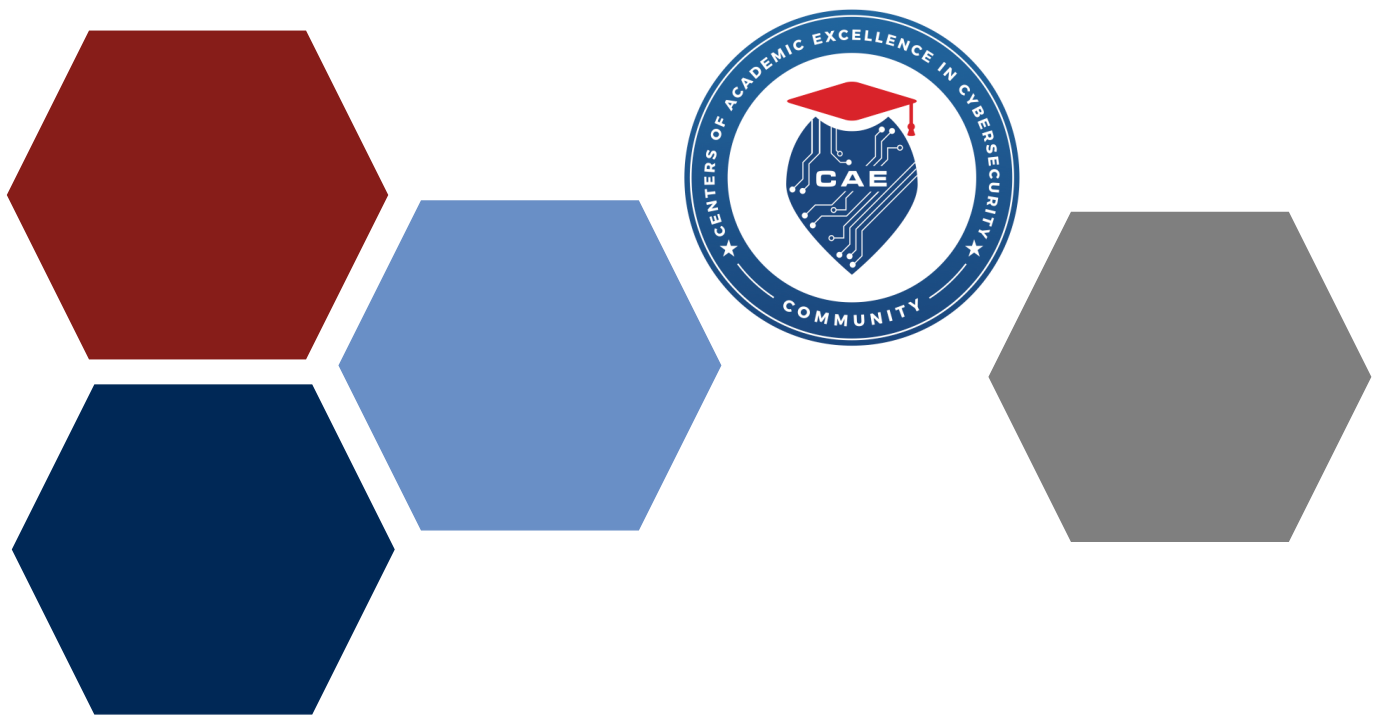


**November 2023**

# **Investigating the Effects of the CAE-C Designation on Minority Serving Institutions**



Prepared by:





# **TABLE OF CONTENTS**

Executive Summary .....	4
Background .....	6
Study Findings .....	8
Impact on Academic & Curricular Changes .....	9
Impact on Access to Resources .....	15
Impact on Hands-On Learning Opportunities for Students .....	19
Impact on Educational & Professional Outcomes for Students .....	22
Impact on Institutional Reputation .....	29
Public Representation of CAE-C Programs .....	31
Challenges & Recommendations .....	32
Conclusions .....	35
Methodology .....	37



# ACKNOWLEDGEMENTS

---

This research project was conducted by Redwood Consulting Collective, Inc. (RCC) on behalf of the Centers of Academic Excellence in Cybersecurity Community (CAE-C) administered through California State University, San Bernardino (CSUSB).<sup>1</sup> RCC is an applied research and program evaluation firm that has expertise in supporting initiatives related to cybersecurity workforce development. Some of RCC's current and recent projects include the external evaluation of the C3P Community College Pilot of the NSF Scholarship for Service Program and the National Center for Cybersecurity Training and Education (NCyTE) Center at Whatcom Community College.

For questions about this report, please contact:

**Dr. Silvana McCormick**

Executive Director

Redwood Consulting Collective, Inc.

[silvana@redwoodconsulting.org](mailto:silvana@redwoodconsulting.org)

---

<sup>1</sup> This study was supported by National Centers of Academic Excellence in Cybersecurity (NCAE-C) Grant H98230-20-1-0292: CAE-C in Cybersecurity Education Innovation Report.



# EXECUTIVE SUMMARY

The [National Centers of Academic Excellence in Cybersecurity](#) (NCAE-C), supported by the National Security Agency, is a robust ecosystem that currently includes 400 institutions of higher education designated as Centers of Academic Excellence in Cybersecurity. In 2023, a research study was conducted to investigate the **impact of the CAE-C designation on Minority Serving Institutions (MSIs)**. Data collected from CAE-C program leaders and alumni of CAE-C programs, along with publicly-available information, suggest that the **CAE-C designation has a large impact on students, faculty, and institutions.**

## Methodology

- 45 program leader surveys
- 18 program leader interviews
- 73 alumni surveys
- Website analysis of 18 CAE-C MSI institutions

## Areas of Greatest Impact

75% - 93% of program leaders believe the CAE-C designation had a moderate or large impact on their **program and institutional reputation**

CAE helped us over the past 18 years significantly with its program **reputation**. Both industry and government have been looking at the designation as an indication that our graduates are quality.  
-Program Leader

The curriculum was redesigned completely to meet the designation requirements, adding a better process to curriculum and much needed **innovation**.

-Program Leader

73% - 80% of program leaders believe the CAE-C designation had a moderate or large impact on their **program rigor, funding, resources, and courses offered**

We have received many **grants** due to the fact that we hold a CAE designation. This is where we have seen the greatest impact.

-Program Leader



73% - 77% of program leaders believe the CAE-C designation had a moderate or large impact on **student enrollment and retention**

We have about **doubled the enrollment** as a result of CAE, but more importantly, [the designation has] allowed us to select much better candidates and be more selective in the enrollment process, especially in the graduate level.

-Program Leader

My professional success is due to the extraordinary **guidance and knowledge** of my professors and CAE directors.

-Program Alumnus

It allowed for me to develop a **competence for cybersecurity** and **prepared me for jobs** within the real-world.

-Program Alumnus

Alumni believe the CAE-C designation impacted their professional success by:

- ✦ **Improving skills and professional preparation**
- ✦ **Increasing knowledge of the field**
- ✦ **Increasing confidence**
- ✦ **Developing relationships**
- ✦ **Assisting in finding employment**

## Areas of Least Impact

The areas with least perceived impact include: **(a) articulation agreements and dual credit options; (b) internship and apprenticeship opportunities; and (c) ability to host events.**

## Recommendations

Although they described numerous benefits of the CAE-C designation, stakeholders also shared challenges along with potential recommendations for both colleges and the CAE Community. Recommendations for colleges focused on **strategies to gain buy-in and support from leaders and faculty, and to support underrepresented minority students.** Recommendations for the CAE Community focused on **increasing and improving training, financial support, communication, opportunities for collaboration, and internship opportunities.**



# BACKGROUND

---

Currently in the United States, the cybersecurity workforce faces a significant challenge due to a pronounced shortage of skilled professionals, which is exacerbated by the continuously evolving landscape of cyber threats. This dearth in cybersecurity expertise is a major concern, as it compromises our nation's ability to effectively defend itself, thereby posing a substantial risk to national security.

“The success and competitive strength of the cyber workforce depends on ensuring all workers, including those from underserved and underrepresented populations, have foundational cyber skills... Recruiting and retaining members of underserved and underrepresented communities will grow the supply of talent to meet growing workforce demands.” (National Cyber Workforce Strategy, 2023, p.4)

The [National Centers of Academic Excellence in Cybersecurity](#) (NCAE-C), supported by the National Security Agency, is a robust ecosystem that supports the [National Cyber Workforce Strategy](#) (2023) Strategic Objective 3.3 to leverage the diversity of America to strengthen the cyber workforce. Two-year, four-year, and graduate-level institutions can apply to become a CAE-C designated institution and must meet a set of rigorous requirements every five academic years to maintain their status. Institutions with the designation commit to producing high-quality cybersecurity professionals and in return, they can leverage the substantial resources provided by the CAE-C Community.

Currently the CAE-C Community includes 400 institutions across the United States, a fourth of which are Minority-Serving Institutions (MSIs; N = 101). In the United States, MSIs are a vital component of the higher education landscape. These institutions open the doors of higher education to countless students from historically minoritized backgrounds, including a significant number from low-income families and those who are the first in their family to pursue a college education. MSIs are known for creating nurturing and inclusive campus environments. Furthermore, they play a crucial role in guiding students towards the completion of their academic credentials (American







Council on Education, 2023). Research indicates that MSIs are instrumental in promoting social mobility, particularly evident in their ability to elevate the most financially disadvantaged students to the upper-middle class at a rate surpassing that of non-MSIs (Espinosa, Kelchen, & Taylor, 2018).

CAE-C-MSIs are therefore poised to play a substantial role in ensuring that cyber training and education are broadly available to persons currently underrepresented in the cyber workforce. The current study was conducted on behalf of the CAE-C Community to examine the impact of CAE-C designation on Minority-Serving Institutions to better understand the role the NCAE-C plays in our national strategy to Transform Cyber Education and Expand and Enhance America’s Cyber Workforce.

**This report includes findings from a range of data sources collected between May - October, 2023.** Details about data collection can be found in the [Methodology](#) section.

**Information from program leaders is representative of a variety of institutions. However, data from alumni should be interpreted with caution given that 53% of responses are from alumni representing one institution.**

Data Sources	Study Participants
 <b>CAE-C Program Leader Survey</b>	<b>45 program leaders</b> representing 45%* of CAE-C MSI institutions
 <b>CAE-C Program Leader Interviews</b>	<b>18 program leaders</b> representing 18%* of CAE-C MSI institutions
 <b>CAE-C Alumni Survey</b>	<b>73 alumni</b> representing six institutions. 53% of surveys were completed by alumni at one institution
 <b>CAE-C MSI Website Analysis</b>	<b>18 MSI institutions</b> 18%* of CAE-C MSI institutions

\*There are a total of 101 CAE-C MSI institutions



# STUDY FINDINGS

---

This report includes findings about how the CAE-C designation has impacted MSIs across five domains. Findings are based on feedback from a range of stakeholders, including: leaders from CAE-C programs, alumni from CAE-C programs, and publicly-available information (institution websites).

**Stakeholders indicated the impact of the CAE-C designation across five domains.**

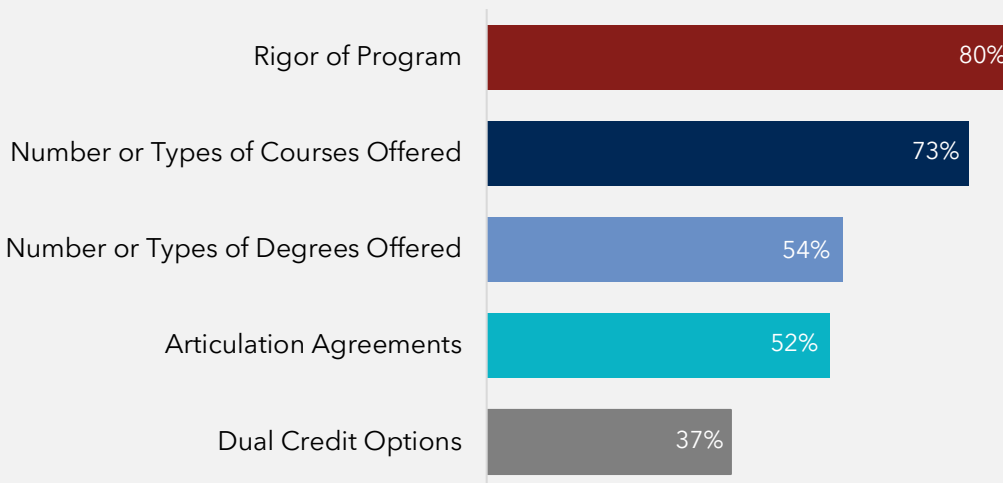




## Impact on Academic & Curricular Changes

Across data sources, program leaders shared how the **CAE-C designation has impacted academic and curricular changes at their MSI**. These include impact to the rigor of the program, number or types of courses offered, number or types of degrees offered, articulation agreements, and dual credit options. Program leaders also shared the benefits of receiving support from their institutions and challenges with hiring and gaining support from faculty.

**Most program leaders believe the CAE-C designation has a moderate-to-large impact on the rigor of their program (80%) and the number/types of courses offered (73%). Fewer leaders believe the designation has an impact on number/types of degrees offered, articulation agreements, and dual credit options.**



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on their academic and curricular changes



**Rigor of Program.** Most (80%) program leaders believe that the **CAE-C designation helps improve the rigor of their program in several ways: (a) informing them about the gaps, strengths, and quality of their offerings; (b) providing a framework for their curriculum (e.g., by aligning courses with Knowledge Units (KUs)); and (c) allowing them to keep their curriculum current and relevant.**

Program leaders appreciate collaborating with and receiving support from the CAE

Community to improve their program. One program leader explained that the designation *“creates a bar, and if your institution does not rise to that bar, you know what you need to do. And that's what I like about it: it improves your program and it makes it more in line with what the expectations are.”* Only three program leaders indicated that the designation has not had much impact, either because they recently received the designation or because rigor was already high and has remained the consistent.

The curriculum was redesigned completely to meet the designation requirements, adding a better process to curriculum and much needed innovation.

-Program Leader



**Number and Types of Courses Offered.** Most (73%) program leaders indicate that the **CAE-C designation helped increase the number and types of courses offered by: (a) expanding their curriculum with both broader and more specialized topics (e.g., application security and pen testing) and (b) improving their course quality by standardizing content.**

Program leaders appreciate learning from others in the CAE Community, which helps to improve their courses.

Based on CAE grant activities some courses like Embedded Systems got completely revamped and course materials and labs developed were instituted. Also, curriculum of BS in Cybersecurity program was updated.

-Program Leader



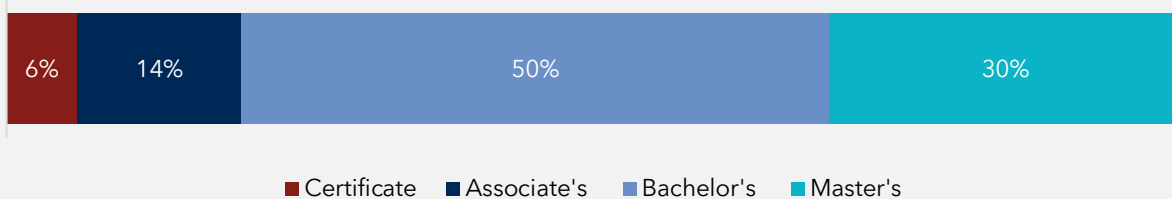
**Number or Types of Degrees Offered.** Approximately half (54%) of program leaders believe that the CAE-C designation helps increase the number and types of degrees offered. For example, **several institutions now offer Bachelor, Master, and Doctoral degrees.**

We originally had only two MS in cybersecurity...that were designated under CAE as technical and non-technical. Since then, we now offer also UG in Cybersecurity and Ph.D. in Cybersecurity Management. By networking with other CAEs and [seeing] what other schools have done with their programs helped us align our programs better. Also, given the CAE-R has 'Cybersecurity Management' as a research topic area, and many of our faculty do research along the lines of that area, we named the program as such. So, the CAE helped even name the programs.

-Program Leader

Feedback from **alumni of CAE programs** suggest that most **have a Bachelor's or Master's degree**, and **degrees are typically in a cybersecurity or related field.**

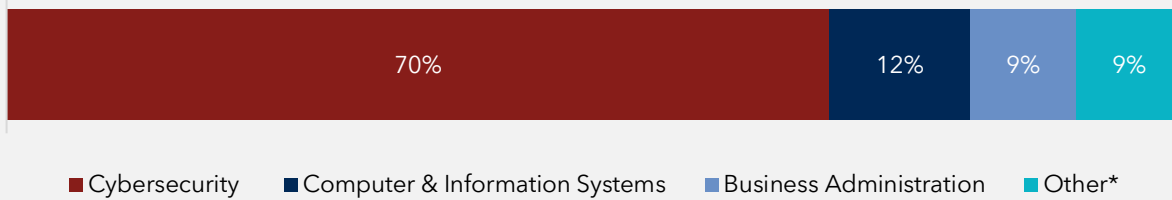
**Most alumni who shared their degree type ( $n = 72$ ) have a Bachelor's (50%) or Master's (30%) degree.**



Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution



## Most alumni who shared their degree area (n = 66) have a degree in the Cybersecurity (70%) field.



Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution

\*Other includes: social and behavioral sciences and electrical engineering



**Articulation Agreements.** Approximately half (52%) of program leaders indicated that the **CAE-C designation helped their articulation agreements by: (a) increasing interest in their program; (b) aligning their standards with local schools; and (c) making the articulation process "smoother because [stakeholders] understand the content within the designation."**



**Dual Credit Options.** Only 37% of program leaders believe that the **CAE-C designation helps increase dual credit options because of improved program reputation and prestige, which consequently leads to a growth of high school and community college partnerships.** For example, one program leader explained that *"the designation added prestige to our program that piqued the interest of local high schools to seek us out for collaboration."*

[The designation] has affected us immensely. Our cyber program is one of the top 10 in the nation in terms of number of dual enrollment students...My workload is six courses and I am teaching three of them in high school. My colleague is teaching two courses in high school.

-Program Leader



**Institutional Support.** Although not an area specifically rated on the survey, **most program leaders reported receiving positive support from their institutions**, which impacts their academic and curricular programming. For example, one program leader shared that *"the [institution leadership] recognize us and they support us just about for everything we do. They're very supportive. I can't say enough about the support we get!"* **Program leaders who do not have institutional support attribute it to a lack of understanding of the value of a CAE designation.** For example, one program leader explained that *"I wish more of my administrators would [understand the value of the designation]. I honestly think, if you went over to our Dean right now and you said 'CAE designation,' [they] wouldn't have a clue what I was talking about. And that's makes me very sad."*

I would characterize [institutional support] as excellent. They are funding my position... you don't have to have somebody in the job that I have to qualify to having a center. So, the commitment to that is huge! And I have to say the commitment to most of the projects that I want to do for students and for curriculum and for faculty are very well supported.

-Program Leader

Similar to support from institutional leaders, some program leaders shared that **faculty buy-in for designation-related activities is challenging.** However, once faculty understand the value of a cybersecurity curriculum and CAE-C designation, they became more supportive of the efforts. One program leader explained that the *"willingness of other faculty to also participate doesn't always happen... Once they know what we are doing, they give us all the resources."* In addition, **programs experience challenges in hiring faculty to teach courses.** Program leaders attribute these challenges to the location of their institution, limited access to people with the necessary expertise, and lack of financial motivation such a position provides. Specifically, they acknowledge that cybersecurity experts will receive a more competitive salary in a cybersecurity position rather than teaching. To assist with this challenge, some program leaders recruit former students as guest speakers and adjunct faculty.



## Specific Examples of Academic and Curricular Activities

<b>Rigor of Program</b>	<ul style="list-style-type: none"><li>* Use KUs to ensure appropriate depth and coverage of topics</li><li>* Meet the Program of Studies requirements</li><li>* Complete annual reports to keep track of curricula and student outcomes</li><li>* Include NetLab-based and Challenge-based (NICE, TryHackMe) activities into curriculum</li><li>* Include industry exam preparation and project-based learning in core courses</li><li>* Collaborate with other CAE institutions to improve rigor</li></ul>
<b>Number or Types of Courses Offered</b>	<ul style="list-style-type: none"><li>* Standardize courses</li><li>* Increase types of courses offered (e.g., software reverse engineering, wireless security, application security, pen testing, artificial intelligence)</li><li>* Offer more electives via use of CLARK materials</li><li>* Offer more online courses</li><li>* Work with CompTIA and EC council to offer classes and vouchers for certification</li></ul>
<b>Number or Types of Degrees Offered</b>	<ul style="list-style-type: none"><li>* Offer new AS degrees (e.g., cyber defense)</li><li>* Offer BS, MS, and PhD degrees in cybersecurity</li><li>* Offer certificates (e.g., Cyber Defense Path)</li></ul>
<b>Articulation Agreements</b>	<ul style="list-style-type: none"><li>* More articulation agreements</li><li>* Designation allows for easier mapping for articulation</li></ul>
<b>Dual Credit Options</b>	<ul style="list-style-type: none"><li>* Offer more courses for local high school students</li><li>* Access to GenCyber allows offering of dual credit</li><li>* Received additional grants to offer dual credit</li></ul>

### Dual Credit Highlight

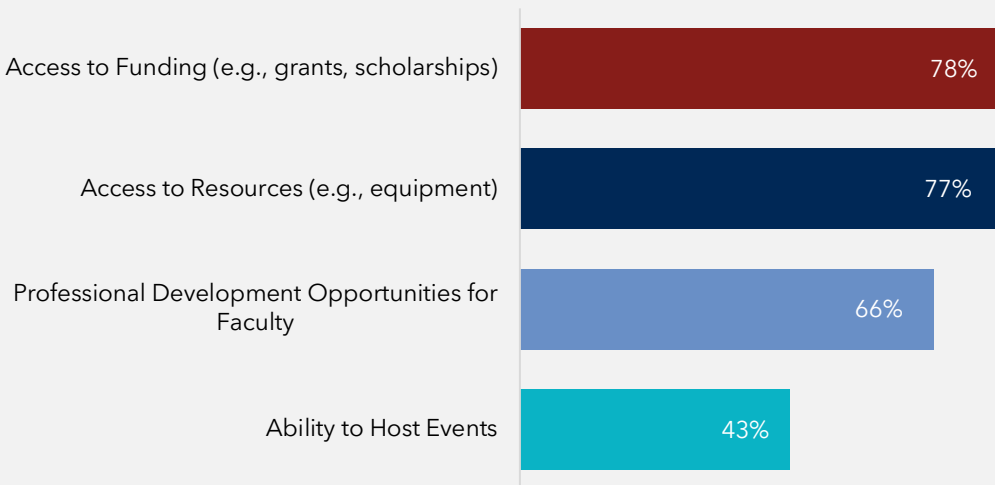
A program leader shared their success of dual credit opportunities between their community college and a local high school and middle school. The college has a Dual Enrollment Director and the Dean overseeing the program is also the Dean of CIS Business. The college developed a partnership with two high school teachers, the high school, and a local middle school. Middle school students and their parents are interviewed and approximately 20-30 students are selected to be a part of a cohort that attend the high school. In high school they enroll in college courses and work with a professional expert on relevant projects. Once they attend college, they finish their cybersecurity core courses and receive preparation for Security+, CySA+, ITF+ exams. These exams are paid for by the high school district. Approximately 54% of students who complete the required college courses are still in high school.



## Impact on Access to Resources

Across data sources, program leaders shared how the **CAE-C designation has impacted access to resources at their MSI**. These include impact to access to funding, resources, professional development opportunities for faculty, and ability to host events. Program leaders also appreciate receiving support from the CAE Community and how this support helps with their access to resources.

**Most program leaders believe the CAE-C designation has a moderate-to-large impact on their access to funding (78%), access to resources (77%), and professional development opportunities for faculty (66%). Fewer program leaders believe the designation has an impact on their ability to host events.**



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on their access to resources



**Access to Funding.** Most program leaders (78%) believe that the **CAE-C designation helps improve their access to funding by increasing their awareness of and eligibility for scholarships and grants.** For example, one program leader shared that *"the designation puts us in the loop to be aware of many more opportunities than we would have been known of on our own. It has also provided opportunities to collaborate with other schools in the CAE Community."*

We have received many grants due to the fact that we hold a CAE designation. This is where we have seen the greatest impact.

-Program Leader



**Access to Resources.** Most program leaders (77%) believe that the **CAE-C designation helps improve their awareness of and access to resources.** These include funding for students via scholarships, professional development for faculty, and equipment for their programs and institutions. Specifically, program leaders noted their appreciation of CARD, CLARK, NCyTE, NICE Challenge, and other CAE websites and resources that they would not have known about if they were not part of the CAE-C community. Many program leaders noted that *"by being CAE members we have access to resources we could not have before."*



**Professional Development Opportunities for Faculty.** More than half (66%) of program leaders believe that the **CAE-C designation helps increase professional development opportunities for faculty by increasing their awareness of and access to opportunities, along with an opportunity to network and collaborate with colleagues in the field.**

The CAE Community and all CAE Initiatives opened our door for massive faculty professional development. Over the past 18 years of being a CAE, we had faculty members be engaged with training and professional development such as Digital Forensics, AI in Cybersecurity, and others via the CAE initiatives that not only did not cost us, but have provided an honorarium for faculty to attend, which made it more attractive for them to engage and finish these faculty professional development events.

-Program Leader



**Ability to Host Events.** Less than half (43%) of program leaders believe that the CAE-C designation helps them to host events. However, some program leaders shared that **the designation has allowed them to increase their network, credibility, and reputation, which has enabled them “to host multiple workshops since becoming a CAE.”**

**CAE Community Support.** Although not an area specifically rated on the survey, **many program leaders emphasized the important connections they have made as a result of their CAE-C designation.**

When you're a part of the CAE...you have opportunities to the tech talks, the yearly events, the conferences. You have opportunities for grants, for networking, the communities. There's so much you learn from other institutions that are part of the CAE.

With the designation we were eligible to join the [state] Partnership for Cybersecurity Excellence. It's a coalition between the government, military, industry people, and academia. All those people, we formed as a coalition in [state] and we got our entry pass into that coalition because of the designation.

-Program Leaders



## Specific Examples of Access to Resources

### Access to Funding

- \* Now eligible to apply for more grants (e.g., Cyber Corps SFS, CySP, DoD)
- \* Received funding (e.g., DoE, DoL, Gencyber, NSF ATE, SFS)
- \* More competitive for HSI grants

### Access to Resources

- \* Access to CARD, CLARK, CoP, NCyTE, RING
- \* Learn about resources from other CAE institutions
- \* Access via CAE professional development opportunities
- \* Able to purchase NetLab

### Professional Development Opportunities for Faculty

- \* More opportunities for faculty to attend events (e.g., Tech Talks) and network

### Ability to Host Events

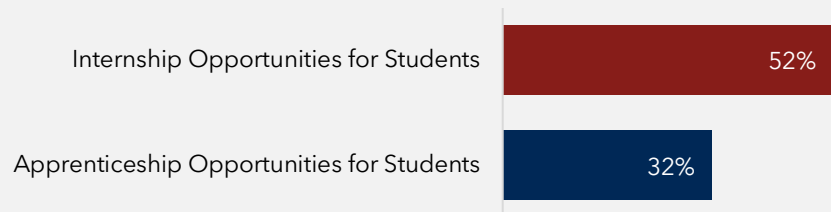
- \* Host more workshops, summits, and cyber competitions
- \* Host state Department of Law Enforcement Cybersecurity Working Groups



## Impact on Hands-On Learning Opportunities for Students

Across data sources, program leaders shared how the **CAE-C designation has impacted hands-on learning opportunities for students at their MSI**. These include impact on internship and apprentice opportunities for students.

**Approximately half (52%) of program leaders believe the CAE-C designation has a moderate-to-large impact on internship opportunities for students. Fewer (32%) of program leaders believe the designation has an impact on apprenticeship opportunities for students.**



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on hands-on learning opportunities for students



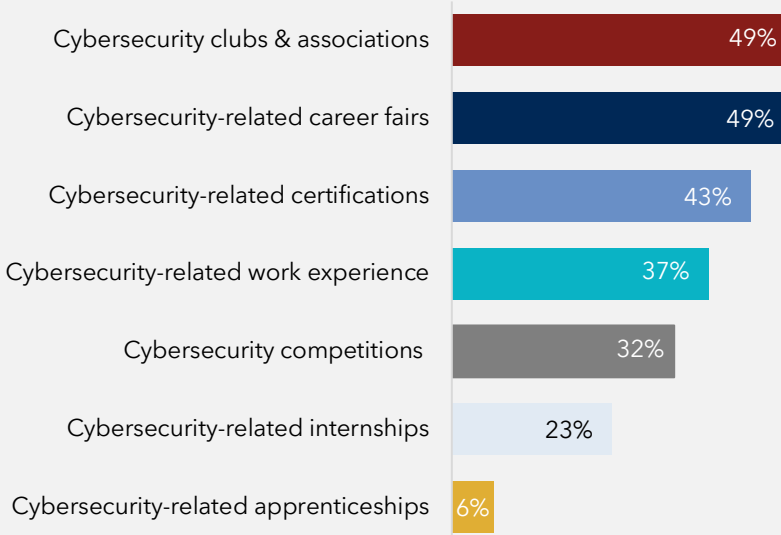
**Internship Opportunities for Students.** Approximately half (52%) of program leaders believe that the **CAE-C designation helps increase internship opportunities for students because they are more connected to federal internship programs (e.g., FBI, NSA), and because employers are aware of the reputation of their program and quality of student preparation.** For example, one program leader explained that *“you make sure that the students have those skillsets that are very much in line with what a lot of industry will be looking for internships and so on. I do think that inherently, because you do have the designation and you have to have certain topics and certain knowledge objectives covered, that in itself lends its way for the advantage of getting internships and jobs.”* In contrast, one program leader shared that *“we need to do a better job in this area”* while another program leader explained that *“we have some internships, but due to the faculty load, no one is actively promoting the internships at our college.”*



**Apprenticeship Opportunities for Students. Only 32% of program leaders believe that the CAE-C designation helps increase apprenticeship opportunities for students.** Few program leaders shared specific examples of apprenticeship opportunities. However, one program leader noted that their institution *“received funding that was only available to CAE-C designated schools to launch an apprenticeship program.”*

Although few program leaders noted the impact of the CAE-C designation on hands-on learning opportunities for students, **alumni from CAE programs reported participating in at least one cyber-related activity while in college.** Similar to feedback from leadership teams, **alumni noted that workforce preparedness activities (e.g., internships, apprenticeships) were either not offered or were not utilized.**

**Most alumni who shared their cyber-related activities (n = 73) participated in clubs/associations (49%), career fairs (49%), and certifications (43%). Internships and apprenticeships were the least utilized.**



Percent of alumni who indicated participation in activities at their CAC-C designated institution. Participants were able to select multiple activities; therefore, percentages do not add up to 100%

Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution



## Specific Examples of Hands-On Learning Opportunities for Students

### Internship Opportunities for Students

- \* Students are approached for internships by local employers
- \* Students receive internships from federal programs (e.g., FBI, NSA)
- \* Offer internships via an advisory board and IAB board

### Apprenticeship Opportunities for Students

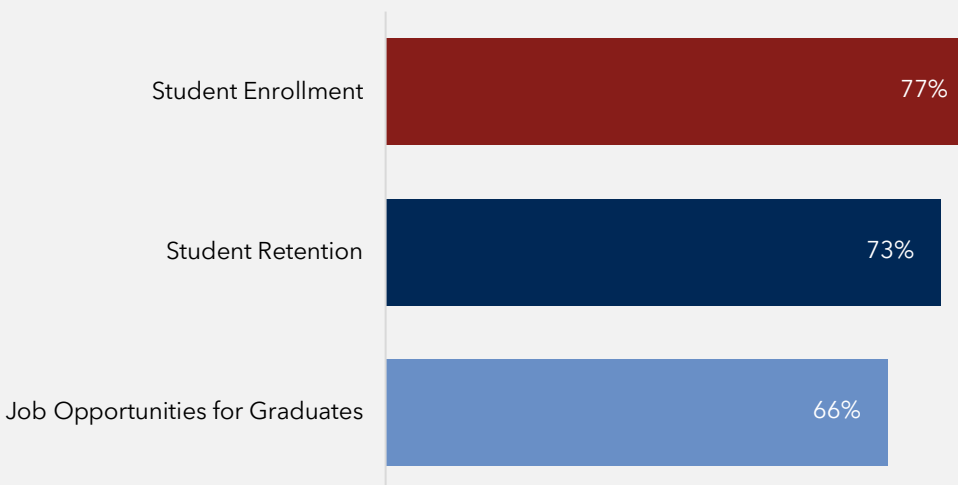
- \* Have a specific apprenticeship program



## Impact on Educational & Professional Outcomes for Students

Across data sources, program leaders shared how the **CAE-C designation has impacted educational and professional outcomes for students at their MSI**. These include impact on student enrollment, student retention, and job opportunities for graduates.

**Most program leaders believe the CAE-C designation has a moderate-to-large impact on student enrollment (77%), student retention (73%), and job opportunities for graduates (66%).**



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on educational and professional outcomes for students



**Student Enrollment.** Most program leaders (77%) believe that the **CAE-C designation helps increase student enrollment because of: (a) increased visibility and credibility of their program; (b) access to better resources; and (c) better student experiences.**

One program leader shared that *"we have about doubled the enrollment as a result of CAE, but more importantly, [the designation has] allowed us to select much better candidates and be more selective in the enrollment process, especially in the graduate level."*

When we started the cyber program, we had 17 students. We are now approaching 600 across all degrees. The department that leads cyber, Information and Decision Sciences, is now the 4th largest program on our campus.



**Student Retention.** Most program leaders (73%) believe that the **CAE-C designation helps increase student retention because having a high-quality program with resources and opportunities encourages students to stay.**

One program leader explained that *"students have more opportunities and funding to do high impact practices, which improves their chances of staying in the program. This directly impacts the number of students enrolled and encourages a network of recruitment from within the programs."*

We see students, especially Hispanic and African American who are first-generation college students that told us that they have struggled in other schools, thrive in our programs given the exceptional faculty and the other resources provided since we are a CAE. [We offer] scholarships, a student cybersecurity club, outreach activities, resources, career preparation via our university Office of Career Services, etc.

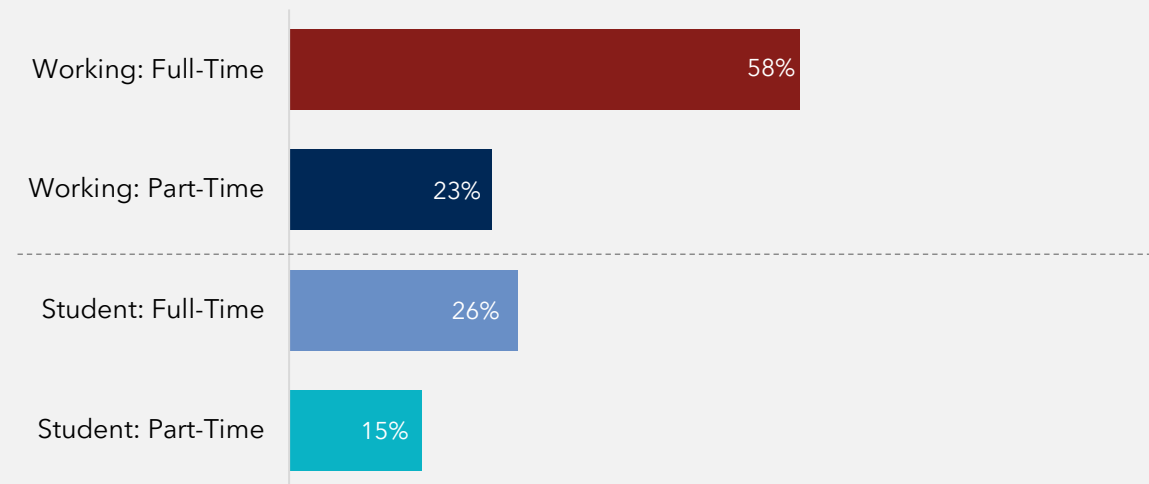
-Program Leader



**Job Opportunities for Graduates.** More than half (66%) of program leaders believe the **CAE-C designation helps increase job opportunities for graduates because of their program’s curriculum, training opportunities, and reputation, which are all appealing to employers.** For example, one program leader explained that *“employers feel more comfortable with our students because of the reputation of the designation. It is something they can look at as a standard that our students are held to.”* Another program leader shared that *“overall, our graduates are finding jobs. It is directly because of our designation.”*

Feedback from alumni mirrored information shared by program leaders. For example, **most alumni shared that they are currently work full-time.**

**Most alumni who shared their employment status (n = 70) work full time (58%).**



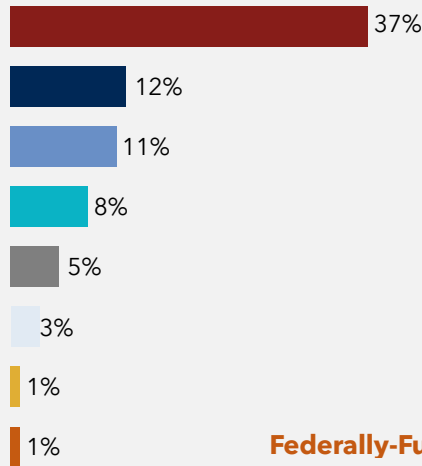
Percent of alumni who indicated their current employment status. Participants were able to select multiple roles; therefore, percentages do not add up to 100%

Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution

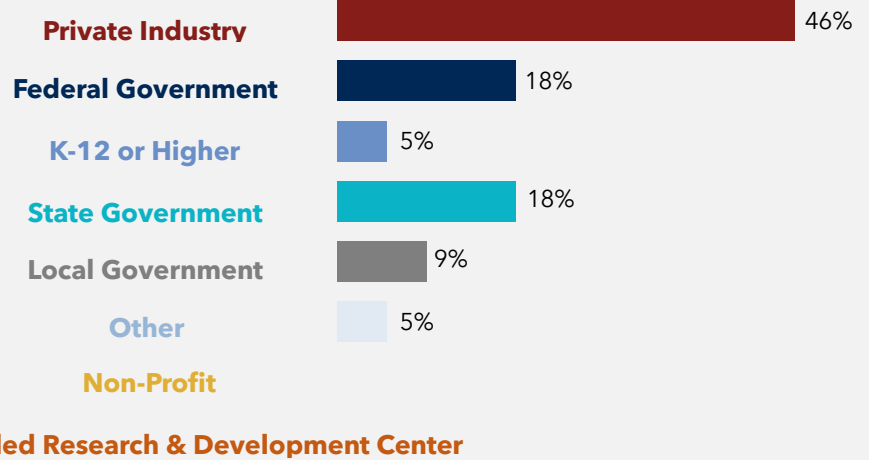


## Most alumni who shared their employment status work in private industry in both their first position and current position.

Sector of **First** Employer (n = 58)



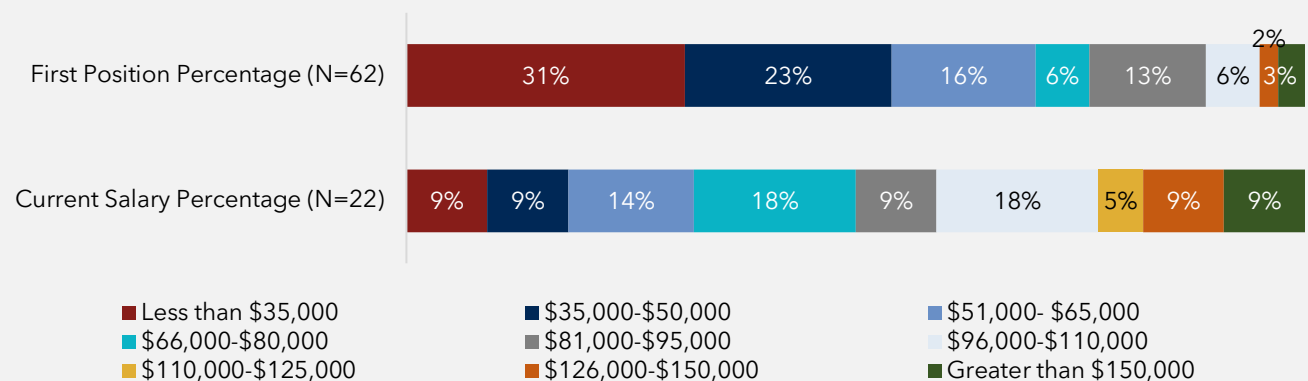
Sector of **Current** Employer (n = 22)



Examples of private industry companies at which alumni work: Tech (Amazon, Cloudnexus, CrowdStrike; ReliaQuest); Finance (Altura Credit Union, USAA, Wells Fargo); Healthcare (Kaiser Permanente)

Examples of federal government agencies at which alumni work: County, Courts, DoD, Space System Command, US Department of Commerce

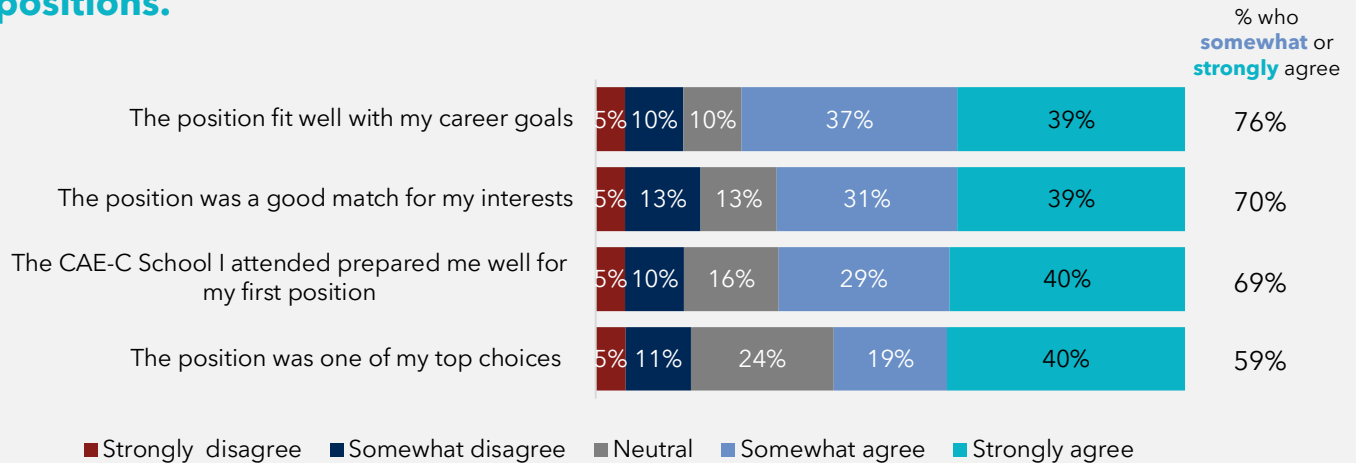
## Not surprisingly, starting and current salaries for alumni vary widely given the range of degrees with which they graduate.



Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution

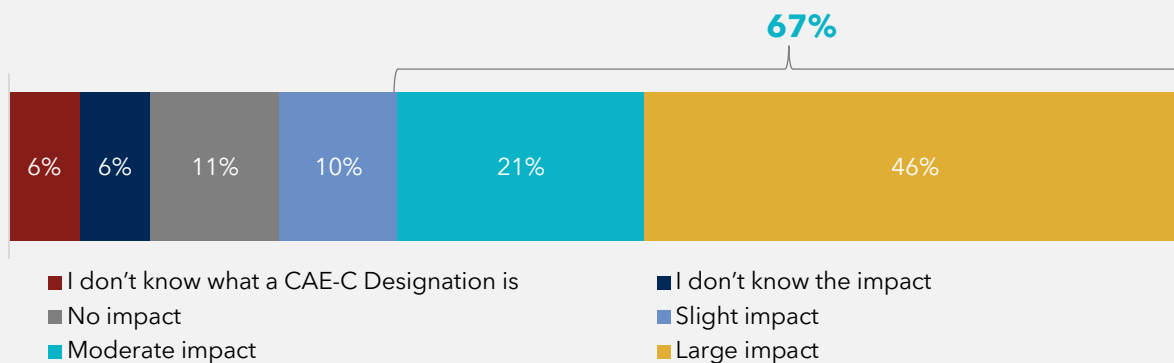


**Most alumni who rated their experience (n = 62) agree that their institution prepared them for employment and are pleased with their positions.**



Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution

**Most alumni (67%; n = 63) believe the CAE-C designation had a moderate-to-large impact on their professional success.**



Percents should be interpreted with caution given that alumni represent only six CAE institutions; in addition, 53% of responses are from a single four-year institution



## Alumni note several ways in which the CAE-C designation impacted their professional success.

### Improved Skills and Professional Preparation

*"It allowed for me to develop a competence for cybersecurity and prepared me for jobs within the real-world."*

### Increased Knowledge of the Field

*"This program provided a lot of insight about the intelligence community. Provided more job/ internship opportunities, tours at federal agencies, etc."*

### Increased Confidence

*"The class prepared me for my career, it has taught me many things that made me confident about going into the workforce."*

### Developed Relationships

*"My professional success is due to the extraordinary guidance and knowledge of my professors and CAE directors."*

### Assisted in Finding Employment

*"CAE-C helped in my initial job search and the following careers. The campus has garnered a reputation in the cybersecurity industry."*



## Specific Examples of Educational and Professional Outcomes for Students

### Student Enrollment

- \* Higher enrollment
- \* More students interested in certificates
- \* Use CAE/NSA relationship in marketing materials for both students and employers

### Student Retention

- \* Increased retention after CAE designation
- \* Supports help retention (e.g., scholarships, tutors, clubs, outreach activities, career preparation, other resources)

### Job Opportunities for Graduates

- \* Greater interest from local and federal employers
- \* Build relationships with agencies (e.g., FBI, InfraGard, ISACA)
- \* Connection with local employers (e.g., FedEx, AmEx, UPS, cruise lines)

## Student Employment Highlight

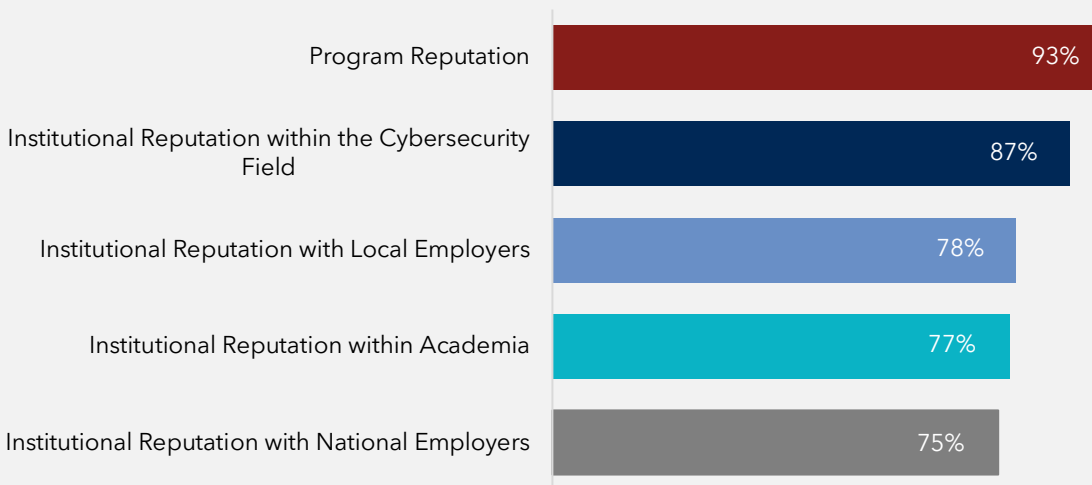
A program leader shared that a student received his undergraduate degree in a local CAE college with which they have an articulation agreement and attended his college for a master's degree. The Hispanic student shared that he worked multiple jobs to support his family. The program leader connected him with a local employer to do part-time security assessments. The salary was more than both his parents combined. He continued to attend school, work part-time, and became the founding president of the cybersecurity club. He also became one of two people who was placed in cyber command in the state. The student reached out 1.5 years later and shared that he now has a top-secret job and the program and program leader "changed his life."



## Impact on Institutional Reputation

Across data sources, program leaders shared how the **CAE-C designation has impacted their program and institutional reputation**. These include impact on program reputation and institutional reputation (within the cybersecurity field, with local employers, within academia, and with national employers).

**Most program leaders believe the CAE-C designation has a moderate-to-large impact on their program and institutional reputation.**



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on their program and institutional reputation



When reflecting on their reputation, program leaders noted large and similar impacts of the CAE-C designation on their program reputation and institutional reputation (within the cybersecurity field, with local employers, within academia, and with national employers). These include **improved: (a) reputation and credibility; (b) visibility; (c) trust; and (d) opportunities to collaborate and network**. Program leaders also noted that the designation creates **competitive graduates**, which helps with future employment opportunities.

**Program Reputation**

CAE helped us over the past 18 years significantly with its program **reputation**. Both industry and government have been looking at the designation as an indication that our graduates are quality.

**Institutional Reputation within the Cybersecurity Field**

The designation provides many opportunities for the institution to **collaborate, network**, and meet with many facets of the cybersecurity arena. These opportunities allow the school to project a positive reputation with peers.

**Institutional Reputation with Local Employers**

The designation made the program more **visible** and sets a standard of excellence that they can **trust** that we and our students must adhere to.

**Institutional Reputation within Academia**

The CAE designation is **well recognized** and known in the academia community. Many institutions we collaborate with are aware and prefer that we own the CAE designation when working in cybersecurity.

**Institutional Reputation with National Employers**

Because of the CAE, we have really good relationships and partnerships with the DoD, with CISA. And so, a lot of our students have been able to **find jobs** within CISA, within NSA, within DoD.

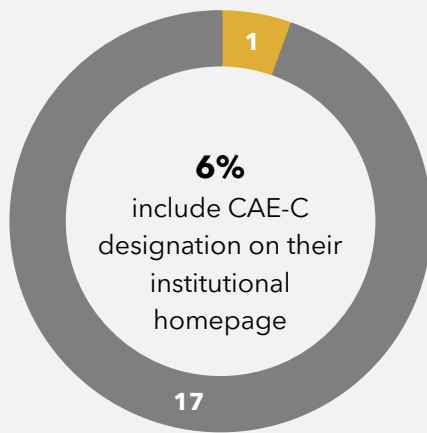
-Program Leaders



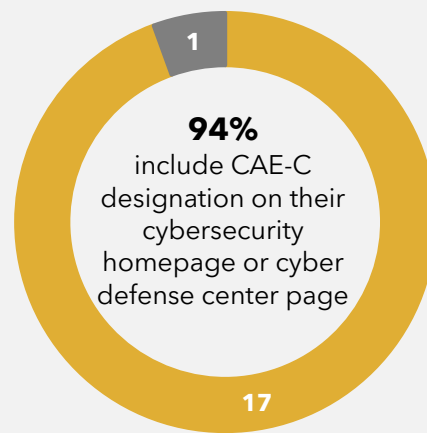
## Public Representation of CAE-C Programs

An analysis was conducted to determine the extent to which the CAE designation was publicly presented and described on CAE-C MSI’s websites. The sample included the 18 colleges and universities that were interviewed.

### Most MSIs include their CAE-C designation on their cybersecurity homepage but not on their institutional homepage.



- Designation on Institutional Homepage
- No Designation on Institutional Homepage



- Designation on Cybersecurity Page
- No Designation on Cybersecurity Page

### Of the 17 institutions that had information about the CAE-C designation:

**11** included logos of the NSA, USDHS, or CAE-C

**9** included a meaningful description of the designation



*“The National Security Agency and Department of Homeland Security designated [school name] a National Center of Academic Excellence in Cyber Defense Education in 2017. This designation ensures that you are getting the best instruction available and offers your future employers the assurance that you are well qualified in the rapidly growing CIS industry.”*

### Of the 18 institutions, only one included a description of the benefits of the designation for students and the institution.



# CHALLENGES & RECOMMENDATIONS

Despite the many benefits, program leaders describe challenges they experience in their CAE-C programs along with potential solutions, both for colleges and for the CAE Community.

## Challenges and Recommendations for Colleges

Program leaders shared challenges and recommendations related to **gaining buy-in and support from leaders and faculty**

Challenge	Recommendation
Gaining buy-in from institutional leaders	⇒ Continue to <b>explain the purpose and benefits</b> of the CAE-C designation. One program lead shared that <i>"once they know what we are doing, they give us all the resources."</i>
Gaining buy-in from faculty for designation-related activities	⇒ Continue to <b>explain the purpose and benefits</b> of the CAE-C designation
Identifying faculty to teach courses	⇒ <b>Hire program alumni</b> as adjunct faculty

**Program leaders shared specific challenges and recommendations when supporting underrepresented minority students at their MSI.** Specifically, they shared that their **institutions are often located in areas with large minority populations but limited cybersecurity jobs**; students are often first-generation college students, so the **cybersecurity field is new** for them and requires more information sharing with students, parents, and the community; students have **basic needs (e.g., housing) that are not met** and are appropriately a priority over meeting course requirements; students are working professions (mainly in other fields outside of cybersecurity (e.g., food industry) and **do not have the technical skills** required at program entry; students **do not have cybersecurity professional role models who look like them**; and students **do not feel like they belong**. Leaders shared recommendations for some of the challenges encountered.



Challenge	Recommendation
Balancing students' basic needs (e.g., income, food) with providing them with opportunities to advance in their field (e.g., internships, apprenticeships)	Develop <b>opportunities on campus</b> that do not create additional burden on students. One program leader shared that <i>"we're trying to solve that through our apprenticeship program where we're letting kids have anchor jobs and we're trying to create a workforce tech hub where kids can remote work on campus so they don't have to choose about transportation issues, they don't have to choose about working for food, or all of those things."</i> In addition, provide <b>access to supports already available on campus</b> (e.g., food pantry, business closet)
Competing responsibilities of students	Be <b>sensitive to who students are as a whole person</b> and their current context (e.g., many students work full-time). One program leader shared that <i>"I teach most of my classes since 2018 at night because that's when my students can come in."</i>
Lack of representation	Prioritize providing <b>access to role models who share characteristics with the student population</b> through diverse faculty, mentors, and guest speakers. One program leader shared that <i>"we've worked really hard at our faculty to be role models. About 50% of us are female, which is great. Of the 12 full-time professors, three are African American and one is Hispanic. We've got a culture that is very diverse."</i>
Fostering student self-confidence in cybersecurity	Share the <b>benefits of the CAE-C designation</b> and the quality of their education with students. One program leader explained that <i>"I talk to them about the CAE and that we're part of it, and that creates for them a sense of greater belonging to a national initiative that's supported by the NSA, and that they are part of. When they graduate and get the certification, that speaks very highly of them and of the institution that provides them that education."</i>
Demystifying cybersecurity careers to help students understand the opportunities available	Continue to provide <b>examples of cybersecurity opportunities and careers</b> . One program leader shared that <i>"many of our students are first generation or are immigrants, and so cyber for many of them is a new area or an area that they've heard about. Trying to demystify it is an important thing so they can understand that they can be successful in it."</i>



## Recommendations for the CAE Community

Program leaders shared specific recommendations for the CAE Community.

### Trainings & Professional Development

- Provide virtual training on specific topics for **students** across institutions, keeping different time zones in mind
- Provide ongoing introductory-level training for **adjunct instructors**
- Provide more advanced training for **faculty** (e.g., forensics, competencies, artificial intelligence)

### Financial Support

- Provide more **grants** for research and capacity building
- Offer **location-based travel stipends** (e.g., more funds for those who are travelling further)
- Work with **vendors** to provide **discounts** on equipment/ resources needed by multiple institutions

### Communication

- Provide guidance and templates to institutions for them to **better advertise** the purpose and benefits of the CAE-C designation on websites
- Provide guidance to institutions on how to **collect personal permanent emails from students** to allow for better long-term communication with alumni
- **Respond to emails** within a reasonable timeframe
- **Provide information** (content and travel details) about upcoming events **in advance**

### Opportunities for Collaboration

- Reinstate **regional hubs**
- Offer opportunities for faculty to join a **working group across institutions** to provide feedback on materials (e.g., on a log management planning guide)

### Other

- **Increase diversity in Advisory Board members** (e.g., from different federal agencies such as the FBI)
- Work with federal agencies to **allow non-citizens to apply for positions** (e.g., research grant PIs)
- RCC recommends funding a more robust **second iteration of the alumni survey study with a longer timeline** to allow for a larger, more representative sample of CAE-C program alumni to be represented to learn critical information about workforce outcomes. Limited information about alumni outcomes was noted as a gap in knowledge by program leaders and the evaluators

### Internship Opportunities

- Leverage CAE relationships, networks, and credibility across the community to **encourage employers to provide paid internship opportunities**
- Develop a **hub for internship opportunities** for MSIs

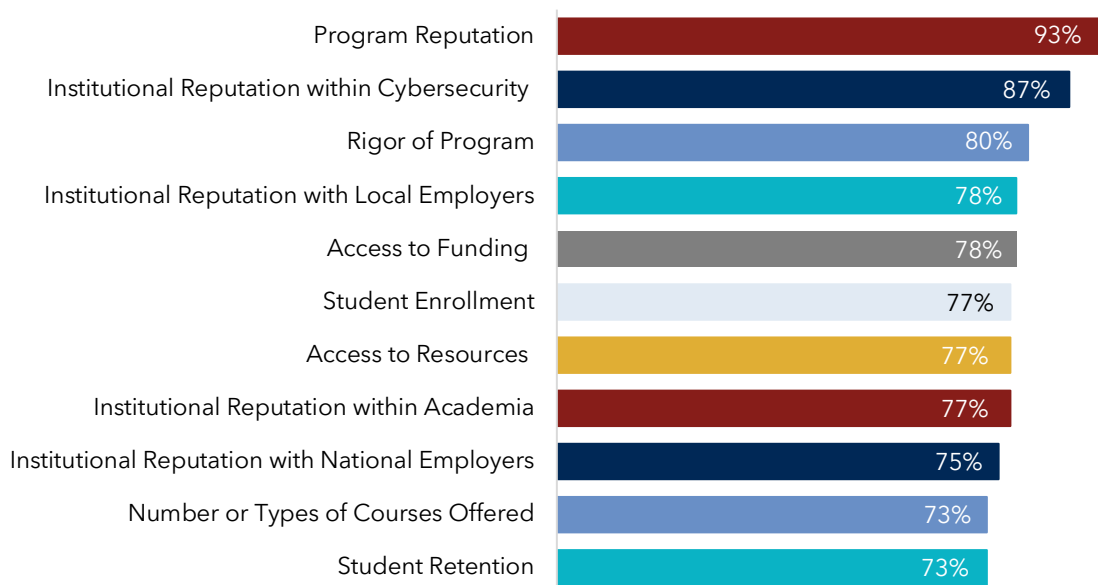


# CONCLUSIONS

Data gathered from program leaders and alumni of CAE-C programs, as well as information sourced from institutional websites, indicate that **the CAE-C designation significantly benefits students, faculty, and institutions across multiple domains.** The effectiveness of the CAE-C program is particularly evident in its role within the broader context of the National Cyber Workforce Strategy. By actively engaging and attracting underrepresented minority (URM) students to pursue careers in cybersecurity, the CAE-C program is pivotal in not only diversifying but also strengthening the cybersecurity workforce. This initiative not only opens doors to well-paying and secure career paths for these students but also aligns with the national objective of building a robust, skilled, and inclusive cybersecurity workforce capable of addressing the complex and evolving challenges in the cyber domain.

## Areas of Greatest Impact

The areas with the **greatest perceived impact** include: (a) program and institutional reputation; (b) program rigor, funding, resources, and courses offered; and (c) student enrollment and retention.

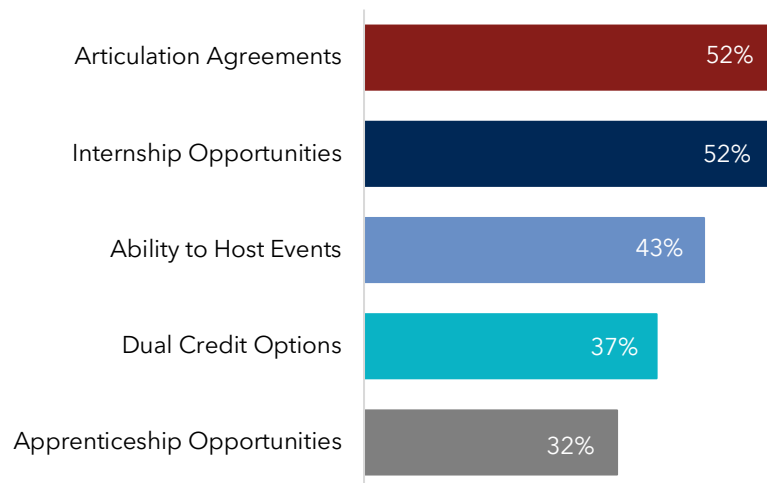


Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on various domains



## Areas of Least Impact

The areas with **least perceived impact** include: (a) **articulation agreements and dual credit options**; (b) **internship and apprenticeship opportunities**; and (c) **ability to host events**.



Percent of program leaders who rated the CAE-C designation as having a moderate or large impact on various domains

## Recommendations

Although they described numerous benefits of the CAE-C designation, stakeholders also shared challenges along with potential recommendations for both colleges and the CAE Community. Recommendations for colleges focused on **strategies to gain buy-in and support from leaders and faculty, and to support underrepresented minority students**. Recommendations for the CAE Community focused on **increasing and improving training, financial support, communication, opportunities for collaboration, and internship opportunities**. These recommendations should be considered as the program continues to be implemented.



# METHODOLOGY

This study analyzed data from four primary and supplemental data sources. The following sections describe data collection processes and limitations.

## Data Source 1: CAE-C Program Leader Survey

All program leaders from CAE-C designated MSIs ( $N = 101$ ) were invited to participate in an online survey. The survey assessed what impact, if any, the CAE-C designation has had on cybersecurity program(s) and students, as well as on the institution as a whole. **Surveys were completed by individuals representing 45 (45% of CAE-C MSI) institutions.** Participants represented a variety of institutions types.

	CAE MSI Population	Survey Participants	Interview Participants
N	101	45 (45%)	18 (18%)
<b>Institution Type</b>			
Community or Technical College	38	18 (47%)	8 (21%)
Public University	46	18 (39%)	5 (11%)
Private University	17	9 (53%)	5 (29%)
<b>MSI Designation (institutions can have multiple designations)</b>			
ANNAPISI	34	6 (18%)	2 (6%)
ANNH	3	2 (67%)	1 (33%)
HBCU	17	5 (29%)	1 (6%)
HSI	66	33 (50%)	15 (50%)
NASNTI	2	2 (100%)	1 (50%)
PBI	7	1 (14%)	1 (14%)
<b>CAE Designation (institutions can have multiple designations)</b>			
CAE-CD	101	44 (44%)	17 (17%)
CAE-R	18	5 (28%)	1 (6%)
CAE-CO	3	2 (67%)	1 (33%)
<b>Length of Designation*</b>			
1-3 years	23	15 (65%)	4 (17%)
4-6 years	36	8 (22%)	4 (11%)
7-10 years	23	11 (55%)	6 (30%)
11+ years	32	9 (28%)	4 (13%)

\*Note: Population total > than 101 due to multiple designations held by a portion of institutions



## Data Source 2: CAE-C Program Leader Interviews

A sample of survey respondents whose institutions had held the CAE-C designation for four years or longer, were invited to participate in a one-hour, semi-structured interview to explore the domains of possible impact in greater depth. Interviews were also used to explore the unique challenges of MSIs as they relate to cybersecurity education and workforce placement, as well as garner suggestions for the CAE Community to continuously improve its systems of support for CAE-C designated institutions. **Interviews were conducted with individuals representing 18 (18% of CAE-C MSI) institutions.** Participants represented a variety of institutions types.

## Data Source 3: CAE-C Alumni Survey

During program leader interviews, participants were invited to distribute a brief survey to their cybersecurity program graduates that explored their educational and professional experiences. **Surveys were completed by 73 alumni representing six institutions (two alumni did not indicate their institution). It is important to note that 53% of surveys were completed by alumni at one institution, and therefore, generalizability of findings should be interpreted with caution.**

Alumni Institution	Institution Type	Degrees Offered	MSI Type	CAE-C Type	Designation Length	Survey Responses
1	Public University	Certs, Bach, Masters	HSI	CAE-CD	11+ Years	<b>39 (53%)</b>
2	CC/Tech College	Certs, Assoc	HSI	CAE-CD	4-6 years	12 (16%)
3	CC/Tech College	Certs, Assoc	ANNAPSIS, ANNH	CAE-CD	4-6 years	10 (14%)
4	CC/Tech College	Certs, Assoc	HSI	CAE-CD	1-3 years	3 (4%)
5	CC/Tech College	Certs, Assoc	ANNAPISI, HSI	CAE-CD	1-3 years	1 (1%)
6	Private College	Certs, Bach, Masters	HSI	CAE-CD	1-3 years	6 (8%)
Unknown						2 (3%)



## Data Source 4: CAE-C MSI Website Analysis

**Eighteen CAE-C MSI institution and cybersecurity program websites were reviewed** as a supplemental data source to provide information on the public image of these programs and the extent to which CAE-C designation and related activities are advertised.