**Academic Program Review: Self-Study**

***Instructions:*** *The following pages will guide your submission of your academic program review self-study. Please type your responses directly into the document. The completed self-study instrument and all attachments must be submitted to the Academic Program Review Coordinator and your Academic Dean by September 1.*

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| **Program Under Review** |
| Degree(s):  |
| Certificate(s): Network Administration & Cybersecurity Fundamentals Certificate |
| Contact Information for lead on Self-Study: Name: Barbara BushelleCampus: SMCPhone: 480-677-7713Email: Barbara.bushelle@centralaz.edu |

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| **Program Description, Vision and Outcomes** |
| What is the description of the program as stated in the current CAC catalog:This Certificate prepares students for responsibilities in creating a network, configuring a network and incorporating cyber-security fundamentals, which leads to an entry-level position as a network administrator. Successful completion may lead to Microsoft Certified System Administration, Network+ Certification, and CCNA Certification. |
| Does your program have any other written mission or vision statements which do not appear in the catalog? If yes, please write them below and indicate where they appear. None |
| Describe how the program’s description, mission and/or vision aligns with the College’s Mission: This program prepares students for lifelong success in IT systems operations and security fundamentals. There are two strategic goals that are supported:1. Optimize fiscal resources that support the needs and expectations of students and the community
2. Contribute to the economic vitality, workforce development, and job training needs of Pinal County and surrounding region

CAC has invested in VMWare virtual computers to provide valuable hands-on experience to the students with both Windows servers, clients and Linux computers, which supports the need of applying knowledge and practicing new skills. The VMWare environment has supported up to nine of the classes in this program. Equipment is reconfigured and reused from one semester to the next. Not all classes are offered in the same semesters. Growth in IT programming, cloud and administrative jobs in Arizona is faster than the rest of the nation. This program is preparing students to get entry level positions, or to continue towards their AAS degree. The starting fundamentals towards validating certifications are included in the class materials. |
| What are the student learning outcomes for the degree or certificate as currently indicated in ACRES:1. (Application Level) Demonstrate installing and configuring Windows server. 2. (Synthesis Level) Create active directories in Windows server. 3. (Synthesis Level) Create and modify user accounts, server policies. 4. (Application Level) Demonstrate installing and configuring Active Directory, DNS and DHCP. 6. (Application Level) Demonstrate installing and configuring network protocols and network clients. 8. (Comprehension Level) Identify and learn protection methods to reduce network security risks. 9. (Evaluation Level) Appraise network communication security. 10. (Synthesis Level) Master an area of specialization, either Exchange e-mail, Wireless Security or Cloud Computing. 11. (Application Level) Apply security and encryption in Exchange server. 12. (Application Level) Demonstrate installation and configuration of Linux. 13. (Synthesis Level) Demonstrate configuration skills to internetwork environments Linux and Microsoft OS systems. |
| Are the outcomes from your program determined or influenced by any external organization, agency, or accreditor? If so, please explain.We continue to align our class materials and overall objectives to active Microsoft, Cisco and CompTIA certification goals, however the programs are not focused solely on achieving certification, but on developing skills and capabilities in working with computer equipment to successfully meet job needs and make progress towards certification. Many certifications are designed to be taken with a combination of training and work experience.Michael Bogner and Barbara Bushelle attended an event at University of Arizona South with the NSA. “The CAE-Cyber Operations program complements the existing Centers of Academic Excellence (CAE) in Cyber Defense (CAE-CD) programs, providing a particular emphasis on technologies and techniques related to specialized cyber operations (e.g., collection, exploitation, and response), to enhance the national security posture of our Nation. These technologies and techniques are critical to intelligence, military and law enforcement organizations authorized to perform these specialized operations” (Reference: <https://www.nsa.gov/resources/educators/centers-academic-excellence/cyber-operations/>, retrieved 4-1-2017). Our plans are to review and update our learning objectives to bring them into alignment with the CAE Cyber Operations program. This will validate that the key learnings are being provided for a quality program both in Network Administration and for preparation of future cyber-operational specialists. |

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| **Program Enrollment and Graduation Trends** |
| Summarize the program enrollment data for the past 5 years in the chart below:

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| Degree/Certificate | 2015-16 | 2014-15 | 2013-14 | 2012-13 | 2011-12 |
| Headcount CIS (all degrees) | 1,301 | 1,385 | 1,444 | 1,500 | 1,481 |
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| Discuss and explain the factors influencing the enrollment trends: 1. The job market has been gaining in strength, which has the impact of fewer people exploring career development options at CAC.
2. General marketing materials for CAC don’t reflect CIS degree options – they typically show the programming track only
3. Other college options in the area, some with larger programs and more options in class mix that they offer
4. CAC as a college and the Business division have occasionally done outreach to high schools, but over this five year period, the outreach has been minimal.
5. Regarding the Network Administration Certificate, the AAS degree was added in Fall of 2012 and some students moved from the certificate program into the AAS program.
6. Many of the students involved in the program are older adults. The college has changed during this time period. Where the classes were all offered on Friday and Saturday back in 2012-13, they all had to shift and take open ITV time slots during the Monday through Thursday day time periods. At the same time, Learning Center assistance cut back in their availability. Students express an interest in having evening classes, but getting ITV at night is impossible.
7. One of the goals that the college had was to expand availability onto additional campuses. The courses are now available on four campuses, but the population on each campus is small, with many of the students taking the classes totally on-line. We get to know each other through class discussions, but maybe need a creative way to build a sense of community that is lacking with face to face time.
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| How has the program typically recruited students and marketed the program:1. When the AAS degree was new in Fall of 2012, the degree and certificate were promoted with a new brochure.
	1. We (the CIS team) did a mailing to businesses during the first year of the new AAS degree.
2. The Business division hosted a special event for high school students during the 2013-14 school year, and CIS program options were promoted along with Business, Accounting, Restaurant Management and Culinary programs.
3. Through the CAC website presence and through the Advisors
4. Word of mouth from students to people that they know
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| Summarize the program graduation rate trends for the past 5 years in the chart below:

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| --- | --- | --- | --- | --- | --- |
| Degree/Certificate | 2015-16 | 2014-15 | 2013-14 | 2012-13 | 2011-12 |
| Network Admin | 2 | 3 | 2 | 3 | 2 |
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| Discuss and explain the graduation trends. What efforts has the program made to help students achieve completion?1. The program was taught initially at SPC, because it was tied to physical equipment on the SPC campus. In 2012-13, CAC invested $20,000 in computer hardware blade equipment to provide virtual computers, allowing the program to expand onto additional campuses.
2. The program was expanded to offer the classes fully on-line in addition to iTV when the college cut back on Friday and Saturday classes.
3. To assist students who struggled with completing totally on-line, a weekend college option was added in 2014-15.
4. Classes are captured on video, so on-line students and students attending in person have these recordings for reference.
5. The labs for most classes are in VMWare, and students have access 24 – 7 (with rare exceptions) wherever they have an Internet connection.
6. I host a business visit each Fall semester, so students get to experience a real work environment and learn from a representative business that could hire them. They hear firsthand about the skills that are needed in the work place.
7. I take students to the Cybersecurity Summit during Spring semester. That event helps them to more fully understand the real world threats with our connected world, and how companies are dealing with these issues. This event also has vendor booths, so students get an opportunity to learn about companies that may be a potential future employer and practice how they present themselves in the business environment.
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| **Program Curriculum:** *Submit a completed Curriculum Comparison Chart along with the self-study, comparing the CAC program curriculum to three similar programs, for each Degree and Certificate discussed in this self-study. Ideally compare to other Arizona programs, and out of state if necessary.* |
| Using information gained from your curriculum comparisons, discuss the strengths and weaknesses of the current program curriculum for each degree or certificate. Comparison done to a certificate with more credit hours, one with fewer credit hours and one that is the same number of credit hours as ours.Strengths:1. Many of the same core classes the board, which included:
	1. Networking Essentials
	2. Network Infrastructure / Administration
	3. Network Security
	4. Cisco Routing and Switching
2. CAC provides one core elective from across three options
3. The fundamentals are covered more completely than the low credit option from Cochise, including classes that match well to the other two comparison certificated with the following topics. These topics form a good foundational base of knowledge to build from when covering the above core Network Administration topics:
	1. Survey of Computer Information Systems
	2. Microcomputer Operating System
	3. Server Operating System

Weaknesses:1. A couple of the comparison programs have a course on Connecting Cisco Networks, which focuses on the WAN connection options and some of the more complex network designs. We cover some of this in our Cisco Routers class, but it may warrant consideration as a separate topic/class.
2. Scottsdale includes A+ exam prep, some programming or web development work. The A+ exam prep may be useful for the individuals who want to work with hardware and the more physical aspects of network operations. We have to keep in mind that their certificate is 40 credits and we may not want to make the certificate too large.
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| Discuss how the program gets feedback on its program and curriculum from external sources, suchas advisory boards, employers, articulation task forces, accreditors, etc.1. The Business division hosts advisory board meeting every one to two years.
2. I have been actively involved with the Arizona Technology Council. Through some of the events that I participate in, I learn about the background that employers are looking for.
3. I serve on the Workforce Development and Training Committee of the Arizona Technology Council, I stay abreast of job growth and needs in AZ.
4. With our Fall field trip to various IT work areas, we learn what these IT departments need as skills for potential employees.
5. During Spring, 2017, we have an employer visiting our classroom and they will share about their Network Administration work and specifics on a new job for entry-level administration work.
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| Indicate any external accreditations which the program has. Are there any available accreditations which the program does not have, but maybenefit from seeking?CAC has no current external accreditations in additional to our overall college accreditation status.  |
| Discuss how the program supports current or future needs for the job market in Pinal County, the state of Arizona, and/or the United States.1. Statistics on job growth:“Arizona is home to two of the metros with rapid employment growth on the horizon, per Moody’s Analytics. Tuscon is No. 5 at 3.3% annually, while Phoenix clocks in at No. 8 with a per-year average of 3.1%” (Forbes, Oct 19, 2016 article written by Kurt Badenhausen , Forbes Staff posted at https://www.forbes.com/sites/kurtbadenhausen/2016/10/19/the-10-best-cities-for-future-job-growth/#1d61d3581141, Retrieved 4-1-2017)“Phoenix has added nearly 20% more tech jobs over the past five years. Uber, [Shutterfly](http://www.forbes.com/companies/shutterfly/) [SFLY +1.24%](http://www.forbes.com/companies/shutterfly/) and [Yelp](http://www.forbes.com/companies/yelp/) [YELP +0.71%](http://www.forbes.com/companies/yelp/) have all recently opened offices there” (Badenhausen, Forbes, 2016).
2. Technical jobs in AZ are growing at the fastest rate in the U.S.A. The demand is outpacing the available talent and many companies are moving talent into the state of AZ. The Commerce Authority for the State of AZ is very interested in developing talent in AZ to help meet the demand and continue to build on the growing technology company base that is building.
3. “Employees interested in technical positions are hot commodities, and growing companies around the Valley only further the demand, according to Aimee Bennett of the Freedom Financial Network, an online financial service company based in Tempe that employs more than 900 in the Valley”(Phoenix Business Journal, July 25, 2016, retrieved from [http://www.bizjournals.com/phoenix/news/2016/07/25/the-list-az-s-largest-employer-s-struggle-to-fill.html on April 1](http://www.bizjournals.com/phoenix/news/2016/07/25/the-list-az-s-largest-employer-s-struggle-to-fill.html%20on%20April%201), 2017).
4. “Phoenix is ranked third for tech job growth among large markets in CBRE’s annual [“Scoring Tech Talent” report](http://www.cbre.com/research-and-reports?PUBID=2166d301-9a78-4f5e-bd43-ec143d145a39). The Valley saw 58 percent growth from 2010 to 2015, behind only the San Francisco Bay area and Baltimore” (Ringle, H., June 30, 2016, Phoenix Business Journal, Retrieved from <http://www.bizjournals.com/phoenix/blog/techflash/2016/06/phoenix-ranks-high-in-tech-growth-in-annual-tech.html> on April 1, 2017).

The program focuses in on developing talent for entry-level help desk and systems analysis jobs with the certificate and AAS degree programs. It strongly encourages students to transfer to university Bachelor-level programs and achieve certification to be prepared to meet the strongest job needs areas. Transfer to the UofA South programs allows students to stay in Pinal County and receive their Bachelor of Applied Science degree in Network Administration, Informatics and Cyber Operations.  |
| For degree programs, identify any specific in-state baccalaureate programs into which this program is particularly suited for transfer |
| Indicate any articulation agreements in place for degree graduates. |

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| **Program Specific Resources:***In this section please focus on program specific resource. You may but do not have to discuss resources available to the college at large such as Blackboard, the Learning Centers, Library, etc. However, if these resources are impacting your program in a positive or negative way which you would like to discuss, please do so.* |
| Discuss the adequacy of the financial and budgetary resources available to the program over the past 5 years:The program has been well funded. CAC has invested at least $30,000 in the VMWare lab environment, which provides valuable hands-on experience for students taking CIS121, CIS130, CIS150, CIS152, CIS153 and CIS220 classes. VMWare has been used for CIS215 and CIS219 over the last few years, however alternate lab technology is in place for those two classes in Spring of 2017.  |
| Discuss the adequacy of the human resources available to the program over the past 5 years:In addition to teaching classes, because computer technology is changing rapidly, there is a large time commitment required to source and keep text books and labs up-to-date. This requires extensive re-work in Blackboard. The staffing of one full-time professor to keep up with the technology, source resources, rebuild classes and teach classes is a very time intensive position.In addition to the class work, managing VMWare in partnership with the IT department, is another time-demanding responsibility. In 2016, CAC applied for Microsoft Imagine utilization, which provides the student computer licensing for our learning environments. Managing the Microsoft Imagine is another demand on time. Of the CIS classes that are offered, the highest number of classes is managed by the Network Administration professor during the last five years. I believe that all the CIS professors are very busy. Compared to other disciplines, there is extra work with Computer Technology as compared to Math, English, Biology because of the rapid changes in the field. This difference is not reflected in our pay scale/staffing level planning.We have been expanding availability of classes to multiple campuses through limited ITV resources and Blackboard Collaborate. The complexities of covering multiple campuses and the changing technology, and managing hundreds of computers for lab work is taxing and tiring.  |
| Discuss the adequacy of the technological resources available to the program over the past 5 years:We have hosted hundreds of computers in VMWare that students use for labs. This equipment is generally available 24-7 and it has enabled us to offer totally on-line classes. When VMWare is overloaded, the responsiveness has been an issue, however, when we balance the load properly, it has worked with excellence. We have moved CIS219 off of VMWare. This has helped the overall load balancing. We have a vulnerability with the existing backup process, and we had one incident where labs were disrupted because of an error. The recovery process was intense, but the impact on classes and student learning was only minor. Establishing a backup process is in place but making slow progress because of time demands and slow system responsiveness. There have been issues with the technology on campus, especially the slow response over wireless connections on remote campuses – most notably San Tan. We have occasional issues with Instructor station and student equipment in ITV, where connectivity to VMWare may not work. Impero software has conflicts with VMWare and if it is loaded, we see conflicts. Unfortunately, our learning lab environment often works significantly better for students from home than when they are at CAC, which is another deterrent for some students. Availability of IT support was limited for a number of the last five years, but they seem to be rebuilding resources and talent in the IT department. Issues can still take a long time to be resolved.  |
| Discuss the adequacy of the physical (building space, classrooms, labs, etc) resources available to the program over the past 5 years:The program has shifted from being face-to-face/ITV to being more dominantly on-line. There are advantages for some students to have the totally on-line option. The factors that led to this were the shift in college hours to a M-Th schedule (with exceptions) and the ability of VMWare to support connectivity from home as well as on campus. Some students would like the option of evening classes. There are no evening ITV slots that can be had – everyone holds on the ITV windows like they are gold and diamonds because of limited number of rooms. We have tried providing a Saturday option, but many students have children and family commitments that conflict with Saturday class time.  |
| Discuss the adequacy of the academic support resources available to the program and its students over the past 5 years:Support resources have been growing in 2017 with the addition of Work-Study tutoring employees at SMC and Maricopa. For the last few years we also now have a graduate working at the O-100 Computer lab at SPC, which is a great resource for student assistance. Blackboard IM is used extensively for support in the networking and security classes. |
| Discuss the adequacy of the student support resources available to the program and its students over the past 5 years:A few years ago, I would receive complaints from students about the problems with registration, financial aid and advising. Over the last year or two, those complaints have diminished, so my impression is that CAC is improving with student support resources. UofA visits my classes and supports CAC special events to answer student questions on transfer questions, so that support has been very helpful. |

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| **Program Effectiveness** |
| Describe how you measure the success of degree and certificate program graduates in achieving the degree and/or certificate program student learning outcomes. What data have you collected that indicates the level of student success of these outcomes? And According to the data, how well have students achieved these outcomes during the past 5 years?Measurements are individual class performance and then overall program projects towards learning outcomes, which include:1. A formal paper on computer standards, how they are incorporated into a key solution (we use e-mail systems of Outlook and Exchange as the base solution), the importance of standards and how standards are coordinated throughout the standards organizational community. Of the students who complete this project, the overall average score is 83 out of 100 points. We had one student who plagiarized information and received zero points for his paper. We have had 11 students who did not complete the assignment, half failed the class and the other half passed, with a major negative impact on their grade.
2. Preparation for the Network+ certification exam is incorporated in CIS220, which is typically the last class in the degree program. Networking fundamentals and skills are reviewed throughout the whole semester, which is a review of the key learnings over the full two years of the program. Students can practice for the exam with a mock exam. No financial incentive is provided to complete the exam. The benefit is that the students have a very clear understanding of the level of knowledge required to successfully pass the exam and the tools to continue and complete it.
3. Some individual classes can be followed by certification exams and we have had a few students take the Cloud+ certification exam during the last few years.

Individual class performance is measured with a mixture of assignments, with heavy emphasis on applying the knowledge to correctly configure lab computers and simulated routers/switches. Quizzes, exams, discussions, lab assignments, computations with subnetting math, diagramming network plans, writing a paper and developing a training module are all incorporated within the individual classes. |
| If you have data which indicates the degree to which students in the program are achieving the college’s Common Student Learning Outcomes please share and explain the data.The following chart shows how the program Measurable Student Learning Outcomes link to the college Common Student Learning Outcomes.

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| **CSLO** | **AAS Computer Networking** |
| **Student Learning Outcomes** |
| **Cultural and Civic Engagement** | 10. (Synthesis Level) Plan, write, revise and deliver oral, written and electronic business communications. |
| Participate in diverse environments while demonstrating global citizenship and social consciousness | 12. (Synthesis Level) Interpret Networking laws and regulations in which businesses operate, including local, regional and global markets. |
| **Integrative Knowledge** | 1. (Synthesis Level) Design and construct a secure and efficient wireless network, including hardware and software. |
| Identify, comprehend, apply and synthesize facts, concepts, theories and practices across broad and specialized knowledge areas | 3. (Synthesis Level) Manage users, groups, login security and system resources in Linux. |
|   | 6. (Evaluation Level) Install, configure and trouble shoot a CISCO router for a network environment. |
|   | 9. (Evaluation Level) Install and customize the Windows operating systems, and evaluate the features, prominent system properties and common operating system commands. |
| **Personal and Professional Skills** | 2. (Evaluation Level) Summarize the basic concepts and the history of telecommunications and career opportunities in the telephony field. |
| Demonstrate skills which enhance personal and professional development | 5. (Synthesis Level) Configure SMTP, POP3, MAPI and Internet clients in the most current version of Exchange Server. |
|   | 7. (Synthesis Level) Install and test a current version of Windows server and Windows workstation, including users, DNS and trust relationships. |
| **Reasoning Skills** | 4. (Evaluation Level) Evaluate each of the seven layers of the OSI model. |
| Inquire and analyze to solve problems, draw logical conclusions, or create innovative ideas | 8. (Evaluation Level) Analyze network security options and techniques to create security plans. |
|   | 11. (Synthesis Level) Build mathematical solutions for business problems. |
|   | 13. (Synthesis Level) Analyze and make recommendations on business solutions utilizing Cloud Computing. |

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| If you have data which indicates the degree to which students in the program are achieving the college’s Common Student Learning Outcomes please share and explain the data. |
| How many program enrollees or graduates studied at an in-state baccalaureate level institution during the past 5 years? Put the data in the table below.

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| --- | --- | --- | --- | --- | --- |
| Degree/Certificate | 2014-15 | 2013-14 | 2012-13 | 2011-12 | 2010-11 |
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See AAS degree program review for specifics. |
| If a degree is intended for transfer, or has transfer articulation agreements in place, indicate how the degree program supports students with continuing their education at CAC or other institutions. See AAS degree program review for specifics.  |
| Describe the level of success (via completion rates, GPA, etc.) the program’s prior students have achieved at transfer institutions.*See AAS degree program review for specifics.* |
| If a degree or certificate is designed to lead directly into the workforce, describe the success of students in obtaining a job in the field of study upon graduation. Please provide any qualitative or quantitative data you have: Steve Corral is employed as an IT Specialist at City of Casa Grande. John Dertinger is a Computer Technician at MTI Solutions in Chandler AZ.I attempt to stay connected to a sub-group of students through Linked In. We recently had a class visit (4-5-2017) from David Ouellette at Global Water Resources, Inc., and they are looking at CAC graduates for an entry-level Network Administration position in Maricopa, AZ.  |
| If your program serves to prepare a student for external certification or licensure of any kind identify the certification or license and the percentage of program graduates who earn/achieve it. Put data in the table below.

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| --- | --- | --- | --- | --- | --- |
| Licensure/Certification | 2014-15 | 2013-14 | 2012-13 | 2011-12 | 2010-11 |
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Steve Corral earned his Cloud+ certification while at CAC.  |

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| **Program Continuous Quality Improvement** |
| Discuss how the program has used learning outcome assessment results to improve instruction and/or student learning over the past 5 years:1. The use of Technet as an industry-standard reference tool was added to the CIS150, CIS152 and CIS219 classes and some others for developing skill with reference materials that are used on the job (related to Learning Objectives 7, 9, 10 and 11).
2. Text books and computer environments have been updated to current technology standards to meet the objectives as stated in our college catalog of learning on actively deployed platforms.
	1. Updated from Windows Server 2008 R2 to Windows Server 2012 R2
	2. Updated from Linux Fedora 14 to Linux Fedora 20 and added Ubuntu 14, so students learn two types of Linux
	3. Updated some classes from Windows 7 to Windows 8.1
	4. Will be updating CIS121 from Windows 7 to Windows 10 in Fall of 2017
3. Syllabus improvements have been made to more effectively communicate course requirements to students

None of the courses were in Blackboard when I first started. A couple of revisions in Blackboard have been completed on each of the classes, including updates to meet standards of the “Quality Matters” online course standards. |
| Discuss how the program has used operational planning goals to achieve quality improvement over the past 5 years:The CIS team has supported each other over the last 5 years with the following activities:1. Enabled the transfer to UofA South by adding two required classes – CIS135 and CIS220
2. Promoted the option to transfer to UofA South, taught in Pinal/Maricopa counties and have a group of graduates active in the UofA programs
3. Assisted UofA with the initial course offerings at CAC campus
4. Modified the degree program to drop one economics class to add Cloud Computing (CIS210) as a course option without changing the overall number of credits. We feel that the Cloud usage demands coverage, and jobs working with the cloud are growing in the Phoenix/Tucson market areas.
5. Revamped course availability and updated pre-requisites for improved flow and preparation for classes.
6. Documented planning documents that are published so students know what classes to take and when they are available.
7. Supported special events to promote the Business Division offerings and transfer options to existing students and high school students
8. Updated books and rewrote classes in Blackboard to keep current with technology changes and keep costs reasonable for students
9. CAC invested in VMWare, so the college is able to provide lab computers to students who are taking CIS121, CIS130, CIS150, CIS152, CIS153, CIS213, CIS215 and CIS220 classes. Students get extensive hands-on experience with the Windows operating systems, Linux operating systems (Fedora and Ubuntu), routers and switches. The VMWare environment is also supporting resources for the Web Development courses. VMWare hosts up to a few hundred lab computers during Fall and Spring semesters.
10. Applications were processed for Microsoft Imagine and a Web Store presence for CAC. This is being administered by Barbara Bushelle.
11. The degree title was expanded to reflect the emphasis on security to “Network Administration and CyberSecurity Fundamentals”
12. A transfer path was established from our program into UofA South’s Cyber Operations degree.
13. We have actively participated in discussions with the NSA as the UofA South is going through validation of their program with the NSA. We can explore this as a community college in the future.

Participation in the Arizona Technology Council, Workforce Development and other state programs to promote technology job growth in the state of Arizona.  |
| Describe other ways the program has engaged in continuous quality improvement:I believe that most activity has been documented above. |

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| **Program Alignment with Institutional Goals:***Describe how the program has directly or indirectly is helping the College achieve its current strategic goals.*  |
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