



February 26, 2019

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 **Master of Science (M.S.) in Aviation Cybersecurity**. 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 **M.S. in Aviation Cybersecurity**. 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 **M.S. in Aviation Cybersecurity** is consistent with this mission.

The construction industry is reporting significant workforce shortages of trained safety personnel with a bachelor's degree. Moreover, the shortage is growing each year with increasing demand and the annual departure of large cohorts of existing professionals who are reaching retirement age. This program is in response to that need; the **M.S. in Aviation Cybersecurity** degree is for new undergraduates and non-traditional students (i.e., experienced aviation and cybersecurity personnel) who desire to advance in their careers by gaining skills in the Aviation Cybersecurity field.

**To respond to needs of the aviation industry, we respectfully submit for approval a Master of Science (M.S.) in Aviation Cybersecurity. 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,

A handwritten signature in blue ink, appearing to read 'BLS', written over the printed name.

Bradford L. Sims, PhD



February 26, 2019

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 a **Master of Science (M.S.) in Aviation Cybersecurity**. As president of the university, I confirm that the library resources, including support staff, are more than adequate to support the **M.S. in Aviation Cybersecurity**. In addition, the university is dedicated to, and has budgeted for, continuous improvement of its library resources.

Respectfully,

A handwritten signature in blue ink, appearing to read 'BLS', written over the printed name of Bradford L. Sims, PhD.

Bradford L. Sims, PhD



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

Institution Submitting Proposal	Capitol Technology University
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***Each action below requires a separate proposal and cover sheet.***

- |   |   |
|---|---|
| <input checked="" type="radio"/> New Academic Program New | <input type="radio"/> Substantial Change to a Degree Program            |
| <input type="radio"/> Area of Concentration New           | <input type="radio"/> Substantial Change to an Area of Concentration    |
| <input type="radio"/> Degree Level Approval New           | <input type="radio"/> Substantial Change to a Certificate Program       |
| <input type="radio"/> Stand-Alone Certificate             | <input type="radio"/> Cooperative Degree Program                        |
| <input type="radio"/> Off Campus Program                  | <input type="radio"/> Offer Program at Regional Higher Education Center |

Department Proposing Program	Department of Cybersecurity	
Degree Level and Degree Type	Master of Science (M.S.)	
Title of Proposed Program	M.S. in Aviation Cybersecurity	
Total Number of Credits	36	
Suggested Codes	HEGIS: 701	CIP: 11
Program Modality	<input type="radio"/> On-campus <input checked="" type="radio"/> Distance Education ( <i>fully online</i> ) <input type="radio"/> Both	
Program Resources	<input checked="" type="radio"/> Using Existing Resources <input type="radio"/> Requiring New Resources	
Projected Implementation Date	<input checked="" type="radio"/> Fall <input type="radio"/> Spring <input type="radio"/> Summer                      Year: 2019	
Provide Link to Most Recent Academic Catalog	URL: <a href="https://www.captechu.edu/current-students/academic-resources">https://www.captechu.edu/current-students/academic-resources</a>	

Preferred Contact for this Proposal	Name: Professor Soren Ashmall
	Title: Director, Assessment & Accreditation
	Phone: (571) 332-4344
	Email: <a href="mailto:spashmall@captechu.edu">spashmall@captechu.edu</a>

President/Chief Executive	Type Name: Dr. Bradford Sims
	Signature:  Date: 2-26-19

Approval/Endorsement by Governing Board	Type Name: Dr. Bradford Sims
	Signature:  Date: 2-26-19

Revised 5/15/18

**PROPOSAL FOR:**

- NEW INSTRUCTIONAL PROGRAM**
- SUBSTANTIAL EXPANSION/MAJOR MODIFICATION**
- COOPERATIVE DEGREE PROGRAM**
- WITHIN EXISTING RESOURCES** or  **REQUIRING NEW RESOURCES**



Institution Submitting Proposal

**Fall 2019**

Projected Implementation Date

**Master of Science  
(M.S.)**  
Award to be Offered

**Master of Science in Aviation  
Cybersecurity**  
Title of Proposed Program

**0701.00**

Suggested HEGIS Code

**11.1003**

Suggested CIP Code

**Cybersecurity**  
Department of Proposed Program

**Professor William Butler**  
Name of Department Head

**Prof. Soren Ashmall**  
Director, Assessment  
and Accreditation

**spashmall@captechu.edu**  
Contact E-Mail Address

**571-332-4344**  
Contact Phone Number

  
Signature and Date

President/Chief Executive Approval

**FEB. 26, 2019**  
Signature and Date

Date Endorsed/Approved by Governing Board

**Proposed Master of Science in Aviation Cybersecurity  
Department of Cybersecurity  
Capitol Technology University  
Laurel, Maryland**

**A. Centrality to Institutional Mission Statement 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.**

*Master of Science in Aviation Cybersecurity Program Description:*

The **Master of Science (M.S.) in Aviation Cybersecurity** degree program is designed to meet the growing needs of today's business and government environments where Aviation Cybersecurity is now a major business consideration. The **M.S. in Aviation Cybersecurity** provides advanced graduate-level management education where the latest aviation cybersecurity concepts are reviewed and analyzed with a laser focus. Throughout the program, the latest technological developments, applications, and considerations in the aviation industry are explored and applied to real-life industry challenges. Students will learn optimum methods and techniques to define resources and associated risks at an executive level in order to maintain profitability, manage work effectivity and efficiently, and ensure customer satisfaction.

The **M.S. in Aviation Cybersecurity** will prepare students for advanced cybersecurity skills and leadership positions throughout the aviation industry and related businesses. The student will learn to analyze patterns, employ powerful technological tools, and to drive business decisions in the aviation cybersecurity field. The student will get hands-on use of the strategic-level technology in aviation business and aviation cybersecurity.

The **M.S. in Aviation Cybersecurity** provides the student with the ability to integrate business and decision-making skills in the technologically complex aviation cybersecurity and aviation business environment. Capitol Technology University graduates will be able to apply their cutting-edge skills in cybersecurity, management, and technology to every day work situations in the industry. While studying aviation cybersecurity at the graduate level, the student will learn how organizations function effectively and efficiently. Students will develop a clear picture of how business areas meld to create a successful organization. Students will learn the latest technological developments, applications, and considerations in the aviation industry. The required core courses will build a foundation that encompasses technology, management, marketing, accounting, finance, Information Technology and human resource management.

The graphic below is from the Cyber Startup Observatory of the Airport of Things (AoT). The graphic depicts the ongoing transformation in airports worldwide. The thread that now ties all of the Airport of Things (AoT) together is Information Technology. The result is a potential cybersecurity vulnerability across every aspect of each airport and every airline on the ground and in the air.



Cyber Startup Observatory® - Insight

The aviation industry relies heavily on computer systems in all of its ground and flight operations. The security of the airline systems can directly impact the operational safety and efficiency of the industry as well as its service, reputation, and financial health. With a growing demand for hybrid leaders within the aviation industry and a shortage of personnel with the required skills in cyber and data security, the need for better prepared Aviation Cybersecurity leaders is great. Aviation companies, especially commercial airlines, are searching for personnel with advanced hybrid skills in aviation and cybersecurity. Those companies are also looking for a reliable pipeline for future leadership hires as well. Graduates with the **M.S. in Aviation Cybersecurity** will help fill this need, making the degree extremely relevant now and in the future.

*Relationship to Institutional Approved Mission:*

The **M.S. in Aviation Cybersecurity** is consistent with the University mission to educate individuals for professional opportunities in engineering, computer science, information technology, and business. We provide relevant learning experiences that lead to success in evolving global community. Fundamental to the degree programs in the Department of Cybersecurity are opportunities to integrate technology, leadership, and business. The **M.S. in Aviation Cybersecurity** is consistent with that philosophy. This same philosophy is supported by existing degree programs and learning opportunities. The **M.S. in Aviation Cybersecurity** degree is an integral part of the Strategic Plan for FY 2017-2025 and afterwards. Funding to support the new degree has been included in institutional and departmental budgets for FY 2019-2020 and forecasted budgets going forward.

The **M.S. in Aviation Cybersecurity** degree will be offered online using the Canvas Learning Management System (LMS) and Adobe Connect. The result is the convenience required by the 21<sup>st</sup> Century learner and provides the interaction with faculty and fellow students that is critical to the high-level learning experience. The curriculum provides the graduate student the necessary learning tools that the University believes critical to success in the Aviation Cybersecurity field. 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 new **M.S. in Aviation Cybersecurity** builds upon the existing areas of graduate study, including the Master of Business Administration (M.B.A.), Master of Science (M.S.) of Aviation, Master of Science (M.S.) in Critical Infrastructure, Master of Science (M.S.) in Cyber Analytics, Master of Science (M.S.) in Electrical Engineering, Master of Science (M.S.) in Internet Engineering, Master of Science (M.S.) in Cyber and Information Security, Master of Science (M.S.) in Computer Science, Master of Science (M.S.) in Information Systems Management, Technical Master of Business Administration (T.M.B.A.) in Business Analytics and Data Science, and Technical Master of Business Administration (T.M.B.A.) in Cybersecurity, Doctor of Science (D.Sc.) in Cybersecurity, Doctor of Philosophy (Ph.D.) in Aviation, Doctor of Philosophy (Ph.D.) in Business Analytics and Decision Sciences, Doctor of Philosophy (Ph.D.) in Critical Infrastructure, Doctor of Philosophy (Ph.D.) in Manufacturing, Doctor of Philosophy (Ph.D.) in Technology, Doctor of Philosophy (Ph.D.) in Technology/Master of Science (M.S.) Research Methods Combination Program, Doctor of Philosophy (Ph.D.) in Unmanned Systems Applications. The University's graduate degree programs are structured to prepare students to provide critical expert leadership as well as technical expertise to meet the needs of a modern technology and information-dependent organization. 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 **M.S. in**

**Aviation Cybersecurity** will contribute to that legacy and will allow students to elevate their skills and careers to the next level within the evolving global aviation cybersecurity community.

The proposed **M.S. in Aviation Cybersecurity** is fully supported by the University's Vision 2025 and Strategic Plan 2017-2025. Funding to support the degree has been included in forecasted budgets going forward.

The University has active partnerships (e.g., Parson Corporation, Leidos, Patton Electronics, Lockheed Martin, Northrup Grumman, Cyber Security Forum Initiative, IRS, and NCS) in the private and public arenas. The **M.S. in Aviation Cybersecurity** 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 Aviation Cybersecurity field will help diversify and increase 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 to support program and course development, online support, office materials, travel, professional development, and initial marketing. There is no substantial impact to the institution due to 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 proposed **M.S. in Aviation Cybersecurity** 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.**



Leaders in the aviation industry are facing an ever-increasing need to expand the application of new technology to their industry in order to remain competitive, efficient, and viable now and in the future. Aviation companies today depend and thrive on timely, accurate and relevant information. Rising passenger expectations have put pressure on the aviation industry to bolster airport throughput, cut queues and make the journey from entrance to departure gate as seamless as possible. In the case of airport security, cyber innovations in machine-learning, artificial intelligence, facial recognition, and biometric ID management technologies can be used to analyse data and identify threats faster than humans. As technology enables the creation and capture of ever-increasing amounts of data, the effective management and understanding of resource needs is becoming an enormous challenge. Aviation is no longer just the task of flying airplanes; it has far reaching implications in the global, environmental, integration, and security aspects of society. Effective leadership in this industry can only be achieved with a holistic approach and the advanced skills that will be covered in this proposed degree.

**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 **M.S. in Aviation Cybersecurity** will expand the field of opportunities for minorities and disadvantaged students.

The need for highly trained Aviation professionals (both pilots and non-pilots) is growing at a significant rate, but the supply of Aviation professionals, especially those with aviation-specific cybersecurity expertise, is not keeping up with the demand. According to The Bureau of Labor Statistics Occupational Outlook Handbook, the Job Outlook for Aviation Managers from 2016-2026 is projected to have faster than average growth of 11% -- a need for 44,800 new Aviation Managers. The faster than average growth is also occurring globally in many regions of the world.

(Source: <https://www.bls.gov/ooh/management/aviation-managers.htm>)

(Source: <https://www.bls.gov/ooh/management/administrative-services-managers.htm>)

(Source: <https://www.bls.gov/ooh/management/top-executives.htm>)

Aviation Managers with Cybersecurity skills are expected to be in high demand as the overall volume of activity in aviation expands. Over the coming decade, increasing population and business growth will result in the construction of new aviation facilities, airports and airplane manufacturing. Along with the growth of the aviation industry, there will be a corresponding growth in data created and captured, identification through biometrics, analysis of business information, and heightened requirements for cybersecurity. The renovation of existing airports national and aviation facilities will also place even greater pressure on the industry by increasing the demand for Aviation professionals with advanced training in cybersecurity.

(Source <https://www.airport-technology.com/features/ai-at-airports-security/>)

**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 **M.S. in Aviation Cybersecurity** will expand the field of opportunities for minorities and disadvantaged students.

A report from the Business-Higher Education Forum notes that African Americans and Hispanics represent just 6 and 7% respectively of STEM employment, even though they represent more than twice that much of the U.S. population.” The opportunities for graduates of color with this degree will increase the

Industry	2017				
	Percent of total employed				
	Women	White	Black or African American	Asian	Hispanic or Latino
Aviation	9.1	88.8	6.1	1.9	29.8

(Source: <https://www.bls.gov/cps/cpsaat18.htm>)

Given the substantial minority population of Capitol Technology University, it is reasonable to assert that the **M.S. in Aviation Cybersecurity** program will add to this base of minority participation in the Aviation industry.

**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

**Goal 1: Access**

*“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 22% 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 approach 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 admissions, employment, programs, or activities.

Through its academic programs, Capitol Technology University seeks to prepare all 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.*
- **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 **M.S. in Aviation Cybersecurity** program and university financial aid will be available to all Maryland residents who qualify academically for admission.

The **M.S. in Aviation Cybersecurity** program, with its academic rigor, will produce highly qualified aviation cybersecurity professionals for this critical 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 Aviation Cybersecurity 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 **M.S. in Aviation Cybersecurity** will be offered online. This 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 throughout the admissions process regarding the cost to attend the University. The information is also publicly available on the University website. The University’s Admissions Office and Office of 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 Advisors prior to enrolling in classes for the first time. Admissions personnel, Student Services Counselors and Departmental Chairs 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 guarantee for undergraduates, which means full-time tuition is guaranteed not to increase more than 1% per year 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 all classroom modalities 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 and agencies.

The University also employs online virtual simulations in a game-like environment to teach the application of knowledge in a practical hands-on manner. 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's 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). The University's students recently launched another satellite aboard a NASA rocket from a location in Norway at the beginning of the 2019 Fall Semester. We are also recruiting additional partners for this proposed **M.S. degree in Aviation Cybersecurity** for which real-world aviation cybersecurity projects will provide students integrative learning opportunities.

The University also supports prior learning assessment. Portfolio analysis is available. The University accepts professional certifications for credit for specific courses. In addition, the University allows students to take a competency exam for credit for required courses up to the current state limits.

#### **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 in government, private industry, and cross-sector organizations for professionals with the proposed **M.S. in Aviation Cybersecurity**. There are currently 2,528 jobs listed on glassdoor.com under the Aviation Manager field and Indeed.com lists 4,769 Cybersecurity Manager jobs.

(Source:

<https://www.glassdoor.com/Job/jobs.htm?suggestCount=0&suggestChosen=false&clickSource=searchBtn&typedKeyword=aviation+manager&sc.keyword=aviation+manager&locT=&locId=&jobType=> & <https://www.indeed.com/jobs?q=Cybersecurity+manager&l=>)

Graduates with the **M.S. in Aviation Cybersecurity** will be expected to fill mid-level management positions in existing commercial companies and government organizations with titles such as:

- Assistant Vice President, Aviation Cybersecurity
- Director, Aviation Cyber Operations
- Assistant Vice President, Avionics and Cybersecurity
- Managing Director, Aviation
- Managing Director, Cybersecurity
- Corporate Aviation Cybersecurity Officer
- Aviation Industry Senior Cybersecurity Strategist
- Aviation Cybersecurity Business Development Consultant
- Aviation Cybersecurity Consultant

Graduates will also possess the required knowledge in aviation cybersecurity to serve as a subject matter expert and form their own private company.

## **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 aviation industry relies heavily on computer systems in its ground and flight operations. The security of the airline systems can directly impact the operational safety and efficiency of the industry, and indirectly impact its service, reputation and financial health.”

(Source: <https://www.iata.org/publications/store/Pages/aviation-cyber-security-toolkit.aspx>)

The projected increase in cyber systems and data analytics used throughout the aviation industry will require aviation professionals with skills in technologies such as computer systems, networks, machine-learning, artificial intelligence, and biometric technologies. Security to protect the data and the systems will be paramount.

(Source: <https://www.airport-technology.com/features/ai-at-airports-security/>)

The Industry watchdog organization, Cyber Startup Observatory, recently sounded the alarm on the need to address the pressing cybersecurity issues in aviation in its web article, “Aviation Cybersecurity: High Level Analysis, Major Challenges and Where the Industry is Heading”.

## *Introduction*

During recent years we have witnessed important attacks on large corporations, critical infrastructures of all kinds, governments and SMEs with different levels of sophistication and diverse severity in their impact.

As we might expect, the aviation industry is not an exception to this status quo. Nevertheless, there is a major difference with other industries like financial services, insurance or e-commerce to name just a few. In transportation and particularly in aviation there is a key life safety issue. A cyberattack, if successful, might end up in loss of numerous lives – resulting in a complete catastrophe. If that were not enough, it might also destroy trust and eventually the brand.

We might consider aviation cybersecurity as a subset of generic cybersecurity with the nuance of the referred possibility of losing lives.

Moreover, aviation and aerospace systems must support real-time behavior and they require ultra-high reliability. Many of these systems are safety critical and require strong certification and rigorous cybersecurity controls.

Complexity is another ingredient and definitely a challenge as avionic software may have between 100 million and 1 billion lines of code. As a consequence, software verification represents an important cost and certification is a not a quick process.

### *Multiple systems that need to be protected*

The aviation industry relies on a quite complex infrastructure integrated in multiple systems that need to be individually and holistically protected.

A thorough cyber assessment is needed involving aircraft and equipment manufacturers, air-traffic control, airports, airlines and all the other elements of the aviation infrastructure as an information system.

This should include penetration testing or red teaming where cyber experts try to gain access to the systems as well as vulnerability testing to look for flaws in security.

The key question is what makes a system vulnerable?

Two components are needed, a vulnerability and a pathway to attack that system or exploit that vulnerability. The suggestion that we do not need to patch a specific vulnerability unless there is a pathway is challenged by the possibility of not having identified an existing attack pathway.

Another very important element to consider is Insider threat. Reports show that Insider threat is on the rise, requiring employees to be educated in their role in mitigating such threats and adhering to cybersecurity policies and best practices. Processes and playbooks should be periodically reassessed and rigorously tested to ensure continuous

improvement. In addition, access controls should be put in place to only allow the people who absolutely need clearance to certain areas to the airport or the aircraft.

### *Challenges for the aviation industry*

During the last decade, the introduction of e-enabled or digital airplanes and widespread connectivity have increased the operational efficiency of the airlines. Nevertheless, this also involves increased interaction with many information systems that are outside the traditionally defined security perimeter.

Moreover, traditionally, one line of defense in aviation was the pretty specific knowledge needed by an attacker or cybercriminal due to the use of aviation specific software and hardware that was unavailable to the general public.

Important changes in recent years have created substantial challenges today:

- Increasing use of commercial off-the-shelf software and solutions that do not require the referred-to aviation specific knowledge to attack them.

- Smart aircraft with Flight-By-Wire (FBW) capabilities.

- Multiple interconnected systems: the security of the interoperation of all these systems needs to be tested from a red teaming perspective.

- The aircraft of the future is heading to software updated on the fly, which also creates important additional challenges.

- Bring Your Own Device (BYOD) into the cockpit.

- Aircraft certification is becoming more complex and it is likely that the strategy of issuing “Special Conditions” to harden the systems which might be at risk, may not be enough as they cover neither the whole interoperation of the systems nor its adaptability.

- There are two ongoing initiatives to modernize Air Traffic Control Systems:

- The Next Generation Air Transportation System or NextGen is the FAA-led modernization of America’s air transportation system, which calls for the information systems to be networked with IP technology into an overarching system of interoperating subsystems.

- The Single European Sky ATM Research or SESAR is the technological pillar of the Single European Sky and aims to improve Air Traffic Management (ATM) performance by modernizing and harmonizing ATM systems.

This upgrade makes sense from a management, communications and modernization standpoint, but it also opens air transportation to unforeseen vulnerabilities.

As we add new functionality, we also add attack vectors that need to be properly analyzed.



But there are also other factors that pose serious risks to the aviation industry:

- Lack of budget of resources for example in small airports or developing countries
- The existence of multiple regulations: this makes it very difficult to adapt the speed of the new regulations to the quickly evolving threat landscape.
- Multiple stakeholders: there are countless stakeholders in the mix and data flows constantly back and forth between numerous internal and external systems.
- Complex business relations and important geopolitics at play.

#### *Elements vulnerable to attacks*

As previously mentioned, the introduction of digital or connected airplanes as well as the airport of things, brings new vulnerabilities to the table. The key elements vulnerable to attacks considering the whole system are:

- Access, Departure and Passport Control Systems
- Cargo handling and shipping
- Reservation Systems
- Fuel gauges
- Hazardous Materials Transportation Management
- In-Flight Entertainment (IFE) and Connectivity Systems
- e-Enabled ground and onboard systems
- Electronic Flight Bags (EFB): an electronic information management device that helps flight crews perform flight management tasks easily and efficiently.
- Cabin crew devices
- Flight traffic management systems: Primary and Secondary Radar, Automatic Dependent Surveillance-Broadcast (ADS-B), Global Navigation Satellite System (GNSS), including GPS, GLONASS, GALILEO, BEIDOU and some other Regional Satellite Systems IRNSS (India), Zenith (Japan) and Compass (China).
- Airplane Information Management System (AIMS), including among others, the Flight Management System, the Thrust Management System, the Data Communication Management (Datalink) / Aircraft Communications Addressing and Reporting System (ACARS), the Central Maintenance System and the Flight Data Acquisition System.

#### *Where is the industry heading?*

The industry is aware of the cybersecurity challenges and is working very hard to address them. In the current climate, with increasing concerns about cybersecurity in all the different areas of our life, including financial transactions, internet, personal data and privacy, the aviation industry needs to show leadership and needs to be at the forefront of cybersecurity.

We are going to see initiatives that take a holistic approach to this complex system, not only its individual components, as well as analyzing its vulnerabilities and attack vectors.

Strategies like micro segmentation are going to be used to divide networks into multiple micro segments and to apply separate access privileges. This approach contains any compromise or data breach to its specific segment.

Artificial Intelligence and, in particular, Machine Learning as its subset will also have its applications in aviation cybersecurity. A weaponized AI in the hands of cyber criminals is a very worrying scenario. However, it also highlights the importance of investing heavily in AI-defence and research. Emerging machine learning models will create greater protection against these sophisticated and complex threats.

With AI, systems will have the ability to learn patterns and identify deviations in a way that traditional systems or analysts could only dream of.

The use of encryption is, and will continue to be, critical to the aviation industry to help protect both air traffic control and flight traffic management systems' information as well as customer and employee information which might include payment cards, national IDs, passport number, bank accounts and other Personal Identifiable Information (PII) and privacy.

Finally, Big Data and Predictive Analytics will also play an important role as we are entering a new age of aircraft sensors and processors the will add the “Big” in aviation data throughout all the aviation ecosystem, including connectivity, operations or predictive maintenance to name just a few.”

(Source: <https://cyberstartupobservatory.com/aviation-cybersecurity-high-level-analysis-major-challenges-and-where-the-industry-is-heading/>)

The dramatic growth in the aviation industry is increasing the demand for aviation professionals in all areas. The aviation industry is thriving as the economy continues to grow and the effect of the recent reduction in the corporate tax rate to 21% is beginning to be felt across the sector.

“All signs and numbers point to a huge year for the aviation industry. Even in December, with much of the nation frozen, the aviation industry added 30,000 jobs, according to the Bureau of Labor Statistics.

The projected need of aviation managers with degrees is high in the United States.

**Employment projections data for administrative services managers, 2016-26**

Occupational Title	SOC Code	Employment, 2016	Projected Employment, 2026	Change, 2016-26	
				Percent	Numeric
Administrative services managers	11-3011	281,700	310,200	10	28,500

SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program

**Long Term Occupational Projections (2014-2024) by State**

Area	Title	Base	Projected	Change	% Change	Avg. Anl Openings
Maryland	Administrative Service	6,930	8,370	1,440	20.9	260

Area	Title ↕	Base	Projected	Change	% Change	Avg. Anl Openings
Virginia	Administrative Service	4,380	4,820	440	10.1	130
Area	Title ↕	Base	Projected	Change	% Change	Avg. Anl Openings
District of Columbia	Administrative Service	1,880	1,980	100	5.6	50
Area	Title ↕	Base	Projected	Change	% Change	Avg. Anl Openings
Pennsylvania	Administrative Service	8,360	8,930	570	6.8	210

(Source: <http://www.projectionscentral.com/Projections/LongTerm>)

A September 12, 2018 job search of openings for aviation management positions with graduate degrees listed 7,644 jobs indicating the demand of these needed executives.

(Source: <https://www.indeed.com/jobs?q=aviation+management&l=>)

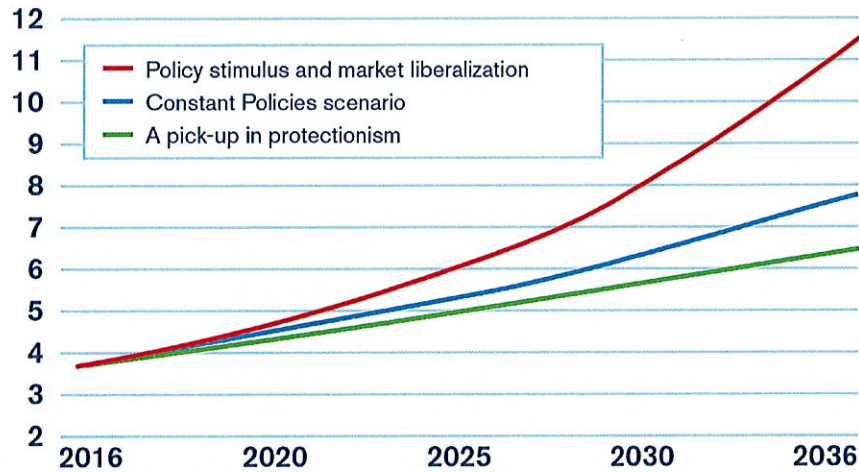
The urgent need for properly trained aviation management professionals with the latest skills in the worldwide aviation industry was described in a recent article by the International Air Transport Association (IATA).

The International Air Transport Association (IATA) expects 7.8 billion passengers to travel in 2036, a near doubling of the 4 billion air travelers expected to fly this year. The prediction is based on a 3.6% average Compound Annual Growth Rate (CAGR) noted in the release of the latest update to the association's 20-Year Air Passenger Forecast (<https://www.iata.org/publications/store/Pages/20-year-passenger-forecast.aspx>).

“All indicators lead to growing demand for global connectivity. The world needs to prepare for a doubling of passengers in the next 20 years. It's fantastic news for innovation and prosperity, which is driven by air links. It is also a huge challenge for governments and industry to ensure we can successfully meet this essential demand,” said Alexandre de Juniac, IATA's Director General and CEO.

Planning for growth will require partnerships to be strengthened between the aviation industry, communities and governments to expand and modernize infrastructure. Runways, terminals, and ground access to airports will come under increasing strain. Innovative solutions to these challenges, as well as to the baggage and security processes, cargo handling, and other activities, will also be needed. And air traffic management needs urgent reform to cut delays, costs and emissions. Most of all, the human capital to support the operations of all the change must be educated and trained to enter this vastly growing field.

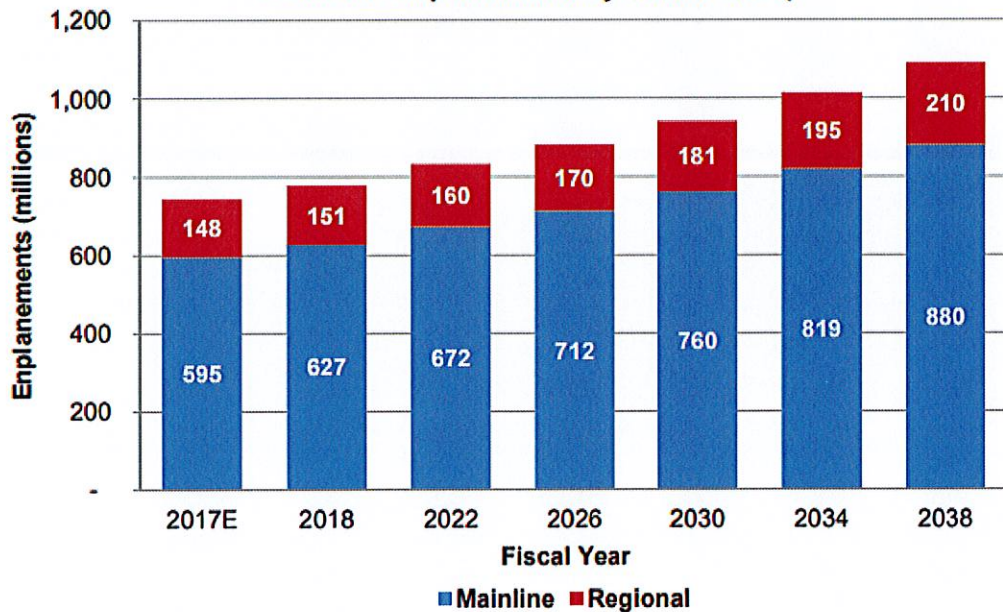
## Global Passengers (billion, segment basis)



(Source: <https://www.iata.org/pressroom/pr/Pages/2017-10-24-01.aspx>)

The demand for aviation cybersecurity professionals is being driven by steady, and at times explosive, growth in airline passenger traffic and commercial package shipping. The commercial air carrier industry in 2018 will be shaped by four distinct trends: (1) easing capacity discipline; (2) steady growth of seats per aircraft, whether through up-gauging or reconfiguring existing aircraft; (3) increasing competitive pressure due to ultralow-cost carrier expansion; and (4) continued reliance on ancillary revenues. Overall, the industry will experience continued growth and increased travel demand.

### U.S. Commercial Air Carriers Domestic Enplanements by Carrier Group



(Source: [https://www.faa.gov/data\\_research/aviation/aerospace\\_forecasts/media/FY2018-38\\_FAA\\_Aerospace\\_Forecast.pdf](https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2018-38_FAA_Aerospace_Forecast.pdf))

Total passengers between the United States and the rest of the world increased an estimated 5.4 percent in 2017 (231.9 million) as all regions posted gains led by a 6.4 percent increase in the Atlantic region.

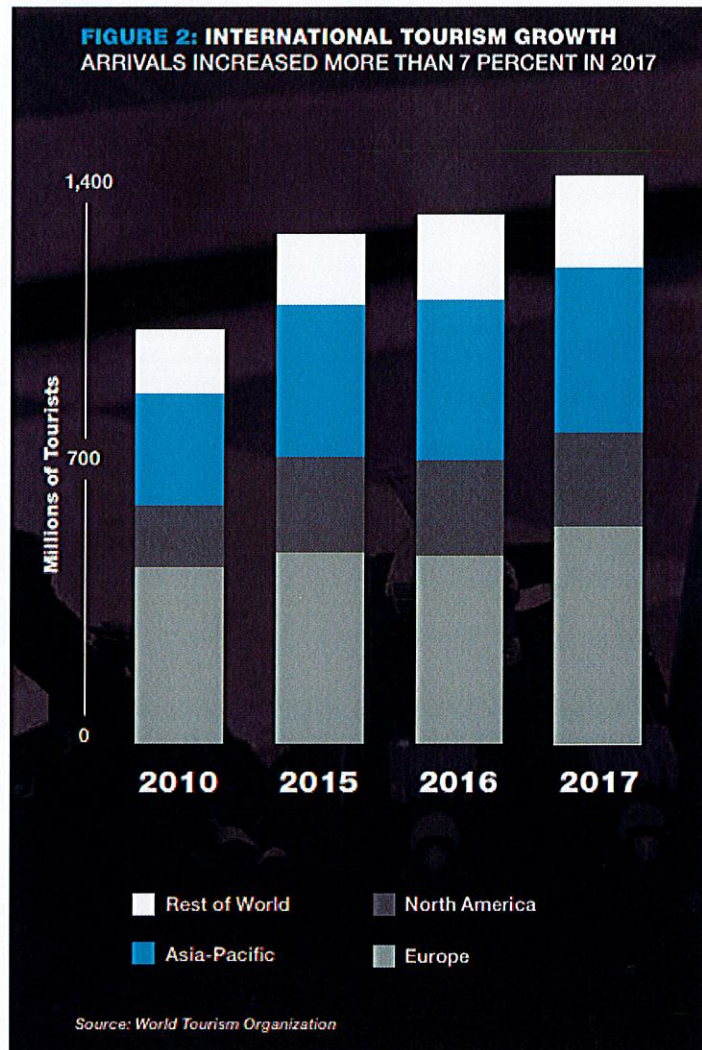
The Federal Aviation Administration projects total passenger growth of 5.2 percent per year as global economic growth accelerates. Stable global economic growth averaging 2.9 percent a year over the next 20 years (2018-2038) is the foundation for the forecast growth of international passengers of 3.5 percent a year, as levels double from 244 million to 486 million.

**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.**

Aviation is a dynamic industry that is constantly affected by, and reacts to, varying economic and socio-political factors. The three key demands that are shown in all forecasts include the underlying increase in demand for air travel, the changes in regulatory requirements, and evolving technology advancements.

Year-over-year traffic growth averaged 6.5 percent during the past five years, setting a pace that exceeded the long-term average of around 5 percent. Low air fares, higher living standards with a growing middle class in large emerging markets, the growth of tourism and travel relative to total consumer spending in major economies, and new airline business models are all driving this boom in air travel.

Within the services sector of the global economy, consumer spending on travel and tourism continues to grow. According to the World Tourism Organization, international tourist arrivals grew 7.1 percent in 2017, faster than overall GDP growth. Like air passenger traffic, overall tourism has grown substantially, with almost 350 million more international tourists in 2017 than 2010. This trend is projected to continue, with the direct contribution of tourism and travel to global GDP expected to grow 4 percent per year in real terms in the next 10 years, according to the World Tourism and Travel Council. The outlook for strong air travel demand is consistent with broad consumer demand trends and travel and tourism outlooks.



(Source: <http://www.boeing.com/resources/boeingdotcom/commercial/market/commercial-market-outlook/assets/downloads/2018-cmo-08-18.pdf>)

After analyzing hundreds of aviation industry survey responses, aviation jobs site JSfirm.com predicted a year-over-year doubling of aviation industry job growth. Seventy-one (71) percent of the 387 companies that responded to the firm's Hiring Trends Survey projected moderate to significant growth, compared to thirty-three (33) percent that responded similarly in 2017.

(Source: <https://www.aopa.org/news-and-media/all-news/2018/march/13/jsfirmcom-survey-predicts-aviation-industry-growth>)

Boeing is the world's largest producer of airliner. Every year the company takes an objective look at the future of the airline business. The report is called Boeing's Commercial Market Outlook and it is based on current firm orders for its aircraft. The Commercial Market Outlook is the single most accurate projection of what the airline industry is going to be for the next 20 years.

In the latest edition of the Outlook, Boeing states:

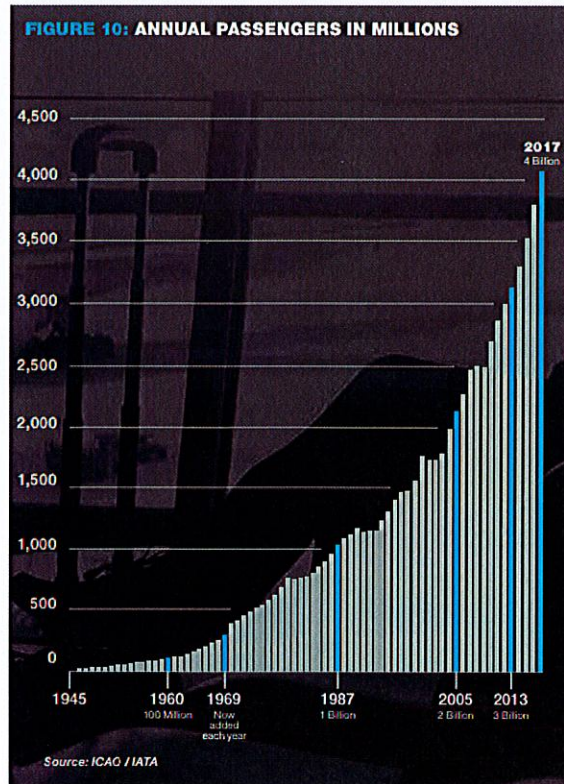
Over the past 20 years, air travel grew by an average of 4.8 percent each year. This was despite two major world recessions, major terrorist acts, the Asian financial crisis of 1997, the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 and two Gulf wars. During 40 years of producing the Current Market Outlook, we have learned that the resilience of air transport growth comes from its importance to the livelihood of people around the world.

On average over the next 20 years, passenger travel will grow at 5.0 percent and cargo at 5.8 percent. The fastest growing economies will lead the transformation into a more geographically balanced market.

A record 31 percent of our forecast for airplanes with more than 100 seats is already on firm order (7,900 aircraft), so we have unprecedented visibility of future airplane requirements, giving more certainty to the shape of our forecast.

(Source: <http://boeing.mediaroom.com/2018-07-17-Boeing-Forecasts-15-Trillion-Commercial-Airplanes-and-Services-Market>)

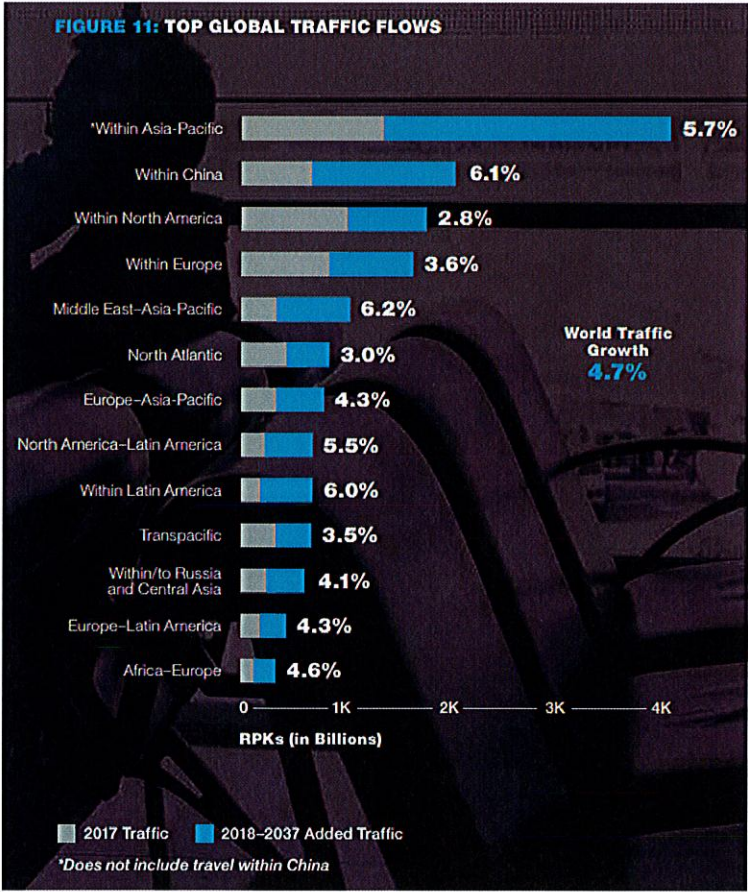
Air travel has proven to be a resilient market, and robust growth is expected to continue in the future. As the industry evolved from its infancy in the 1940s through the dawn of the jet age, the number of passengers traveling annually grew from about 100 million in 1960 to just over 1 billion in 1987. It took 18 years to double to 2 billion passengers, and only 7 more years to grow to 3 billion. The upward trajectory is expected to continue.



(Source: <http://www.boeing.com/resources/boeingdotcom/commercial/market/commercial-market-outlook/assets/downloads/2018-cmo-08-18.pdf>)

Demand in the commercial market is forecast to more than double in the next two decades. To meet this demand, we forecast the number of jet airplanes will nearly double to 48,000, at an average annual growth rate of 3.5 percent. To support this fleet growth, Boeing forecasts a need for more than 42,700 new deliveries, valued at over \$6 trillion, for growth and replacement in the next 20 years. Single-aisle airplanes command the largest share of new deliveries at more than 70 percent, with airlines needing more than 31,300 in the next 20 years. These new airplanes will continue to stimulate growth and provide required replacements for older, less-efficient airplanes. In addition, more than 9,000 new wide body airplanes will be delivered, allowing airlines to serve new markets—passenger and cargo—more efficiently than in the past.

In light of the above factors, we view recent performance as evidence of real demand, not a bubble prone to burst in subsequent years. Our forecast traffic growth remains healthy, with an average RPK growth rate of 4.7 percent per year over 20 years.



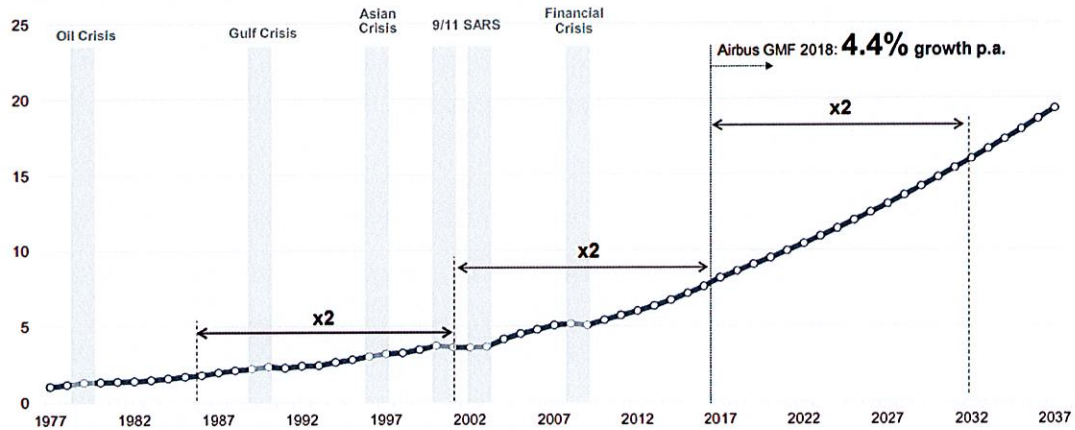


(Source: <http://www.boeing.com/resources/boeingdotcom/commercial/market/commercial-market-outlook/assets/downloads/2018-cmo-08-18.pdf>)

Overall, the aviation industry, and largest employers of aviation professionals, continues to rebound and, over time, doubles approximately every 15 years. This projects tremendous growth and opportunities for the industry and for the aviation professionals who operate the complex air travel system to have a shining and rewarding future.

### Traffic has proven to be resilient to external shocks and doubles every 15 years

World annual traffic (trillion RPKs)



5

RPK = Revenue Passenger Kilometre  
Source: ICAO, Airbus GMF 2018

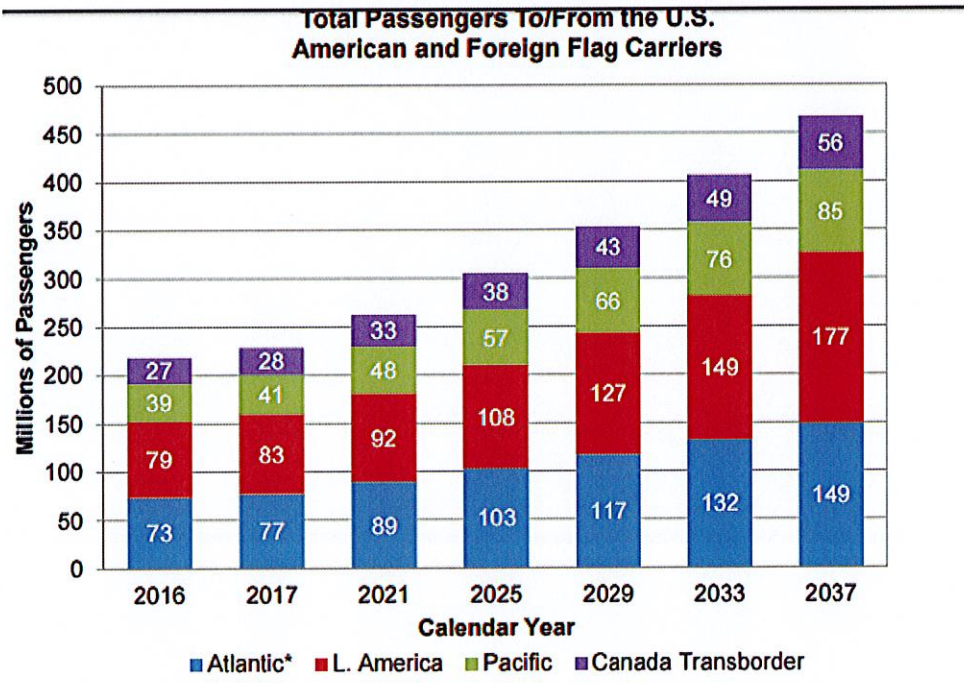
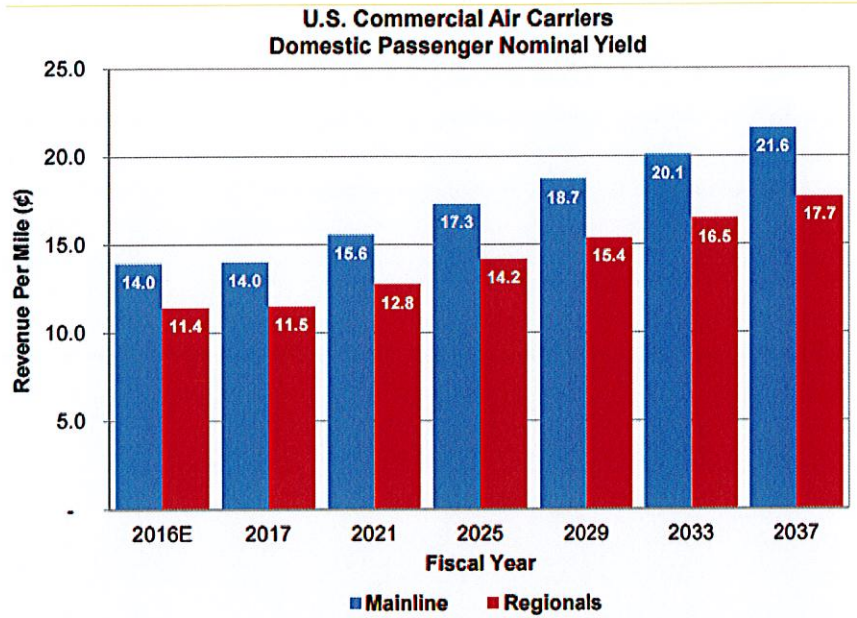


(Source: <https://www.airbus.com/aircraft/market/global-market-forecast.html>)

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

The need for aviation professionals with graduate degrees will continue to rise to support the demands of the airline industry as growth continues in manufacturing, airline travel, airports, cargo, and related government agencies as noted in a recent FAA report.

(Source: [https://www.faa.gov/data\\_research/aviation/aerospace\\_forecasts/media/FY2017-37\\_FAA\\_Aerospace\\_Forecast.pdf](https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2017-37_FAA_Aerospace_Forecast.pdf))



Source: US Customs & Border Protection data processed and released by Department of Commerce; data also received from Transport Canada  
 \* Per past practice, the Mid-East region and Africa are included in the Atlantic category.

However, the graduation rate of aviation professionals with a first graduate degree is lagging well behind the growth in the aviation industry. The number of aviation professionals with formal aviation specific cybersecurity training is just a small fraction of the group.

#### **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 master's degrees in Aviation Cybersecurity in Maryland or the surrounding region that the university could find. In addition to Capitol Technology University, there are seven other institutions in Maryland that offer a master's degree in Cybersecurity or a related Cyber area (e.g., Cyber Forensics, Cyber Operations, Cybersecurity Engineering Technology, Cybersecurity Policy, Cybersecurity Law, and Digital Forensics and Cyber Investigation). Those universities and colleges are Hood College, Johns Hopkins University, Stevenson University, University of Maryland Eastern Shore, University of Maryland University College, and University of Maryland Baltimore. However, none of those master's degrees are specifically focused on Aviation Cybersecurity.

If approved, Capitol Technology University's **M.S. in Aviation Cybersecurity** will position its graduates to fill the burgeoning requirement for Aviation Cybersecurity managers and senior leaders with cybersecurity expertise in the aviation industry in Maryland and the surrounding region.

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

The **M.S. in Aviation Cybersecurity** program is strongly aligned with the University's strategic priorities and is supported by adequate resources. The new **M.S. in Aviation Cybersecurity** degree will strengthen and expand upon existing technology degree programs at the University. In addition, **M.S. in Aviation Cybersecurity** 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 highly complex discipline. Research shows there is a significant shortage of highly skilled Aviation Cybersecurity professionals and leaders in a field being rapidly transformed by technology. This program helps fill the gap. 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. The University of Maryland Eastern Shore (UMES) has a M.S. in Cybersecurity Engineering Technology which is focused on the broad area of cybersecurity by providing "technical knowledge and skills needed to conduct operations that protect and defend information and information systems by ensuring availability, integrity, authentication, confidentiality and non-repudiation." (Source: <https://www.umes.edu/Tech/Pages/Master-of-Science-in-Cybersecurity-Engineering-Technology/>) The UMES degree does not have any courses focused on aviation cybersecurity. **Capitol Technology University's proposed degree is different; Capitol Technology University's M.S. in Aviation Cybersecurity is focused on the narrow area of Aviation Cybersecurity and will be offered online.**

#### **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. The University of Maryland Eastern Shore (UMES) has a M.S. in Cybersecurity Engineering Technology which is focused on the broad area of cybersecurity by providing "technical knowledge and skills needed to conduct operations that protect and defend information and information systems by ensuring availability, integrity, authentication, confidentiality and non-repudiation." (Source: <https://www.umes.edu/Tech/Pages/Master-of-Science-in-Cybersecurity-Engineering-Technology/>) The UMES degree does not have any courses focused on aviation cybersecurity. **Capitol Technology University's proposed degree is different; Capitol Technology University's M.S. in Aviation Cybersecurity is focused on the narrow area of Aviation Cybersecurity and will be offered online.**

#### **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 proposed program was established through a rigorous review of unmet needs by the University's New Programs Group. The group includes selected representation from the faculty, administrators, and Executive Council. The program will be overseen by a diverse group of faculty members with backgrounds in aviation, cybersecurity, aviation science and management, mechanical engineering, environmental engineering, aviation technology, 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:*

- Students will critically analyze problems in a variety of disciplines and synthesize relevant information to support the attainment of desired outcomes.
- Students will identify, formulate, and solve complex aviation cybersecurity problems by selecting and applying appropriate tools and techniques.
- Students will identify and synthesize problems in aviation cybersecurity processes, communications, methods, materials, systems, equipment, planning, scheduling, safety, economics, accounting, cost analysis and control, decision analysis, and optimization in order to develop optimum solutions.
- Students will conceptualize, apply and integrate effective strategies to use aviation cybersecurity information effectively in the decision-making process.
- Students will evaluate executive decisions in the context of the modern aviation cybersecurity threat environment to determine the potential impact on resources and profitability.
- Students will evaluate the legal, social, economic, environmental, and global ramifications of leadership actions and business decisions within aviation cybersecurity.

*Learning Outcomes:*

Upon graduation:

- a. Graduates will critically analyze problems within the aviation cybersecurity, synthesize the relevant information, and formulate solutions to attain desired outcomes.
- b. Graduates will demonstrate highly-developed traditional and technological techniques and skills in communicating ideas effectively and persuasively.
- c. Graduates will evaluate the legal, social, economic, environmental, and global ramifications of their leadership actions and business decisions within the aviation cybersecurity environment.
- d. Graduates will integrate advanced knowledge of aviation cybersecurity in the application of concepts, plans, processes, project management, and team leadership skills on the job.
- e. Graduates will identify, formulate, and solve complex aviation cybersecurity problems by selecting and applying appropriate tools and techniques.
- f. Graduates will demonstrate advanced knowledge of the impact of technology and technology-enabled operations in an integrated manner within the aviation cybersecurity.

**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 -- the Middle States Commission on Higher Education (MSCHE) and the 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

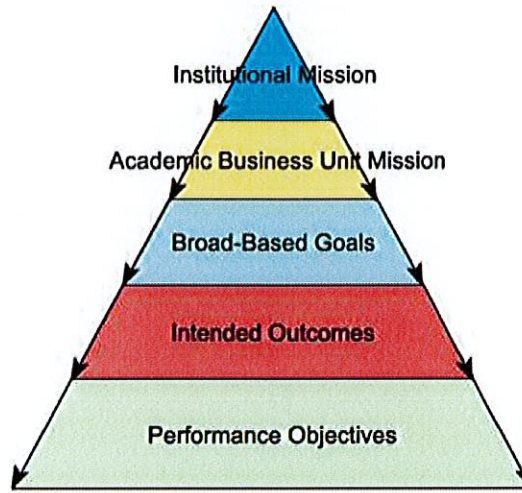
5. periodic assessment of the effectiveness of assessment processes utilized by the institution for the improvement of educational effectiveness.

(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



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 University (using Capitol Technology University's current M.B.A. and M.S. in Information Systems Management programs). The IACBE Assessment Pyramid will be tailored to the Cybersecurity Department and the **M.S. in Aviation Cybersecurity** if the degree is approved:

# OUTCOMES ASSESSMENT PLAN

## Capitol Technology University

### 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)
<p>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.</p> <p>Broad-Based Student Learning Goals Associated with this Outcome: 1, 3</p> <p>Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: 1, 2, 3</p>
<p>2. Graduates will be able to employ quantitative techniques and methods and interpret the results in the analysis of real-world business situations.</p> <p>Broad-Based Student Learning Goals Associated with this Outcome: 3</p> <p>Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: 3</p>
<p>3. Graduates will be able to communicate effectively in multiple forms in a convincing and persuasive manner.</p> <p>Broad-Based Student Learning Goals Associated with this Outcome: 2</p> <p>Key Learning Outcomes for Master's-Level Business Programs to which this Outcome is Linked: 4</p>

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

	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

<b>Intended Operational Outcomes for the School of Business and Information Sciences:</b>	
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	

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

Intended Operational Outcomes Assessed by this Measure: 5	
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**b) document student achievement of learning outcomes in the program**

The University will document student achievement of the learning outcomes in the **M.S. in Aviation Cybersecurity** 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). The public disclosure of learning outcomes assessment will be tailored to the Cybersecurity Department and the **M.S. in Aviation Cybersecurity** if the degree is approved.

## Report of Student Learning and Achievement

### Capitol Technology University Department of Business and Information Sciences

<b>Mission of the Department of Business and Information Sciences</b>
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.

<b>Student Learning Assessment for the Master of Business Administration (MBA)</b>
<b>Program Intended Student Learning Outcomes (Program ISLOs)</b>
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:
<p>1. Capstone Strategic Management (MBA 650) Case Study</p> <p>Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7</p>	<p>At least 80% of the students will score 80% or higher on the case study evaluation rubric.</p>
<p>2. Capstone Project (MBA 700)</p> <p>Program ISLOs Assessed by this Measure: 1, 2, 4, 5, 6</p>	<p>At least 80% of graduating MBA students will score 80% or higher on the Capstone Project evaluation rubric.</p>
Assessment Instruments for Intended Student Learning Outcomes— Indirect Measures of Student Learning:	Performance Objectives (Targets/Criteria) for Indirect Measures:
<p>1. Graduating Student Survey (Graduate)</p> <p>Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7</p>	<p>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.</p>
<p>2. End-of-course survey (contains overall course and curriculum questions)</p> <p>Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7</p>	<p>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.</p>
<p>Assessment Results: Master of Business Administration (MBA)</p>	
Summary of Results from Implementing Direct Measures of Student Learning:	
<p>1. <u>Capstone Strategic Management (MBA 650) Case Study:</u></p> <p>Percentage of Students Achieving a Score of 80% or Higher on the Capstone Strategic Management Case Study:</p> <p>Capstone Strategic Management Case Study (Program ISLO 1, 2, 3, 4, 5, 6, 7): 100% of Total (Class average score: 90.8%)</p>	

	<p><b>2. <u>Capstone Project (MBA 700):</u></b></p> <p>Percentage of Students Achieving a Score of 80% or Higher on the Capstone Project:</p> <p>Capstone Project (Program ISLO 1, 2, 3, 4, 5, 6, 7):      100% of Total      (Class average score: 96.6%)</p>																		
	<p><b>Summary of Results from Implementing Indirect Measures of Student Learning:</b></p> <p>1. <u>Graduating Student Survey (Graduate):</u></p> <p>Not Assessed: the response rate was not statistically significant.</p>																		
	<p>2. <u>End-of-course Survey:</u> (contains overall course questions, curriculum questions, and percentage of students who “agree” and “strongly agree”)</p> <table border="0"> <tr> <td>1. The instructor was well prepared to present and discuss course material.</td> <td>96.4%</td> </tr> <tr> <td>2. The instructor presented content in a systematic and organized fashion, relating parts to the whole.</td> <td>97.5%</td> </tr> <tr> <td>3. The instructor used supplemental technology to present material (ex., audio visual aids, Canvas, www, etc.)</td> <td>95.7%</td> </tr> <tr> <td>4. The instructor posed questions to students designed to promote critical thinking and analysis.</td> <td>90.4%</td> </tr> <tr> <td>5. The instructor promoted free-flow of communication: instructor and student, and between students.</td> <td>97.5%</td> </tr> <tr> <td>6. The instructor introduced divergent viewpoints in areas where different points of view exist.</td> <td>92.5%</td> </tr> <tr> <td>7. The instructor clarified abstract and complex ideas, using examples within students</td> <td>91.5%</td> </tr> <tr> <td>8. The instructor periodically evaluated students.</td> <td>90.3%</td> </tr> <tr> <td>9. The instructor assigned homework which reinforces the lecture materials.</td> <td>95%</td> </tr> </table>	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%
1. The instructor was well prepared to present and discuss course material.	96.4%																		
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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							
	Direct Measure 1 Performance Target Was...	Direct Measure 2 Performance Target Was...	Direct Measure 3 Performance Target Was...	Direct Measure 4 Performance Target Was...	Indirect Measure 1 Performance Target Was...	Indirect Measure 2 Performance Target Was...	Indirect Measure 3 Performance Target Was...	Indirect Measure 4 Performance Target Was...
1. Graduates will be able to identify organization problems and use information systems, technology, financial and accounting techniques, and marketing research, and other decision-making tools to strategically analyze, assess, and devise solutions to business problems in a global	Met	Met			NA	Met		

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	Met	NA	Met		
<b>Proposed Courses of Action for Improvement in Learning Outcomes for which Performance Targets Were Not Met:</b>							
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.							

<b>Student Learning Assessment for the Master of Science in Information Systems Management (MSISM)</b>	
<b>Program Intended Student Learning Outcomes (Program ISLOs)</b>	
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.	
<b>Assessment Instruments for Intended Student Learning Outcomes—</b>	<b>Performance Objectives (Targets/Criteria) for Direct Measures:</b>

<b>Direct Measures of Student Learning:</b>	
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.
<b>Assessment Instruments for Intended Student Learning Outcomes— Indirect Measures of Student Learning:</b>	
1. Graduating Student Survey (Graduate)  Program ISLOs Assessed by this Measure: 1, 2, 3, 4, 5, 6, 7	Performance Objectives (Targets/Criteria) for Indirect Measures:  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)	
<b>Summary of Results from Implementing Direct Measures of Student Learning:</b>	
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%)	
<b>Summary of Results from Implementing Indirect Measures of Student Learning:</b>	
1. <u>Graduating Student Survey (Graduate):</u>	

Not Assessed: the response rate was not statistically significant.

2. <u>End-of-course Survey:</u> (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							
	Direct Measure 1 Performance Target Was...	Direct Measure 2 Performance Target Was...	Direct Measure 3 Performance Target Was...	Direct Measure 4 Performance Target Was...	Indirect Measure 1 Performance Target Was...	Indirect Measure 2 Performance Target Was...	Indirect Measure 3 Performance Target Was...	Indirect Measure 4 Performance Target Was...
<b>Program ISLOs</b>								
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				NA	Met		
2. Graduates will develop leadership skills and demonstrate the ability to become a change agent in a complex global economy.	Met				NA	Met		
3. Graduates will be able to communicate effectively in multiple forms and demonstrate the ability to	Met				NA	Met		



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.	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									NA				Met	
<b>Proposed Courses of Action for Improvement in Learning Outcomes for which Performance Targets Were Not Met:</b>															
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 **Master of Science (M.S.) in Aviation Cybersecurity** program is designed to meet the growing needs of today's business and government environments where aviation cybersecurity is now a major business consideration. The **M.S. in Aviation Cybersecurity** provides advanced graduate-level management education where the latest aviation cybersecurity concepts are reviewed and analyzed with a laser focus. Throughout the program, the latest technological developments, applications, and considerations in the aviation industry are explored and applied to real-life industry challenges. Students will learn optimum methods and techniques to define resources and associated risks at an executive level in order to maintain profitability, manage work effectivity and efficiently, and ensure customer satisfaction.

The **M.S. in Aviation Cybersecurity** will prepare students for advanced cybersecurity and leadership positions throughout the aviation industry and related businesses.

*Description of program requirements:*

Entrance requirements: To be fully accepted into the program, students must have completed an undergraduate degree with a cumulative GPA of no less than 3.0 on a 4.0 scale.

Students who have not met the 3.0 undergraduate cumulative GPA requirements, or do not meet all the program specific prerequisites, are provided an opportunity to gain full acceptance. Depending on the degree program, additional information may be requested. In this case, students are provisionally admitted and limited to three courses of enrollment. To achieve full acceptance, provisional students must maintain a 3.0 cumulative GPA in their first three graduate courses. Upon doing so, students are automatically converted to full acceptance status. If a provisional student fails to achieve a minimum 3.0 cumulative GPA after completing three courses, then he or she will be academically dismissed, and will not be permitted to enroll in any further courses.

Degree Requirements:

The following is a list of courses for the **M.S. in Aviation Cybersecurity** degree. Students expecting to complete this degree must meet all prerequisites for the courses listed below. Credit may be granted for IAE-500 and CS-620 with the Cybersecurity Department Chair's and University Academic Dean's approval based on the student's demonstrated skills and previous professional work experience in the Cybersecurity field.

**Master of Science in Aviation Cybersecurity  
Courses**

***AVIATION CYBERSECURITY COURSE CURRICULUM: 36 CREDITS***

The **M.S. in Aviation Cybersecurity** provides a strong operational, managerial, and research background at the executive level for the aviation cybersecurity. Students learn to define the resources and risks to maintain profitability, manage work effectivity and efficiently, and ensure customer satisfaction in an aviation cybersecurity setting. The program focuses on strengthening the student's leadership skills, enhancing the student's understanding of new technologies, expanding the student's ability to use technology to solve aviation cybersecurity problems, and understanding the process of innovation. M.S. in Aviation Cybersecurity students must take all the following courses.

**IAE-500 Introduction to Information Assurance (3 Credits)**

This course will provide the requisite computer, data communications, Internet and database skills to students embarking on careers in information assurance (IA), at the senior levels. It is designed primarily for professionals who seek concentrated professional education in one or more of the many fields associated with IA. Labs, simulations and special problems will be used throughout the course. Prerequisite: None. (Note: Credit may be granted for IAE-500 with the Cybersecurity Department Chair's and University Academic Dean's approval based on the student's demonstrated skills and previous professional work experience in the Cybersecurity field.)

**CS-620 Operating System Principles for Information Assurance (3 Credits)**

This course is an overview of the UNIX operating system. The content will include shell programming, process management, processor management, storage management, scheduling algorithms, resource protection and system programming. The course will include programming projects focused on Information Assurance problem solving utilizing the C programming language primarily. Students are expected to be familiar with virtual machines, the UNIX command line and a basic programming language. Basic knowledge of C programming and UNIX helpful. Prerequisite: None. (Note: Credit may be granted for CS-620 with the Cybersecurity Department Chair's and University Academic Dean's approval based on the student's demonstrated skills and previous professional work experience in the Cybersecurity field.)

**AVT-627 Impact of Emerging Technology on Aviation (3 Credits)**

The course will focus on emerging technologies that influence aviation leadership and management. Students will learn leading edge skills to understand the technologies and innovations that are increasingly changing the aviation landscape. The course will put students at the forefront of new technology to produce value for their future business, employers, and customers. Prerequisite: None.

**AVT-635 Technology-Enabled Aviation Operations (3 Credits)**

The course will prepare the student to contribute effectively in today's technology-enabled aviation workplace by understanding how to leverage processes, systems, and data to create business value. The course will examine aviation operations in established companies and start-up firms. Students will explore the perspectives and needs of both established and start-up

organizations. Prerequisite: AVT-627.

**IAE-679 Vulnerability Mitigation (3 credits)**

This "Defense-in-Depth" course provides the student detailed understanding of the need for internal and external vulnerability assessment. An integral technical part of any risk management program, this course goes hand-in-hand with analytical practices. Prerequisite: IAE-500. Co-requisite: IAE-685.

**IAE-685 Principles of Cybersecurity (3 Credits)**

This class explores the overarching security architectures and vectors of information assurance from a management perspective to allow the learner to formulate the basis for sound business decisions. Students gain an appreciation for systems, networks, processes, methodologies, documentation requirements, recovery processes, certification and accreditation processes as well as "best practice" implementation, training and continuous improvement. Discussions in this course give the correct acumen of personnel security, physical security, and technical operational security as these principles relate and interface with information security principles. Defense-in-depth principles also are covered for designing proper physical security programs. At the completion of the course students should be able to manage an IA function and evaluate an organization's Contingency Planning process for adequacy. Prerequisite: IAE-500.

**AVT-686 Aviation Cybersecurity Management (3 Credits)**

Aviation cybersecurity management is becoming one of the most important aspects of aviation. Aircraft systems integrity, airport security, security of the passengers and cargo are a few examples of where the reliance on computer networks is significant and the consequences of a breach are great. Students will cover the needs and developments of cybersecurity techniques to minimize or eliminate threats. The course covers aviation cybersecurity management within the context of rapid technological changes. Prerequisite: IAE-685.

**IAE-675 Computer Forensics and Incident Handling (3 Credits)**

This course begins with lectures discussing the laws and rights to privacy by individuals and what organizations may or may not do. Online ethics are considered. It then moves on to understanding incident handling and how incident response teams work, managing trouble tickets, and basic analysis of events to determine if an incident has occurred. It concludes with computer forensics issues and practices, and rules of evidence. This course prepares students for the AccessData Certified Examiner (ACE) and Mobile Phone Examiner Plus (MPE+) Certifications. Prerequisite: IAE-685.

**IAE-677 Malicious Software (3 Credits)**

This course examines malicious software detection and malicious software defenses including tripwire and signature software techniques. Viruses, worms and Trojan horses, logic bombs, malicious CGI scripts will be discussed. Students will review the anatomy of well-known viruses and worms to understand how they work. Mobile code issues as they apply to web and application technologies and resulting insecurities will be discussed in detail. Students will then review the underlying methodologies used by the anti-virus vendors and freeware offerings to protect electronic assets from harm or other compromise. Co-requisite: IAE-675.

**IAE-679 Vulnerability Mitigation (3 Credits)**

This "Defense-in-Depth" course provides the student detailed understanding of the need for internal and external vulnerability assessment. An integral technical part of any risk management program, this course goes hand-in-hand with analytical practices. Co-requisite: IAE-685.

**IAE-680 Perimeter Protection (3 Credits)**

In this "defense-in-depth" course, firewalls and network IDS issues are discussed. A detailed understanding of firewall configuration and rule sets, load balancing, web farms, wireless access, web security issues and network intrusion detection is explored to prepare the student with the basic tools to coordinate the design and implementation of perimeter network defenses for a high volume, high access site. Prerequisite: IAE-679.

**IAE-682 Internal Protection (3 Credits)**

This course explores the protections available to the practitioner through host operating systems and third party equipment and software, to protect the inner network from the attacker who has successfully circumvented the perimeter or from the disgruntled insider. Use of methodologies including host-based intrusion detection methods, audit settings and review PC Firewalls, host operating hardening for Linux and Windows 2000, and Virtual LANs will be reviewed. Prerequisite: IAE-680.

**AVT-703 Aviation Cybersecurity Research Project (3 Credits)**

Students will conduct a graduate level research project in the field of aviation cybersecurity. The research and thesis development are supervised by a faculty member. The student will research and write the thesis in this course and prepare to defend the thesis in a viva voce (i.e., oral) examination. This course is the last course in the program as the student applies accumulated knowledge of program's classes to this effort. Prerequisite: All other course requirements must be completed.

**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 content. Capitol Technology University is currently accredited by, 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 **M.S. in Aviation Cybersecurity** 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 in the on-ground classroom and online environment to facilitate a high-level 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 **M.S. in Aviation Cybersecurity** 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.**

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 faculty members with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, or 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. Antunes, Dr. Bajracharya, Dr. Bajwa, Dr. Baker, Dr. Butler, Dr. McAndrew, and Dr. Pitman are

fulltime faculty members. Thirteen of the fifteen faculty members hold terminal degrees. Prof. Morgan and Prof. Weideman are professionally qualified given their significant years of experience and positions held in Aviation. Their resumes and curriculum vitae have reviewed and each one is deemed professionally qualified to teach their courses at this level. 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 **M.S. in Aviation Cybersecurity** are:

INSTRUCTOR	BACKGROUND	COURSES ALIGNED TO BE TAUGHT
Dr. Alex “Sandy” Antunes Full time	Ph.D. Computational Sciences and Informatics M.S. Astronomy B.S. Astronomy	AVT-627, AVT-635, AVT-703
Dr. Chandra Bajracharya Full time	Ph.D. Electrical and Computer Engineering M.S. Applied Computing M.S. Electrical Power Engineering B.E. Electrical Engineering	AVT-627, AVT-635, AVT-703
Dr. Garima Bajwa Full time	Ph.D. Computer Science and Engineering M.S. Electrical and Computer Engineering B.S. Electronics and Communication Engineering	AVT-627, AVT-635, AVT-703
Dr. Richard Baker Full time	Ph.D. Information Systems M.S. Computer Science B.S. Mathematics F-4 Pilot	All AVT courses
Dr. Hasna Banu Adjunct	Ph.D. Theoretical Physics M.S. Mathematics B.S. Mathematics	AVT-627, AVT-635, AVT-703
Dr. Malcolm Beckett Adjunct	DBA. Quality Systems Management in Homeland Security and Defense M.S. Information Systems Management	All IAE 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	AVT-686, AVT-703, all IAE courses

Dr. Jami Carroll Adjunct	D.Sc. Cyber Security M.S. Cyber Security M.B.A.	AVT-686, AVT-703, all IAE courses
Dr. Emily Darraj Adjunct	D.Sc. Cybersecurity M.S. Information Assurance	All IAE 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 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)	All AVT courses
Dr. Raymond Letteer Adjunct	D.Sc. Cyber Security M.S. Information Assurance	All IAE courses
Prof. Sam Morgan III Adjunct	M.S. Aerospace, Aeronautical, & Astronautical Engineering B.G.S. General Studies MQ-1 Predator Pilot MQ-9 Reaper Instructor Pilot A-10 Instructor/Evaluator Pilot F-16 Maintenance Officer Military Pilot (T-37, T-38)	All AVT courses
Dr. Alexander Perry Adjunct	D.Sc. Cyber Security M.S. Computational Mathematics	AVT-686, AVT-703, all IAE courses
Dr. Jason Pittman Full time	Ph.D. Information Assurance M.S. Network Security B.S. English Literature and Micro-Biology	AVT-686, AVT-703
Prof. Nathan Weideman Adjunct	M.S. Astronautical Engineering B.S. Professional Aeronautics	All AVT courses

Additional doctorally-qualified faculty will be added in the near future.



ADDITIONAL JUSTIFICATION:

Capitol Technology University's instructors for this program are leading experts in the aviation and cybersecurity fields:

1. Dr. Richard (Dick) Baker has served as the Chair and a member of Indiana State University's Department of Aviation Technology. The Director of Indiana State University's Center for Unmanned Systems and Human Capital Development, Baker holds a bachelor's degree in Mathematics and master's degree in Computer Science from Indiana State University. He received his doctorate in Information Systems from Nova Southeastern University. Baker has been instrumental in the successful launch of ISU's Center for Unmanned Systems and directs the research and collaboration efforts with strategic partners. Baker brings many years of executive level experience in Information Technology (IT) from companies such as General Motors and Electronic Data Systems (EDS). Prior to entering the academic world, he also had extensive experience in the Aviation industry. Baker served as the Director of Human Factors and Safety for American Airlines where his responsibilities included CRM and safety training for all pilots and flight attendants. He received professional certification in Risk Management from the Transportation Safety Institute. Baker retired as a Colonel from the Indiana National Guard in 2003 where he held command positions including Indiana State Director of Operations, Indiana State Director of Support, 181st Fight Wing Support Group Commander, 181st Mission Support Squadron Commander, and 181st Chief of Supply. During his tenure with the Air Guard, he was a Weapons Systems Officer in the F-4 and worked extensively with airspace issues, rapid response teams for counter-terrorism, the Counterdrug Operations at United States Joint Forces Command, and was a trainer for the Air National Guard's Domestic Preparedness Operations.
2. Prof. Sam Morgan III has served as the Director of Unmanned Systems and an Aviation Instructor at Indiana State University. Mr. Morgan has over 26 years of experience in aviation and unmanned systems. During his 24 years as a pilot in the United States Air Force, Mr. Morgan served as an A-10 Instructor/Evaluator Pilot, MQ-9 Reaper Instructor Pilot, MQ-1 Predator Pilot, F-16 Maintenance Officer, T-37/T-38 Pilot, Flight Safety Officer, Functional Check Flight Pilot, A-10 IP Flight Commander, Command Post Chief, Emergency Actions Controller, Airborne Jump-certified Battalion Air Liaison Officer, and Air Force ROTC Detachment Commander. He retired from active duty as a Colonel in the U.S. Air Force. Following his retirement from active duty, Mr. Morgan continued his work in aviation and unmanned systems as an instructor at Indiana State University.
3. Prof. Weideman is professionally qualified given his significant years of experience and positions held in the aviation industry. He has served as an Aerospace Maintenance Duty Officer for the U.S. Navy for over the past 5 years. He also works with the Defense Threat Reduction Agency (DTRA) and U.S. Special Operations Command (USSOCOM) on aerospace issues for Counter Weapons of Mass Destruction (CWMD) efforts. His previous positions include directing Navy Reserve Aircraft Maintenance Modification and Overhaul for a C-130 squadron, Senior Technical Writer for Aviation, and Naval Analyst for Naval Aviation matters.
4. Dr. William Butler, Chair, Cyber and Information Security, Director, Critical Infrastructures and Cyber Protection Center (CICPC). Dr. Butler is currently Director, Critical Infrastructures and Cyber Protection Center (CICPC) at Capitol Technology University. Prior to this appointment in 2013 Bill worked in the networking and IT industries as a network engineer and consultant for over 20 years. Bill also served as a joint qualified communications information systems officer in

the U.S. Marine Corps and retired as a Colonel with 30 years of service (active and reserve). Bill holds a Doctorate in cybersecurity earned from Capitol focusing on preserving cellphone privacy and countering illegal cell towers (IMSI catchers).

5. Dr. Jason Pittman a full-time Professor at Capitol Technology University. Dr. Pittman draws on his previous experiences as a network engineer, security architect and software developer to make the cybersecurity courses he teaches come alive for his students.
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, 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 well 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 full time 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.**

*Library 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 Engineering Technology, 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.B.A., M.S. in Aviation, 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, T.M.B.A. in Business Analytics and Data Science, T.M.B.A. in Cybersecurity, D.Sc. in Cybersecurity, Ph.D. in Aviation, Ph.D. in Business Analytics and Decision Sciences, Ph.D. in Critical Infrastructure, Ph.D. in Manufacturing, 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 **M.S. in Aviation Cybersecurity**.

Services provided to online students include:

- “Ask the Librarian”
- Research Guides
- Tutorials
- Videos

- Online borrowing

Capitol Technology University's online library and the on-campus library provide 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 access to 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 decision science documents. The proximity of the University of Maryland, College Park and other local area research and academic libraries provide the Puente Library with quick access to these materials as well.

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

**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](http://www.canvaslms.com)). The university pairs Canvas with Adobe Connect ([www.adobe.com/products/adobeconnect.html](http://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. Finance data for the first five years of the program implementation are to be entered. Figures should be presented for five years and then totaled by category for each year.**

**TABLE 1: RESOURCES**

<b>Resource Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Reallocation Funds	\$27,500	\$0	\$0	\$0	\$0
2. Tuition/Fee Revenue (c + g)	\$200,232	\$364,608	\$549,054	\$766,080	\$994,356
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	18	32	47	64	81
e. Credit Hour Rate	\$618	\$633	\$649	\$665	\$682
f. Annual Credit Hour	18	18	18	18	18
g. Total P/T Revenue (d x e x f)	\$200,232	\$364,608	\$549,054	\$766,080	\$994,356
3. Grants, Contracts and Other External Sources	0	0	0	0	0
4. Other Sources	0	0	0	0	0
<b>TOTAL (Add 1 – 4)</b>	<b>\$227,732</b>	<b>\$364,608</b>	<b>\$549,054</b>	<b>\$766,080</b>	<b>\$994,356</b>

- 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.

3. **Table 2: Expenditure.** Finance data for the first five years of the program implementation are to be entered. Figures should be presented for five years and then totaled by category for each year.

**TABLE 2: EXPENDITURES**

<b>Expenditure Category</b>	<b>Year 1</b>	<b>Year2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Faculty (b + c below)	\$144,000	\$184,500	\$226,937	\$310,147	\$397,374
a. #FTE	2	2.5	3	4	5
b. Total Salary	\$120,000	\$153,750	\$189,114	\$258,456	\$331,145
c. Total Benefits (20% of salaries)	\$24,000	\$30,750	\$37,823	\$51,691	\$66,229
2. Admin Staff (b + c below)	\$4,942	\$5,090	\$5,243	\$5,374	\$5,243
a. #FTE	.07	.07	.07	.07	.07
b. Total Salary	\$4,084	\$4,207	\$4,333	\$4,441	\$5,508
c. Total Benefits	\$858	\$883	\$910	\$933	\$956
3. Support Staff (b + c below)	\$57,475	\$87,638	\$119,772	\$153,460	\$188,755
a. #FTE	1.00	1.5	2	2.5	3
b. Total Salary	\$47,500	\$73,032	\$99,810	\$127,883	\$157,296
c. Total Benefits	\$9,975	\$14,606	\$19,962	\$25,577	\$31,459
4. Technical Support and Equipment	\$1,170	\$2,240	\$3,525	\$5,120	\$6,885
5. Library	\$0	\$0	\$0	\$0	\$0
6. New or Renovated Space	\$0	\$0	\$0	\$0	\$0
7. Other Expenses	\$51,500	\$53,500	\$55,500	\$57,500	\$59,500
<b>TOTAL (ADD 1-7)</b>	<b>\$259,087</b>	<b>\$332,968</b>	<b>\$410,977</b>	<b>\$531,601</b>	<b>\$657,757</b>

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 1. Additional support staff will be added in Years 2-5.

**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 \$65 per student in Year 1; the license fee per student is calculated to increase at \$5 per year 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 Dean 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 Dean.
- Department Chairs and University Academic Dean review the Graduating Student Survey data.
- Department Chairs and University Academic Dean review student internship evaluations.
- Department Chairs and University Academic Dean review grade distribution reports from the spring and summer semesters.
- Department Chairs and University Academic Dean 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 Dean, faculty and the advisory boards will develop the most effective strategy to move the changes forward.
  - NOTE: A complete curriculum review for degrees in each department occurs every two years. In most cases, the changes only require that the University Academic Dean 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 Dean 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 Dean meets 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 Dean review grade distribution reports from the Fall Semester.
- Department Chairs and University Academic Dean review the Graduating Student Survey data.
- Department Chairs and University Academic Dean review student course evaluations from the Fall Semester and the Spring Semester (in May before the Summer Semester begins).
- Department Chairs and University Academic Dean 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 Dean 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 Dean 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 Dean. 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 Dean 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 **M.S. in Aviation Cybersecurity** will be measured using the instruments identified in Section G and Section M as well as the assigned rubrics and assessment measures (e.g., competency exams/projects, case study exams) dictated by 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 individual courses 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 Graduate Academic Advisors work with each student to create a plan to remove any barriers to success. The Graduate 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 Dean review the student evaluations for every course offered at the University. The Department Chairs and University Academic Dean 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 Dean. If changes are needed at the faculty level, the Department Chairs 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 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.B.A., M.S. in Aviation, 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, T.M.B.A. in Business Analytics and Data Science, T.M.B.A. in Cybersecurity, D.Sc. in Cybersecurity, Ph.D. in Aviation, Ph.D. in Business Analytics and Decision Sciences, Ph.D. in Critical Infrastructure, Ph.D. in Manufacturing, 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 **M.S. in Aviation Cybersecurity**.

**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 **M.S. in Aviation Cybersecurity** 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 Cybersecurity, where this degree will be sponsored, is staffed by qualified teaching Department Chair, and other appropriately credentialed faculty.

The evaluation of programs and courses are done using the same process as all other programs at the University (please see Section M of this document). All Capitol Technology University faculty teach in the traditional classroom environment and online. (Please see 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. 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.

**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 consultants 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 will 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 Executive Council, University Academic Deans, and Department Chairs. On an annual basis, the information is reported to the University's accreditation authorities (e.g., MSCHE, IACBE, ABET, NSA, and DHS).