
	Performance Target Was...	Performance Target Was...	Performance Target Was...	Performance Target Was...	Performance Target Was...	Performance Target Was...	Performance Target Was...	Performance Target Was...
1. Graduates will be able to identify organization problems and use information systems, technology, financial	Met	Met			NA	Met		

and accounting techniques, marketing research, and other decision-making tools to strategically analyze, assess, and devise solutions to business problems in a global environment.						
2. Graduates will be able to employ quantitative techniques and methods and interpret the results in the analysis of real-world business situations.	Met	Met		NA	Met	
3. Graduates will be able to communicate effectively in multiple and present arguments in a convincing and persuasive manner.	Met	Met		NA	Met	
4. Graduates will be able to collaborate effectively with a team of colleagues on diverse projects.	Met	Met		NA	Met	
5. Graduates will be able to deduce the ethical obligations and responsibilities of a business in a leadership role.	Met	Met		NA	Met	

6. Graduates will be able to differentiate and synthesize discipline-based knowledge as well as hypothesize the interrelationships of the specific areas of study.	Met	Met			NA	Met		
7. Graduates will develop leadership skills and demonstrate the ability to become a change agent in a complex global economy	Met	Met			NA	Met		

Proposed Courses of Action for Improvement in Learning Outcomes for which Performance Targets Were Not Met:

1. Indirect Measure 1: The university will implement an improved administrative procedure prior to 2018 Commencement that requires master's degree graduates to answer the Graduating Student Survey.

Student Learning Assessment for the Master of Science in Information Systems Management (MSISM)
Program Intended Student Learning Outcomes (Program ISLOs)
1. Graduates will be able to identify organization problems and use information systems, technology, project management, and other decision-making tools to strategically analyze, assess, and devise solutions to business problems in a global environment.
2. Graduates will develop leadership skills and demonstrate the ability to become a change agent in a complex global economy.
3. Graduates will be able to communicate effectively in multiple forms and demonstrate the ability to devise plans of action for real-world business challenges.
4. Graduates will be able to the ethical obligations and responsibilities of a business in a leadership role.
5. Graduates will be able to employ information systems, technology, and other decision-making tools and interpret the results in

analyzing and providing solutions to business problems in a global business environment.	
6. Graduates will be able to define and conceptualize opportunities for enhanced information analysis and exploitation in order to facilitate business planning and execution.	
7. Graduates will be able to collaborate effectively with a team of colleagues on diverse projects.	
Assessment Instruments for Intended Student Learning Outcomes—Direct Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Direct Measures:**
1. Capstone Project (SM 569) Project Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7	At least 80% of the students will score 80% or higher on the Capstone Project evaluation rubric.
Assessment Instruments for Intended Student Learning Outcomes—Indirect Measures of Student Learning:	**Performance Objectives (Targets/Criteria) for Indirect Measures:**
1. Graduating Student Survey (Graduate) Program ISLOs Assessed by this Measure: 1, 2, 3 4, 5, 6, 7	On the exit survey instrument, at least 75% of the MSISM graduates will indicate that they were "successful" or "very successful" in achieving the intended learning outcomes for the major in business.
2. End-of-course survey (contains overall course and curriculum questions) Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7	At least 70% of the students "agree" or "strongly agree" that the overall quality of the course has met their expectations of quality and intended learning outcomes of the course.
Assessment Results: Master of Science in Information Systems Management (MSISM)	
Summary of Results from Implementing Direct Measures of Student Learning:	
1. <u>Capstone Project (SM 569) Project</u>: Percentage of Students Achieving a Score of 80% or Higher on the Capstone Project:	

Capstone Project (Program ISLO 1, 2, 3, 4, 5, 6, 7): 100% of Total (Class average score: 96.5%)

Summary of Results from Implementing Indirect Measures of Student Learning:

1. Graduating Student Survey (Graduate):

   Not Assessed: the response rate was not statistically significant.

2. End-of-course Survey:
   (contains overall course questions, curriculum questions, and percentage of students who "agree" and "strongly agree")

1.	The instructor was well prepared to present and discuss course material.	94.2%
2.	The instructor presented content in a systematic and organized fashion, relating parts to the whole.	93.3%
3.	The instructor used supplemental technology to present material (ex., audio visual aids, Canvas, www, etc.)	94.2%
4.	The instructor posed questions to students designed to promote critical thinking and analysis.	90%
5.	The instructor promoted free-flow of communication: instructor and student, and between students.	90%
6.	The instructor introduced divergent viewpoints in areas where different points of view exist.	87.5%
7.	The instructor clarified abstract and complex ideas, using examples within students	91.7%
8.	The instructor periodically evaluated students.	90.8%
9.	The instructor assigned homework which reinforces the lecture materials.	94.2%
10.	The instructor provided useful feedback on submitted materials.	81.7%
11.	The instructor was available outside of scheduled class hours.	88.3%
12.	Course objectives were clearly defined.	96.7%
13.	Dates for the submission of major materials were specified.	88.3%
14.	Guidelines and requirements for presentations and written assignments were clearly stated.	96.7%

15.	Clear, well-developed policies and procedures for evaluating student performance and grading were explained.	90%
16.	Expectations of students including, but not limited to attendance, make-up work, and honor code policies were clearly explained.	96.7%
17.	The course objectives were accomplished.	100%
18.	Exams and quizzes were designed to test the course outcomes (covered appropriate subject matter).	96.7%
19.	The required text(s) were valuable in contributing to my overall understanding of the course content.	97.5%
20.	The labs demonstrated and reinforced the course objectives.	93.3%

Summary of Achievement of Intended Student Learning Outcomes:

Intended Student Learning Outcomes	Learning Assessment Measures							
Program ISLOs	***Direct Measure 1***	***Direct Measure 2***	***Direct Measure 3***	***Direct Measure 4***	***Indirect Measure 1***	***Indirect Measure 2***	***Indirect Measure 3***	***Indirect Measure 4***
	Performance Target Was...	**Performance Target Was...**	**Performance Target Was...**	**Performance Target Was...**	**Performance Target Was...**	**Performance Target Was...**	**Performance Target Was...**	**Performance Target Was...**
1. Graduates will be able to identify organization problems and use information systems, technology, project management, and other decision-making tools to strategically analyze, assess, and devise solutions to business problems in a global environment.	Met	[redacted]			NA	Met	[redacted]	
2. Graduates will develop leadership skills and demonstrate the ability to	Met	[redacted]			NA	Met	[redacted]	

become a change agent in a complex global economy.					
3. Graduates will be able to communicate effectively in multiple forms and demonstrate the ability to devise plans of action for real-world business challenges.	Met		NA	Met	
4. Graduates will be able to the ethical obligations and responsibilities of a business in a leadership role.	Met		NA	Met	
5. Graduates will be able to employ information systems, technology, and other decision-making tools and interpret the results in analyzing and providing solutions to business problems in a global business environment.	Met		NA	Met	
6. Graduates will be able to define and conceptualize opportunities for enhanced information analysis and exploitation in order to facilitate business planning and execution.	Met		NA	Met	

7. Graduates will be able to collaborate effectively with a team of colleagues on diverse projects.	Met	[redacted]	NA	Met	[redacted]

Proposed Courses of Action for Improvement in Learning Outcomes for which Performance Targets Were Not Met:

1. Indirect Measure 1: The university will implement an improved administrative procedure prior to 2018 Commencement that requires master's degree graduates to answer the Graduating Student Survey.

4. **Provide a list of courses with title, semester credit hours and course descriptions, along with a description of program requirements.**

Program description, as it will appear in the catalog:

The Doctor of Philosophy (Ph.D.) in Manufacturing provides students with the opportunity to conduct extensive and sustained original research at the highest level in the field of Manufacturing. The Ph.D. in Manufacturing is a unique interdisciplinary program designed to meet the demand for the highest skilled professionals to become the leaders who will direct the transformational development, logistics, operational usage, support and associated areas for the sector. The Ph.D. in Manufacturing provides students a unique avenue to pursue a deep proficiency in this arena. Graduates will contribute significantly to the Manufacturing field through the creation of new knowledge and ideas. They will contribute to the body of knowledge at a critical point in history as the entire sector expands and uses technology to change and evolve. The Ph.D. in Manufacturing program is designed as a doctorate by research where students will quickly engage in research and publishing. This degree is for current professionals in the field who desire to elevate their skills to the highest level and contribute to the body of knowledge in Manufacturing.

Description of program requirements:

Entrance Requirements

To be accepted into the Ph.D. in manufacturing program, students must have completed an appropriate Master's degree with a cumulative GPA of no less than 3.0 on a 4.0 scale. Students must also possess a high level of expertise in the Manufacturing field, or a closely related field, and show the academic promise of their future ability to produce original research of publishable quality (suitable for a scholarly peer-reviewed journal or publication and presentation of high stature).

Students must also provide a prospectus of at least 750 words that details their existing expertise and preparation for success in conducting original research within Capitol Technology University's Ph.D. in manufacturing program. International students are required to take the TOEFL and score at least 550 on the paper-based test or 79 on the internet-based test.

Degree Requirements:

The Ph.D. in manufacturing program is designed for students with an appropriate Master's degree and experience. During the program, students will conduct original research in an approved area of Manufacturing. Successful completion of the program culminates in the award of the Doctor of Philosophy (Ph.D.) in Manufacturing degree.

There are two options for completion of the Ph.D. in Aviation program. Under the thesis option, the student will produce, present, and defend a doctoral dissertation after receiving the required approvals from the student's Committee and the Ph.D. Review Board. Under the publication

option, the student will produce, present, and defend their original doctoral research after receiving the required approvals from the student's Committee and the Ph.D. Review Board. The student must also publish three works of original research in a scholarly peer-reviewed journal(s). One of the three published works may be in a peer reviewed conference proceeding.

Degree Requirements:

The following is a list of courses for the Ph.D. in Manufacturing degree. Students expecting to complete this degree must meet all prerequisites for the courses listed below.

Doctor of Philosophy in Manufacturing
Courses
Total Credits: 60

MANUFACTURING DOCTORAL CORE: 30 CREDITS

MAF-800 – Manufacturing Research Background (6 credits)
The student will focus on the study of Manufacturing process and developments over the previous decades. The course will assist the student in synthesizing how demand and technology have led to the current systems and procedures. The student will explore current operations within a global context as well as areas improvement for the future. The focus will be to start identifying areas for research at a later stage and explore the background. Prerequisite: None.

MAF-810 - Manufacturing Research Methodologies (6 credits)
The student will evaluate and develop research methodologies and strategies suitable for Manufacturing and address the data sources and information to test a hypothesis or research question. It is expected the student will be building upon MAF 800 in refining and developing their research task and plan. Prerequisite: MAF 800.

MAF-820 – Manufacturing Future Demands (6 credits)
The student will research the future demands on a regional, national and global level and how these influence the specific research questions and demands. Data collection and applications will be central to evaluating the needs of Manufacturing on the short, medium and long term. Prerequisite: MAF 810.

MAF-830 - Strategies for Manufacturing (6 credits)
The student will undertake a robust and comprehensive analysis of the strategies for preparation, protection, and resilience of Manufacturing. Students will be introduced to the influences of economics and politics that dictate manufacturing planning based upon non-technical aspects and requirements (e.g., how noise pollution dictates design and efficiency as well as operations). Prerequisite: MAF 810.

MAF-840 - Manufacturing Research Proposal (6 credits)
The student will produce a proposal for research that is comprehensive in detail and planning. The proposal will address the research topic, scope and aims, objectives and a timing plan. The doctoral student will then complete the research milestones according to the proposal and research plan. Prerequisite: MAF 830.

MANUFACTURING DOCTORAL RESEARCH AND WRITING: 30 CREDITS

MAF-900 - Manufacturing Doctoral Writing I (6 credits)
The student will compose and complete Chapters 1 and 2 within the boundaries of the proposal and research plan. Chapters 1-2 will be reviewed by the student's Chair and Committee and must be approved for the student to advance. Prerequisite: MAF 850.

MAF-910 – Manufacturing Doctoral Writing II (6 credits)
The student will compose and complete Chapter 3 within the according to the approved proposal. The student will also submit Chapters 1-3 to the Institutional Review Board (IRB) and Academic Review Board (ARB). After receiving the necessary approvals, the student will conduct data collection and analysis activities consistent with the research plan. Prerequisite: MAF 900.

MAF-920 - Manufacturing Doctoral Writing III (6 credits)
The student will compose and complete Chapter 4. The student will provide a complete and substantive presentation of the research results in Chapter 4. The student's Chair and Committee must review and approve Chapter 4 for the student to advance. Prerequisite: MAF 910.

MAF-930 – Manufacturing Doctoral Writing IV (6 credits)
The student will compose and complete Chapter 5 and submit the work to the student's Chair and Committee. The student will also finalize all required elements of their research. The student's Chair and Committee must review and approve the complete document. The student's Chair and Committee will then submit the complete document to the University Reviewers and Ph.D. Review Board for approval. The student must receive approval from the University Reviewers and Ph.D. Review Board to advance forward. Prerequisite: MAF 920.

MAF-940 – Manufacturing Doctoral Defense (6 credits)
Upon approval from the University Reviewers and Ph.D. Review Board, the student will prepare and deliver an oral presentation summarizing the body of research and defend the same through viva voce (i.e., oral examination). The student's Chair, Committee and Ph.D. Review Board will confer to determine if the student has provided a sufficient and necessary final oral defense of the research. Prerequisite: MAF 930.

5. **Discuss how general education requirements will be met, if applicable.**

   N/A. This is a graduate program.

6. **Identify any specialized accreditation or graduate certification requirements for this program and its students.**

   The program will be accredited regionally by Middle States Commission on Higher Education (MSCHE). The program will also receive specialized accreditation by International Accreditation Council for Business Education (IACBE) for its management and leadership content. Capitol Technology University is currently accredited by MSCHE and IACBE and in good standing with both organizations.

7. **If contracting with another institution or non-collegiate organization, provide a copy of the written contract.**

The university will not be contracting with another institution or non-collegiate organization.

8. **Provide assurance and any appropriate evidence that the proposed program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, learning management system, availability of academic support services and financial aid resources, and costs and payment policies.**

   The Ph.D. in Manufacturing program will provide students with clear, complete, and timely information on the curriculum, course and degree requirements, nature of faculty/student interaction, assumptions about technology competence and skills, technical equipment requirements, Learning Management System, availability of academic support services and financial aid resources, and costs and payment policies.

   Curriculum, course and degree information will be available on the university website and via e-mail as well as regular mail (by request). The expectations on faculty/student interaction are available to students during virtual open house events, literature, website, etc. In addition, this information is part of the material distributed for each course. Students receive guidance on proper behavior/interaction with their Chair and Ph.D. Committee members as well as the online environment to facilitate a high-level doctoral learning experience. Technology competence and skills and technical equipment requirements are part of the material distributed for each course. The technical equipment requirements are also listed on our website and provided to students in the welcome package.

   The University's academic support services, financial aid resources, costs and payment policies, and Learning Management System are covered in the University open houses, application process, welcome aboard process, orientation, student town halls, and individual counseling.

9. **Provide assurance and any appropriate evidence that advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available.**

   The Ph.D. in Manufacturing program's advertising, recruiting, and admissions materials will clearly and accurately represent the proposed program and the services available. The material for every new program is derived from the new program request sent to the Maryland Higher Education Commission.

H. Adequacy of Articulation:

1. **If applicable, discuss how the program supports articulation with programs at partner institutions. Provide all relevant articulation agreements.**

   This program does not currently have articulation partners. However, the articulation process will work as it does for the University's current degrees. The University is very active with its transfer partners throughout the state and beyond. The goal of the University is to work with partners to make transfer as seamless as possible and to maximize the student's transfer credits as allowable. There are transfer admissions personnel to guide the student through the process.

I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11):

1. **Provide a brief narrative demonstrating the quality of the program faculty. Include a summary list of the faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach.**

   All faculty listed below have been engaged with the University for at least several years. Dr. Abu-Ageel, Dr. Antunes, Dr. Bajracharya, Dr. Bajwa, Dr. Baker, Dr. Butler, Dr. McAndrew, Dr. Pitman, and Dr. Sims are fulltime faculty members. All of the faculty members hold terminal degrees. The University leadership is confident in the quality of the faculty and their abilities to provide a learning environment supportive of the University goals for student success. Additional doctorally-qualified faculty will be added as needed.

Instructors who will be engaged with the Ph.D. in Manufacturing are:

INSTRUCTOR	BACKGROUND	COURSES ALIGNED TO BE TAUGHT
Dr. Nayef Abu-Ageel Full-time	Ph.D. Electrical and Computer Engineering M.S. Electrical Engineering B.S. Electrical Engineering	All MAF 900 courses
Dr. Tariq Abughazaleh Adjunct	Ph.D. Technology M.Sc. Quality Engineering B.S Mechanical Engineering	All MAF 800 and 900 courses
Dr. Alex "Sandy" Antunes Full time	Ph.D. Computational Sciences and Informatics M.S. Astronomy B.S. Astronomy	All MAF 800 and 900 courses
Dr. Chandra Bajracharya Full time	Ph.D. Electrical and Computer Engineering M.S. Applied Computing M.S. Electrical Power Engineering B.E. Electrical Engineering	All MAF 900 courses
Dr. Garima Bajwa Full time	Ph.D. Computer Science and Engineering M.S. Electrical and Computer Engineering B.S. Electronics and Communication Engineering	All MAF 900 courses
Dr. Richard Baker Full time	Ph.D. Information Systems M.S. Computer Science B.S. Mathematics F-4 Pilot	All MAF 800 and 900 courses
Dr. Hasna Banu Adjunct	Ph.D. Theoretical Physics M.S. Mathematics B.S. Mathematics	All MAF 800 and 900 courses

Dr. Simon Barrens Adjunct	Ph.D. Engineering M.S. Engineering Physics B.S. Physics and Nuclear Engineering	All MAF 800 and 900 courses
Dr. Kristen Broz Adjunct	J.D. Law B.A. History and English	All MAF 900 courses
Dr. William Butler Full time	D.Sc. Cyber Security M.S. Strategic Studies B.S. Computer Science NSTISSI No. 4011 CNSSI No. 4012 NSTISSI No. 4015 CNSSI No. 4016	All MAF 900 courses
Dr. Craig Capano Adjunct	Ph.D. Civil Engineering with Concentration in Construction Engineering and Management and focus on Business M.C.S.M. (Master of Construction Science and Management) B.S. Construction Management A.S. Architectural Engineering	All MAF 800 and 900 courses
Dr. Jami Carroll Adjunct	D.Sc. Cyber Security M.S. Cyber Security M.B.A.	All MAF 900 courses
Dr. Andrew Carruthers Adjunct	Ph.D. Engineering M.S. Engineering Management B.S. Engineering Technology	All MAF 900 courses
Dr. George Ford Adjunct	Ed.D. Educational Leadership M.E. Environmental Engineering M.B.A. B.S. Mechanical Engineering Professional Engineer (P.E.)	All MAF 800 and 900 courses
Dr. Soheil Sadat Hosseini Full time	Ph.D. Engineering, Electrical Engineering & Computer Science M.Sc. Electrical Engineering B.S. Electrical Engineering	All MAF 900 courses
Dr. Ronald Mau Adjunct	Ph.D. Business M.B.A. M.S. Civil Engineering B.S. Civil Engineering	All MAF 900 courses
Dr. Ian McAndrew Full time	Ph.D. Mechanical Engineering M.Sc. Manufacturing Engineering M.A. Education Management Post-Graduate Diploma in Education B.Sc. (Hons) Mechanical Engineering B.A. Production Engineering Fellow of the Royal Aeronautical Society	All MAF 800 and 900 courses

	Technical Qualifications (Associate Degrees) Higher National Certificate, HNC, in Mechanical Engineering Higher National Diploma, HND, in Production Engineering System Safety in Occupational Hygiene and Safety – HAS Courses City and Guilds 200, 205 II & III (all distinctions – highest grade ever achieved in Ford's Training Scheme) Apprentice Toolmaker 1977 – 1981 (Distinction)	
Dr. Daryl Orth Adjunct	Ph.D. Curriculum Instruction Design M.S. Management of Technology B.S. Industrial Technology-Construction	All MAF 800 and 900 courses
Dr. Alexander Perry Adjunct	D.Sc. Cyber Security M.S. Computational Mathematics	All MAF 900 courses
Dr. Jason Pittman Full time	Ph.D. Information Assurance M.S. Network Security B.S. English Literature and Micro-Biology	All MAF 900 courses.
Dr. Bradford Sims Full time	Ph.D. Curriculum Instruction Design M.S. Building Construction Management B.S. Building Construction Technology	All MAF 900 courses
Dr. Howard Van Horn Adjunct	Ph.D. Technology Management M.S. Business Administration M.S. Network Security M.S. Information Assurance PMP B.S. Special Studies Sciences	All MAF 800 and 900 courses

2. **Demonstrate how the institution will provide ongoing pedagogy training for faculty in evidenced-based best practices, including training in:**

a) Pedagogy that meets the needs of the students

The primary pedagogy for faculty at Capitol Technology University is the Active Learning model. The University believes strongly in a highly-interactive, thinking, and hands-on experience for students in each class to the maximum extent possible.

> It was two Missouri State professors, historian Charles Bonwell and psychologist James Eison, who coined the term "active learning." In their 1991 book on the subject, Active Learning: Creating Excitement in the Classroom, they offered this definition of the concept: "active learning involves students in doing things and thinking about the things they are doing."

> The definition, though it seems circuitous, marks a definitive pedagogical shift in college teaching and learning. Rather than think about what they are watching, hearing, or reading, students are first encouraged to be "doing" something in class, and then to apply critical thought and reflection to their own classroom work and activity. Their argument was backed up by research. Even Bligh, 20 years earlier, had pointed out that the immediate rehearsal of new information and knowledge had a significant impact upon learning.
>
> This approach is as helpful in the sciences as it is in the arts or humanities: whether it's organic chemistry, creative writing, or behavioral economics, concepts are all best understood through repeated practice and open, social exploration. The central tenet of active learning is that practice matters, and that classroom time is better spent giving students opportunities to work with concepts over and over, in a variety of ways and with opportunities.
>
> The central tenet of active learning — that practice and interaction matters— can be applied across disciplines for immediate feedback, so that knowledge can take hold in their own minds.
>
> (Source: Preville, P. Active Learning: The Perfect Pedagogy for the Digital Classroom: An Essential Guide for the Modern Professor)

All faculty receive regular periodic and recurring pedagogical training during the academic year. Those training sessions occur in a hybrid format – simultaneously live online and live on-ground in the classroom. The sessions are designed to reach all faculty, both fulltime and adjunct, in order to ensure everyone receives the training. Additionally, the sessions are recorded for those faculty who are unable to attend the live training session due to other professional and teaching commitments.

b) The learning management system

The Department of Online Learning (formerly the University's Department of Distance Learning) and the instructional technology division support the online program needs of faculty and students. Those university organizations and the IT Help Desk provide constant and on-going support to the faculty. The Canvas portion of the program is the online Learning Management System. When a new faculty member is assigned to teach an online course, the Department of Online Learning provides formal training for the instructor. New faculty are assigned an experienced faculty mentor to ensure a smooth transition to the online environment as well as to ensure compliance with the institution's online teaching pedagogy. The university believes this provides the highest-level learning experience for the faculty member and, in turn, students attending online classes.

c) Evidenced-based best practices for distance education, if distance education is offered.

Faculty at Capitol Technology University receive training in Keller's ARCS Motivational Model and his associated strategies for distance education/online learning.

> A model used in online delivery of teaching and learning to increase learner motivation is the Keller's ARCS motivational model. This model has been considered an important

element in online education because of its implications on increased learner motivation and learning outcomes. The Keller's model consists of motivating students by maintaining and eliciting attention (A), such as virtual clinical simulations; making the content and format relevant (R), by modeling enthusiasm or relating content to future use; facilitating student confidence (C), by providing "just the right challenge"; and promoting learner satisfaction (S), by providing reinforcement and praise when appropriate. Examples of the Keller's model include increasing motivation including the arousal of curiosity of students, making the connection between learning objectives and future learning goals, autonomous thinking and learning, and fostering student satisfaction. Keller's ARCS model has been researched by various educational online programs to analyze student motivation and learning outcomes. The Keller's model serves as an example and guide for instructors to motivate and increase online engagement with their students as wells as research purposes.

A qualitative study by Chan Lin investigated online student learning and motivation. Discussion boards, student projects, and reflection data were collected and analyzed from a 12-week web-based course. Respondents indicated the importance of online feedback from the instructor and peer modeling of course tasks to visualize learning progress. The study revealed using Keller's ARCS strategies fosters greater student online engagement by fostering self-efficacy and a sense of accomplishment.

In a mixed method study, assessing the use of Keller's ARCS on instructional design, the use of educational scaffolding fostered positive levels of student motivation. Relevancy, attention, confidence, and satisfaction were all common factors associated with student success in the course and course completion.

(Source: Pinchevsky-Font T, Dunbar S. Best Practices for Online Teaching and Learning in Health Care Related Programs. The Internet Journal of Allied Health Sciences and Practice. January 2015. Volume 13 Number 1.)

All faculty receive regular periodic and recurring training on evidence-based practices for distance education/online learning during the academic year. Those training sessions occur in multiple formats: asynchronous, synchronous (live online), hybrid (simultaneously live online and live on-ground), and on-ground in the classroom. The sessions are designed to reach all faculty, both fulltime and adjunct, to ensure all members receive the training. Additionally, the live sessions are recorded for those faculty who are unable to attend the live training session due to other professional commitments or who are teaching classes at the training delivery time.

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12):

1. **Describe the library resources available and/or the measures to be taken to ensure resources are adequate to support the proposed program. If the program is to be implemented within existing institutional resources, include a supportive statement by the President for library resources to meet the program's needs.**

Services: The Puente Library offers extensive services and a wide collection for Capitol Technology University students to be academically successful. Library resources are available digitally. The library also provides a mailing service for materials borrowed through the Maryland system. The library is currently supporting the following degrees at the undergraduate

level: B.S. in Astronautical Engineering, B.S. in Business Analytics and Data Sciences, B.S. in Computer Engineering, B.S. in Computer and Cyber Operations Engineering, B.S. in Computer Science, B.S. in Construction Management and Critical Infrastructure, B.S. in Cyber Analytics, B.S. in Cyber and Information Security, B.S. in Electrical Engineering, B.S. in Electrical Engineering Technology, B.S. in Engineering Technology, B.S in Management of Cyber and Information Technology, B.S. in Mechatronics Engineering, B.S. in Mechatronics and Robotics Engineering Technology, B.S. in Mobile Computing, B.S. in Software Engineering, and B.S. in Technology and Business Management, and B.S in Unmanned and Autonomous Systems. The library is currently supporting the following degrees at the graduate level: M.S. in Computer Science, M.S. in Cyber Analytics, M.S. in Cyber and Information Security, M.S. in Electrical Engineering, M.S. in Information Systems Management, M.S. in Internet Engineering, M.S. in Unmanned and Autonomous Systems Policy and Risk Management, M.B.A., T.M.B.A. Business Analytics and Data Science, T.M.B.A. in Cybersecurity, D.Sc. in Cybersecurity, Ph.D. in Business Analytics and Decision Sciences, Ph.D. in Technology, Ph.D. in Technology/M.S. in Research Methods Combination Program, and Ph.D. in Unmanned Systems Applications. Therefore, the library is fully prepared to support a Ph.D. in Manufacturing.

Services provided to on line students include:

- "Ask the Librarian"
- Research Guides
- Tutorials
- Videos
- Online borrowing

Capitol Technology University's online library as well as the on-campus library provides faculty and students with reference documents as well as texts appropriate to their learning experiences. Information about those services may be found at: https://www.captechu.edu/current-students/puente-library

The John G. and Beverley A. Puente Library provides access to management, decision science, and research methods materials through its 10,000-title book collection, e-books, and its 90 journal subscriptions. The library will continue to purchase new and additional materials in the management, decision science, and research methods area to maintain a strong and current collection in this subject area. Students can also access materials through the library's participation in Maryland's Digital eLibrary Consortium. This online electronic service provides access to numerous databases (Access Science, NetLibrary) that supply students with the materials they need. Available databases include ProQuest, EBSCO, ACM, Lexis Nexis, Taylor Francis, and Sage Publications.

The Puente Library can provide additional access to Aviation, historical management, and decision science materials through its membership in the Maryland Independent College and University Association (MICUA) and the American Society of Engineering Education (ASEE). Reciprocal loan agreements with fellow members of these organizations provide the library access to numerous research facilities that house and maintain archives of management and data science documents. The proximity of the University of Maryland, College Park and other local area research and academic libraries provides the Puente Library with quick access to these materials as well.

The library currently supports the needs students at the undergraduate, masters and doctoral level.

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

1. **Provide an assurance that the physical facilities, infrastructure and instruction equipment are adequate to initiate the program, particularly as related to spaces for classrooms, staff and faculty offices, and laboratories for studies in the technologies and sciences. If the program is to be implemented within existing institutional resources, include a supportive statement by the President regarding adequate equipment and facilities to meet the program's needs.**

   No new facilities are required for the program. The online class platform is web based and requires no additional equipment for the institution. The current Learning Management System, Canvas and Adobe Connect, meets the needs of the degree program. The Business and Technology lab, Computer Science Lab, Cyber Lab, Robotics Lab, and Unmanned Systems Lab together meet the potential research needs of the students. The labs provide both local and virtual support.

2. **Provide assurance and any appropriate evidence that the institution will ensure students enrolled in and faculty teaching in distance education will have adequate access to:**

   a. An institutional electronic mailing system

   Capitol Technology University provides an institutional electronic mailing system to all students and faculty. The capability is provided to all students and faculty in all the institution's modalities of course delivery. Capitol Technology University students and faculty are required to use the institution's email addresses (e.g., xxxxxxxx@captechu.edu) in all university matters and communications. The university uses the email capabilities in Microsoft Office 365 and Microsoft Outlook.

   b. A learning management system that provides the necessary technological support for distance education

   Capitol Technology University provides a robust Learning Management Systems (LMS) through the use of the Canvas LMS by Instructure (www.canvaslms.com). The university pairs Canvas with Adobe Connect (www.adobe.com/products/adobeconnect.html) to provide a platform for every student and faculty member to meet face-to-face in a synchronous "live" mode of communication. The use of Canvas is required for every course offered at the University; as a result, every course has a classroom on Canvas and Adobe Connect. All syllabi, grades, and assignments must be entered in to Canvas on a timely basis throughout the semester.

   Canvas provides the world's most robust LMS. It is a 21st Century LMS; Canvas is a native cloud, Amazon Web Service hosted system. The system is adaptable, reliable, and customizable. Canvas is easy to use for students and faculty. The system is fully mobile and has proven to be time-saving when compared to other systems. The following list provides the features of the system:

Time and Effort Savings

- CANVAS DATA
  Canvas Data parses and aggregates more than 280 million rows of Canvas usage data generated daily.
- CANVAS COMMONS
  Canvas Commons makes sharing a whole lot easier.
- SPEEDGRADER ANNOTATIONS
  Preview student submissions and provide feedback all in one frame.
- GRAPHIC ANALYTICS REPORTING ENGINE
  Canvas Analytics help you turn rich learner data into meaningful insights to improve teaching and learning.
- INTEGRATED MEDIA RECORDER
  Record audio and video messages within Canvas.
- OUTCOMES
  Connect each learning outcome to a specific goal, so results are demonstrated in clearly measurable ways.
- MOBILE ANNOTATION
  Open, annotate, and submit assignments directly within the Canvas mobile app.
- AUTOMATED TASKS
  Course management is fast and easy with automated tasks.
- NOTIFICATION PREFERENCES
  Receive course updates when and where you want - by email, text message, even Twitter or LinkedIn.
- EASE OF USE
  A familiar, intuitive interface means most users already have the skills they need to navigate, learn, and use Canvas.
- IOS AND ANDROID
  Engage students in learning anytime, anywhere from any computer or mobile device with a Web-standard browser.
- USER-CUSTOMIZABLE NAVIGATION
  Canvas intelligently adds course navigation links as teachers create courses.
- RSS SUPPORT
  Pull feeds from external sites into courses and push out secure feeds for all course activities.
- DOWNLOAD AND UPLOAD FILES
  Work in Canvas or work offline—it's up to you.
- SPEEDGRADER
  Grade assignments in half the time.

Student Engagement

- ROBUST COURSE NOTIFICATIONS
  Receive course updates when and where you want—by email, text message, and even Facebook.
- PROFILE
  Introduce yourself to classmates with a Canvas profile.
- AUDIO AND VIDEO MESSAGES
  Give better feedback and help students feel more connected with audio and video messages.
- MULTIMEDIA INTEGRATIONS
  Insert audio, video, text, images, and more at every learning contact point.
- EMPOWER GROUPS WITH COLLABORATIVE WORKSPACES
  By using the right technologies in the right ways, Canvas makes working together easier than ever.
- MOBILE
  Engage students in learning anytime, anywhere from iOS or Android, or any mobile device with a Web-standard browser.
- TURN STUDENTS INTO CREATORS
  Students can create and share audio, video, and more within assignments, discussions, and collaborative workspaces.
- WEB CONFERENCING
  Engage in synchronous online communication.
- OPEN API
  With its open API, Canvas easily integrates with your IT ecosystem.
- BROWSER SUPPORT
  Connect to Canvas from any Web-standard browser.
- LTI INTEGRATIONS
  Use the tools you want with LTI integrations.
- MODERN WEB STANDARDS
  Canvas is built using the same Web technologies that power sites like Google, Facebook, and Twitter.

Lossless Learning

- CANVAS POLLS
  Gauge comprehension and incorporate formative assessment without the need for "clicker" devices.
- MAGICMARKER
  Track in real-time how students are performing and demonstrating their learning.

- QUIZ STATS
  Analyze and improve individual assessments and quiz questions.
- LEARNING MASTERY FOR STUDENTS
  Empower students to take control of their learning.

(Source: https://www.canvaslms.com/higher-education/features)

Capitol Technology University has been using Canvas for over four years. Canvas has proven to be a completely reliable LMS system that provides the necessary technological support for distance education/online learning.

L. Adequacy of Financial Resources with Documentation (as outlined in COMAR 13B.02.03.14):

1. **Complete Table 1: Resources and Narrative Rationale. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year. Also provide a narrative rationale for each resource category. If resources have been or will be reallocated to support the proposed program, briefly discuss the sources of those funds.**

TABLE 1: RESOURCES

Resource Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated Funds	$17,000	$0	$0	$0	$0
2. Tuition/Fee Revenue (c + g below)	$61,425	$135,675	$242,190	$325,890	$503,370
a. Number of F/T Students	0	0	0	0	0
b. Annual tuition/Fee rate	$0	$0	$0	$0	$0
c. Total F/T Revenue (a x b)	$0	$0	$0	$0	$0
d. Number of P/T Students	7	15	26	34	51
e. Credit Hour Rate	$585	$603	$621	$639	$658
f. Annual Credit Hour	15	15	15	15	15
g. Total P/T Revenue (d x e x f)	$61,425	$135,675	$242,190	$325,890	$503,370
3. Grants, Contracts and Other External Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
TOTAL (Add 1 – 4)	$78,425	$135,675	$242,190	$325,890	$503,370

2. **Provide a narrative rationale for each of the resource categories. If resources have been or will be reallocated to support the proposed program, briefly discuss those funds.**

a. Reallocated Funds

Capitol Technology University has reallocated funds during Year 1 for support of program and course development, online support, office materials, travel, professional development, and initial marketing. There is no substantial impact on the institution because of the reallocation of these funds. The reallocated funds will be recovered after the first year. The program is expected to be self-sustaining after Year 1.

b. Tuition and Fee Revenue

Tuition is calculated to include an annual 2.5% tuition increase. A 20% attrition rate has been calculated.

c. Grants and Contracts

There are currently no grants or contracts.

d. Other Sources of Funds

There are currently no other sources of funds.

e. Total Year

No additional explanation or comments needed.

2. **Complete Table 2: Program Expenditures. Provide finance data for the first five years of program implementation. Enter figures into each cell and provide a total for each year.**

TABLE 2: EXPENDITURES
Courses are taught by adjunct professors.

Expenditure Category	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b + c below)	$14,672	$32,870	$65,784	$82,176	$115,046
a. Number of FTE	1.25	2	4	5	8
b. Total Salary	$12,227	$27,392	$54,784	$68,480	$95,872
c. Total Benefits (20% of salaries)	$2,445	$5,478	$10,957	$13,696	$19,174
2. Admin Staff (b + c below)	$4,658	$4,798	$5,090	$5,243	$5,243
a. Number of FTE	.07	.07	.07	.07	.07
b. Total Salary	$3,850	$3,966	$4,207	$4,333	$4,333
c. Total Benefits	$809	$833	$883	$910	$910
3. Support Staff (b + c below)	$14,250	$29,039	$86,400	$99,750	$114,000
a. Number of FTE	.25	.5	1.5	1.75	2
b. Total Salary	$11,875	$24,000	$72,000	$83,125	$95,000
c. Total Benefits	$2,375	$5,039	$14,400	$16,625	$19,000
4. Technical Support and Equipment	$570	$1,029	$1,821	$2,454	$4,560
5. Library	$0	$0	$0	$0	$0
6. New or Renovated Space	$0	$0	$0	$0	$0
7. Other Expenses	$17,000	$18,500	$19,500	$39,000	$42,000
TOTAL (ADD 1-7)	$51,150	$83,236	$178,595	$228,623	$280,849

1. **Provide a narrative rationale for each expenditure category. If expenditures have been or will be reallocated to support the proposed program, briefly discuss those funds.**

a. Faculty

Table 2 reflects the faculty hours in total, but this does not imply that these are new hire requirements.

b. Administrative Staff

Capitol Technology University will continue with current the administrative staff through the proposed time period.

c. Support Staff

Capitol will continue with current administrative staff through year two. Additional support staff will be added in year 3.

d. Technical Support and Equipment

Software for courses is available free to students or is freeware. Additional licenses for the LMS will be purchased by the university at the rate of $50 per student. No additional equipment is needed.

e. Library

Money has been allocated for additional materials to be added to the on campus and virtual libraries to ensure the literature remains current and relevant. However, it has been determined that the current material serves the needs of this degree due to the extensive online database.

f. New or Renovated Space

No new or renovated space is needed.

g. Other Expenses

Funds have been allocated for office materials, travel, professional development, course development, marketing, additional scholarships.

h. Total Year

No additional explanation or comments needed.

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

1. **Discuss procedures for evaluating courses, faculty and student learning outcomes.**

The assessment process at the university consists of a series of events throughout the Academic Year. The results of each event are gathered by the University Assessment Team and stored in Canvas for analysis and use in annual reports, assessments, etc. The University Assessment Team analyzes the results, develops any necessary action plans, and monitors implementation of the action plans.

Academic Year Assessment Events:

Fall Semester:

- At the August Faculty Retreat, the faculty reviews any outstanding student learning challenges that have not been adequately addressed. The issues are brought to the University

Academic Deans for review and development of implementation plans.

- Faculty submit performance plans consistent with the mission and goals of the university and department. The document is reviewed and approved with the University Academic Deans.
- Department Chairs and University Academic Deans review the Graduating Student Survey data.
- Department Chairs and University Academic Deans review student internship evaluations.
- Department Chairs and University Academic Deans review grade distribution reports from the spring and summer semesters.
- Department Chairs and University Academic Deans review student course evaluations from the Summer Semester.
- Departments conduct Industrial Advisory Board meetings to review academic curriculum recommendations. The Advisory Board meets to begin curriculum review or address special issues that may arise related to curriculum. Based on an analysis and evaluation of the results, the University Academic Deans, faculty and the advisory boards will develop the most effective strategy to move the changes forward.

    - NOTE: A complete curriculum review for degrees in the Doctoral Programs occurs every 2 years. In most cases, the changes only require that the University Academic Deans inform the Chief Academic Officer and provide a report that includes a justification and the impact of the changes as well as a strategic plan. Significant changes normally require the approval of the Chief Academic Officer and the Executive Council.

- University Academic Deans and Vice President for Academic Affairs attend the Student Town Hall and review student feedback with department chairs.
- Department Chairs conduct interviews with potential employers at our Career Fair.
- Post-residency, the University Academic Deans meet with the faculty to review the student learning progress and discuss needed changes.

Spring Semester:

- Faculty Performance Plans are reviewed with faculty to identify issues of divergence and to adjust the plan as needed.
- Department Chairs and University Academic Deans review grade distribution reports from the Fall Semester.
- Department Chairs and University Academic Deans review the Graduating Student Survey data.
- Department Chairs and University Academic Deans review student course evaluations from the Fall Semester and the Spring Semester (in May before the Summer Semester begins).
- Department Chairs and University Academic Deans meet to review the content of the graduating student, alumni, and course surveys to ensure the surveys continue to meet the university's assessment needs.
- At Annual Faculty Summit in May, the faculty review and discuss student learning challenges from the past academic year and provide recommendations to the Academic Deans for review and development of implementation plans.
- Department Chairs conduct interviews with potential employers at our Career Fair.
- Departments conduct Industrial Advisory Board meetings to review academic curriculum recommendations.

In addition to these summative assessments, the University Academic Deans meets with the Department Chairs on a weekly basis to review current student progress. This formative assessment allows for immediate minor changes, which increase faculty effectiveness and, ultimately, student outcomes.

The Faculty Senate meets monthly during August through April. The Faculty Senate addresses issues that impact student outcomes as those issues emerge. The leadership of the Faculty Senate then provides a report on the matter to the University Academic Deans. The report may include a recommendation or a request to move forward with a committee to further examine the issue. In most cases, the changes only require the University Academic Deans to inform the Chief Academic Officer and provide a report that includes a justification and the impact of changes as well as a strategic plan. Significant changes normally require the approval of the Chief Academic Officer and the Executive Council.

2. **Explain how the institution will evaluate the proposed program's educational effectiveness, including assessments of student learning outcomes, student retention, student and faculty satisfaction, and cost-effectiveness.**

Student Learning Outcomes:

Student learning outcomes for the proposed Ph.D. in Manufacturing will be measured using the instruments identified in Section G and Section M (i.e., those instruments tailored for a Ph.D.), the assessment measures indicated in each module of the doctoral program, and the accreditation requirements of the university's regional accreditor [i.e., Middle States Commission in Higher Education (MSCHE)] and our degree specific accrediting organizations (i.e., IACBE, ABET, NSA, DHS). This program is designed to meet the requirements of MSCHE as well as IACBE. The program will be reviewed for accreditation by MSCHE and IACBE. The university is in good standing with all its accrediting bodies.

Student Retention:

The University maintains a comprehensive student retention program under the Vice President for Student Engagement. The program assesses student retention at all levels, including the individual course, major, and degree. During the semester and term, the University's Drop-Out Detective capability, within its Learning Management System (Canvas), provides an early alert at the course level to potential issues related to retention. Within the Office of Student Life, Academic Advisors monitor Drop-Out Detective and contact students who appear to have issues affecting their academic performance. The Academic Advisors work with each student to create a plan to remove any barriers to success. The Academic Advisors also work with the course instructors as needed to gain additional insight that may be helpful to correcting the situation.

Each student also meets with their Academic Advisor each semester to evaluate their progress toward degree completion. An updated plan of action is developed for each student for their next semester's registration and each succeeding semester through degree completion.

The Vice President for Student Engagement also meets on a regular basis with the Vice President of Academics/Chief Academic Officer to review the student retention within each degree program and address any issues that appear to be impediments to degree completion.

Student and Faculty Satisfaction:

Evaluations and assessment of Student and Faculty satisfaction occur every semester. Faculty members are evaluated every semester by students enrolled in their courses. Students are required to complete a course evaluation online within a specified time frame at the end of the semester for every enrolled course or they are locked out of Canvas (the University's Learning Management System) until they complete each survey. Every faculty member is also required to review each of their courses for the semester.

The Department Chairs and University Academic Deans review the student evaluations for every course offered at the University. The Department Chairs and University Academic Deans also review faculty satisfaction every semester. If changes are needed at the course level, the changes are developed and implemented by the faculty responsible for the courses upon approval of the University Academic Deans. If changes are needed at the faculty level, the Department Chairs and University Deans will make the changes. At the end of this cycle, an evaluation is repeated, and the results are analyzed with the appropriate stakeholders regarding the effectiveness of the changes. This is an ongoing process. The university has a vice president and team in charge of outcomes and assessment supporting the formal assessment measures.

Cost Effectiveness:

Based on the year-long inputs, evaluations, and reviews described in Section M from faculty, students, industry representatives, and Department Chairs, the University Academic Dean prepares the proposed academic budget for each program for the upcoming year. Budget increases are tied to intended student learning improvements and key strategic initiatives.

Each academic program is also monitored by the Vice President for Finance and Administration throughout every semester and term for its cost effectiveness. Additionally, the revenue and costs of every University program are reviewed annually by the Executive Council and Board of Trustees prior to approving the next year's budget.

N. Consistency with the State's Minority Student Achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Post-Secondary Education):

1. **Discuss how the proposed program addresses minority student access & success, and the institution's cultural diversity goals and initiatives.**

Capitol Technology University is a majority/minority school. Our programs attract a diverse set of students. Special attention is provided to recruit females into the STEM and multidisciplinary programs at all degree levels – undergraduate, master's, and doctoral. The University also recruits minority populations for all of its undergraduate degrees as well as for its graduate level degrees: M.S. in Computer Science, M.S. in Critical Infrastructure, M.S. in Cyber Analytics, M.S. in Cyber and Information Security, M.S. in Electrical Engineering, M.S. in Information Systems Management, M.S. in Internet Engineering, M.S. in Unmanned and Autonomous Systems Policy and Risk Management, M.B.A., T.M.B.A. Business Analytics and Data Science, T.M.B.A. in Cybersecurity, D.Sc. in Cybersecurity, Ph.D. in Business Analytics and Decision Sciences, Ph.D. in Critical Infrastructure, Ph.D. in Technology, Ph.D. in Technology/M.S. in Research Methods Combination Program, and Ph.D. in Unmanned Systems Applications. The same attention will be given to the Ph.D. in Manufacturing.

O. Relationship to Low Productivity Programs Identified by the Commission:

1. **If the proposed program is directly related to an identified low productivity program, discuss how the fiscal resources (including faculty, administration, library resources and general operating expenses) may be redistributed to this program.**

   This program is not associated with a low productivity program identified by the commission.

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

1. **Provide affirmation and any appropriate evidence that the institution is eligible to provide Distance Education.**

   Capitol Technology University is fully eligible to provide distance education. The university has a long history of providing high-quality distance education. The university is accredited regionally by the Middle States Commission in Higher Education (MSCHE) and through four specialized accrediting organizations: International Accreditation Council of Business Education (IACBE), Accreditation Board for Engineering and Technology (ABET), NSA, and DHS. All five accrediting organizations have reviewed the university's distance education program as part of their accreditation process. Capitol Technology University is fully accredited by MSCHE, IACBE, ABET, NSA, and DHS. The university is in good standing with all its accrediting bodies.

2. **Provide assurance and any appropriate evidence that the institution complies with the C-RAC guidelines, particularly as it relates to the proposed program.**

   Capitol Technology University has a long history of providing high quality distance education/online learning that complies with the Council of Regional Accrediting Commissions (C-RAC) Interregional Guidelines for the Evaluation of Distance Education. The university will also continue to comply with the C-RAC guidelines with the proposed Ph.D. in manufacturing program.

   a. **Council of Regional Accrediting Commissions (C-RAC) Interregional Guidelines for the Evaluation of Distance Education.**

      1. **Online learning is appropriate to the institution's mission and purposes.**

         Online learning is consistent with the institution's mission, purpose and history. Please refer to Section A of this proposal.

      2. **The institution's plans for developing, sustaining, and, if appropriate, expanding online learning offerings are integrated into its regular planning and evaluation processes.**

         All programs at the university – online, hybrid, and on-ground – are subject to the same regular planning, assessment, and evaluation processes. Please see Section M of this proposal for the detailed process.

      3. **Online learning is incorporated into the institution's systems of governance and academic oversight.**

All programs at the university – online, hybrid, and on-ground – are subject to the same systems of governance and academic oversight. Please refer to Section G and Section M of this proposal.

4. **Curricula for the institution's online learning offerings are coherent, cohesive, and comparable in academic rigor to programs offered in traditional instructional formats.**

   Online programs/courses meet the same accreditation standards, goals, objectives, and outcomes as traditional on-ground instruction at the University. The online course development process incorporated the Quality Matters research-based set of standards for quality online course design to ensure academic rigor of the online course is comparable to the traditionally offered course. The University Academic Deans, Department Chairs, and faculty review curriculum annually. Courses are reviewed at the end of each term of course delivery. This process applies to online and traditional courses. In addition, advisory boards are engaged in the monitoring of course quality to ensure quality standards are met regardless of the delivery platform.

5. **The institution evaluates the effectiveness of its online learning offerings, including the extent to which the online learning goals are achieved, and uses the results of its evaluations to enhance the attainment of the goals.**

   Online programs/courses meet the same accreditation standards, goal, objectives, and outcomes as traditional classroom delivery. Learning platforms are chosen to ensure high standards of the technical elements of the course. The University Academic Deans monitor all course conversions from in-class to online to ensure the online course is academically equivalent to traditionally offered course and the technology is appropriate to support the expected rigor and breadth of the course.

6. **Faculty responsible for delivering the online learning curricula and evaluating the students' success in achieving the online learning goals are appropriately qualified and effectively supported.**

   The Department of Doctoral Programs, where this degree will be sponsored, is staffed by qualified University Academic Dean, Dr. Ian McAndrew has worked in manufacturing and won the Prestigious Henry Ford Award of Innovative Manufacturing in 1990 and is recognized internationally for his research in Manufacturing. Other appropriately credentialed faculty are available with skills of multi-disciplinary level, for example, manufacturing designers, manufacturing engineers, and manufacturing software experts.

   The evaluation of the courses in the program will be done using the same processes as all other programs at the University. (Please see Section M.) All Capitol Technology University faculty teach in the traditional classroom environment and online. (Please see faculty qualifications in Section I of this document.)

7. **The institution provides effective student and academic services to support students enrolled in online learning offerings.**

Students can receive assistance in using online learning technology via several avenues. Student Aides are available to meet with students and provide tutoring support in both subject matter and use of the technology. Tutors are available in live real-time sessions using Adobe Connect or other agreed upon tools. Pre-recorded online tutorials are also available.

In addition to faculty support, on ground and online tutoring services are available to students in a one-on-one environment.

Laboratories (on ground and virtual) are available for use by all students and are staffed by faculty and tutoring staff who provide academic support.

Library services and resources are appropriate and adequate. Please refer to Section J of this document and the attached letter from the university president. The library adequately supports the students learning needs.

8. **The institution provides sufficient resources to support and, if appropriate, expand its online learning offerings.**

The University has made the financial commitment to the program. (Please refer to Section L). The University has a proven track-record of supporting degree completion for several years and this is expanding currently to support students synchronous and asynchronous demands.

9. **The institution assures the integrity of its online offerings.**

Faculty currently employed at the University will act as an Internal Advisory Board for program changes, including course and program development. All current faculty were selected based on domain experience and program-related teaching experience.

When new faculty or outside consults are necessary for the design of courses offered, our Human Resource Department initiates a rigorous search and screening process to identify appropriate faculty to design and teach online courses. All new faculty are selected on domain experience and program-related teaching experience.

The University online platform offers several avenues to support instructors engaged in online learning. The Director of our Online Learning Division is highly skilled and trained in faculty development. Several seminars and online tutorials are available to the faculty every year. Mentors are assigned to new faculty. Best practice sharing is facilitated through the University Academic Deans, Department Chairs, and formal meetings.

The assessment for distance learning classes and students in this program will be the same as for all doctoral programs at the University. Faculty provide required data on student achievement. The Learning Management System provides data on student achievement. Proof of these assessments is available during the class and post-class to the Vice President of Academic Affairs, University Academic Dean, and Department Chairs. On an annual basis, the information is reported to the University's accreditation authorities (e.g., MSCHE, IACBE, ABET).